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Forest Resources of Africa

An Approach to International Forest Resource Appraisals

Part I: Country descriptions

Afrikas skogsresurser

En metodansats för uppskattning och beskrivning av världens skogstillgångar

Del I: Länderbeskrivningar

Reidar Persson

SKOGSHÖGSKOLAN

ROYAL COLLEGE OF FORESTRY

STOCKHOLM

Abstract

This report describes the forest resources of all African countries. The country notes contain information about natural vegetation, closed forests, man-made forests, inventories and so on. For most countries special forestry maps have been prepared.

The information has been collected through travels, desk studies at FAO Headquarters in Rome, interviews with field experts and correspondence with the Forest Services in the countries concerned.

Sammandrag

Denna rapport beskriver skogsresurserna i alla afrikanska länder. Länderbeskrivningarna innehåller information om naturlig vegetation, sluten naturlig skog, planteringar, inventeringar och så vidare. Skogskartor har ritats för de flesta länder.

Informationen har insamlats genom resor, skrivbordsstudier vid FAO:s huvudkontor i Rom, intervjuer med fältextexperter och korrespondens med skogsstyrelserna.

Preface

The present study was initiated by FAO in 1968. Mr Reidar Persson was working at FAO Headquarters in Rome during 1968-1972 as an associate expert sponsored by SIDA. After his return to the Royal College of Forestry in Stockholm he has been given a possibility to finalize this work partly by sustained support from SIDA.

The main objective of the work is to summarize the existing knowledge of the forest resources of Africa not least from the point of view of revealing existing knowledge gaps. A better knowledge of the world forest resources is of utmost importance for all countries. Especially a country like Sweden, where forestry is so important, needs a better knowledge not only about its own resources but about the resources of other countries as well.

FAO has an important role to play as a catalyst for all work aimed at increasing the knowledge of the world forest resources and for strengthening international cooperation in this field. The present study makes out a Swedish study to such cooperation.

Department of Forest Survey

Nils-Erik Nilsson

Foreword

This is a detailed appraisal of the forest resources of Africa. It can be seen as an attempt to improve the World Forest Inventories (WFI) which were earlier undertaken by FAO at five years intervals. The work on the fifth version of this series started in 1968 was never finished mainly due to lack of resources. However an unofficial version of the WFI was published by myself in 1974 under the title "World Forest Resources".

"Forest Resources of Africa" gives more details about the forest resources of Africa than was available in the earlier report.

The information presented in this report (as well as in "World Forest Resources") is of new type compared to the WFI:s which essentially contained tables. In this report (Part I) detailed country notes and maps have been prepared for all countries.

I spent four years employed as an Associate Expert in the Forest Economics and Statistics Branch of FAO in Rome, working on the assembly of forest resource statistics. In view of the lack of resources within FAO to prepare a publication, the material assembled on Africa since 1968 has been put at my disposal to make publication of this Forest Resource Appraisal for Africa possible. FAO has been keen to have this pilot study completed and has supported me in my work. Naturally this does not mean that they necessarily agree with my presentation or with my opinions.

This work was initially funded by SIDA. Completion of the work has been made possible by an agreement of cooperation between FAO and The Royal College of Forestry in Stockholm under sustained support by SIDA.

Many people have helped me in this work; I must thank Mrs I. Andersson who with great skill and interest has drawn most of the maps and Mrs I. Hjalmarsson-Pinna who during a critical stage in this work initiated new interest by her skill in map-drawing.

I am also in debt to the forestry officers at FAO:s Forestry Department and especially to Messrs S. Pringle and M. de Backer. I should also like to thank Messrs J. P. Lanly, B. Steenberg and P. Vakomies for valuable help.

At The Royal College of Forestry in Stockholm Professor N-E. Nilsson has always been very interested in the WFI and has supported my work for many years. Without this support it would have been impossible to finish the job.

Thanks are due also to Mr K. Janz (Royal College of Forestry) who introduced me to this work when he was working at FAO Headquarters. It was he who worked out the definitions of the various types of forest used in this report.

Messrs L. G. Blomkvist (Jaakko Pöyry Ingenjörbyrå AB), G. Bengtsson and S. Ohlsson (Royal College of Forestry) have read and made suggestions for the improvement of different parts of the report.

I am also very grateful to all the forestry officers in Africa who have given me information about the forests in their countries and helped me in so many ways during my visits and to those who replied to my letters and submitted valuable information in this way. Without this cooperation there would have been no report.

Mr G. Evans (of SIDA) has checked and improved my English as well as given me valuable advice concerning the editing of the report.

I also thank all the secretaries in Rome and Stockholm who over the years have patiently interpreted my unreadable handwriting, especially Mrs K. Jordansson, Mrs G. Lindau and Mrs K. Ohlsson who have done the final typing.

Finally, I should like to say that I should be most grateful to receive comments, corrections or additional information.

Stockholm, December, 1974

Reidar Persson

Royal College of Forestry
Fack
104 05 Stockholm 50
Sweden

Table of Contents

<u>Part I</u> Country descriptions	page
General notes	12
Abbreviations and symbols	12
1. Introduction	13
1.1. General	13
1.2. Earlier investigations	13
1.3. Background to this report	13
1.4. Method used	16
1.5. Objectives of this report	17
2. Vegetation types in Africa	18
2.1. General	18
2.2. Moist forest at low and medium altitudes	20
2.3. Forest-savanna mosaic	23
2.4. Open woodlands (savanna region)	24
2.5. Dry deciduous forest	26
2.6. Tropical mountain areas	26
2.7. Thickets	27
2.8. Grasslands in the tropics	27
2.9. Dry vegetation types	27
2.10. Mangrove and other tropical shore formations	29
2.11. Temperate and subtropical vegetation types in Southern Africa	29
2.12. Mediterranean vegetation types	29
3. Country notes	31
3.1. General	31
3.2. General about definitions	32
3.3. Comments on items in the country notes	33
3.3.1. General	33
3.3.2. Geography and climate	34
3.3.3. Land use	34
3.3.4. Forest and other wooded areas (forest land)	34
3.3.5. Man-made forest	35
3.3.6. Results from inventories	35
3.3.7. Standing timber	35
3.3.8. Other information	35
3.4. General about the maps	36
3.5. Country notes	39
Algeria	40
Angola	43
Botswana	49
Burundi	51
Cameroon	54
Central African Republic	60
Chad	63
Comoro Islands	65
Congo	66
Dahomey	72
Egypt	76
Equatorial Guinea	76
Ethiopia	81

French Territory of Afars and Issas	86
Gabon	87
Gambia	96
Ghana	98
Guinea	105
Guinea Bissau	108
Ivory Coast	111
Kenya	119
Lesotho	126
Liberia	127
Libyan Arab Republic	133
Madagascar	136
Malawi	146
Mali	150
Mauritania	153
Mauritius	155
Morocco	156
Mozambique	162
Namibia	166
Niger	166
Nigeria	169
Réunion	174
Rhodesia	175
Rwanda	178
St. Helena	181
Senegal	181
Seychelles	185
Sierra Leone	186
Somalia	190
South Africa	193
Spanish Sahara	196
Sudan	197
Swaziland	207
Tanzania	208
Togo	213
Tunisia	216
Uganda	219
Upper Volta	228
Zaire	228
Zambia	234
4. Conclusions	238
Bibliography	239
Appendix I Glossary	253
Appendix II A Common names of species	265
Appendix II B Scientific names of species	269
Appendix III Yangambi scheme for the classification of African vegetation	293

Part II Regional analysis (Preliminary outline, report not finished)

1. Introduction	
2. Regional summaries	
2.1. General	
2.2. North Africa	
2.3. Northern savanna region	
2.4. West Africa	
2.5. Central Africa	
2.6. East Africa	
2.7. Southern Africa	
2.8. Islands	
3. Discussion of results	
3.1. General	
3.2. Reliability of the information	
3.3. Land use	
3.4. General forestry background	
3.5. Forest and other wooded areas	
3.6. Change in forest area	
3.7. Man-made forest	
3.8. Ownership	
3.9. Forest reserves	
3.10. Management status	
3.11. Accessibility	
3.12. Exploitation	
3.13. Available wood resources	
4. The future of forestry in Africa	
4.1. General	
4.2. Local need for fuelwood	
4.3. Local need for timber	
4.4. Export of valuable species	
4.5. Production of pulpwood	
4.6. Need for plantations	
etc.	
5. The need for inventory work in Africa	
6. Conclusions and recommendations	
Appendix I Definitions of terms	
Appendix II Summary tables	

General notes

The terms used throughout the report are defined in the appendix I, "Glossary". Appendix II A gives the scientific names for the common species names used. Some late comments to the maps are given on page 37.

The designations employed and the presentation of the material in this publication does not imply the expression of any personal opinion whatsoever concerning the legal status of any country or territory or of its authorities, or concerning the delimitations of its frontiers.

As far as possible the countries are listed according to their "de facto" situation at the middle of 1974.

Abbreviations and symbols

-	Nil
..	Information not available
cm	Centimetre (1 cm = 0.3907 inch)
m	Metre (1 m = 3.281 feet)
ha	Hectare (1 ha = 2.471 acres)
m ³	Cubic metre of roundwood (1 m ³ = 35.31 cubic feet)
m ³ (s)	Cubic metre of sawnwood
1 acre	= 0.4047 ha
1 foot	= 0.3048 m
1 inch	= 2.540 cm
CIDA	Canadian International Development Authority
CTFT	Centre Technique Forestier Tropical
d.b.h.	Diameter at breast height
FAO	Food and Agriculture Organization of the United Nations
IBRD	International Bank for Reconstruction and Development
o.b.	Over bark
SF	United Nations Special Fund
SIDA	Swedish International Development Authority
Sp.	Species (singular)
Spp.	Species (plural)
u.b.	Under bark
UNDP	United Nations Development Programme
WFI	World Forest Inventory

1. Introduction

1.1. General

The report is in two parts. This first part gives information about each separate country in Africa. It can be seen as a reference book about forest resources in Africa. The second part will summarize the information given here and discuss conditions in the different geographical regions of Africa and in Africa as a whole. It will also include complete "guesstimates" of many items (e.g. standing timber) for which national estimates do not normally exist and Summary tables of the type included in previous WFI:s.

Since these two parts will be as complete as possible, some overlapping cannot be avoided.

The original plan was to include the information given in this report as an appendix to one single report about the forest resources in Africa. However, since the country notes and maps were ready it has been considered necessary to publish this information as quickly as possible while it is still up to date. The complete report is already somewhat delayed.

Part II will be published in a few months time. Probably certain background facts which will be included in Part II would be of value when studying the country notes.

The introductory chapters to this report are quite short. Further details relating to the WFI, as well as background to this report can be found in my report World Forest Resources. A coming report titled International Forest Resource Appraisals will in further detail discuss the methodological problems related to such appraisals.

1.2. Earlier investigations

The first known attempt to estimate the forest resources of Africa was made by Dr R. Zon and Mr W. A. Sparhawk in their book Forest Resources of the World published in 1922. They estimated the forest area to be 320 million ha (timber forest) and woodlands, consisting of thorn and brush, to be 60 million ha.

Further investigations have been done mainly by FAO in its World Forest Inventories (WFI). In the last one, WFI 1963, the "forest area", was given as 700 million ha. A far more detailed study has been done in the FAO report titled "Timber Trends and Prospects in Africa", published in 1967. The area of "forest" has here been estimated to be 683 million ha but of this area only 196 million ha was given as closed high forest (the rest was classified as other natural forest).

Most other studies dealing with the forest resources of Africa have been purely botanical with little or no statistical information.

1.3. Background to this report

This work was initiated at the FAO Headquarters in Rome where I worked with the WFI from 1968 to 1972.

The four World Forest Inventories carried out by FAO have tried to provide a general picture of the nature and extent of the world's forests and, to

some degree, information on how they are being used to supply wood. This has been done in the hope that the information would be useful in answering the question of whether or not the world's forest resources are sufficient in extent and productive capacity to meet the need for wood products and to provide basic and comparative data for the formulation of national forest policy.

The information shown in the WFI:s has been obtained by sending questionnaires to individual countries and then compiling the resulting data. In those cases where insufficient or no information was provided, best estimates were made by FAO personnel. The fact that these world inventories were based on data supplied by individual countries means that their accuracy and reliability varied according to the quality of the information available to the respondent in the country.

The questionnaires have changed and developed in a search for the most important information available. As the same standard questionnaire has been sent to the whole world some questions have been meaningless and irrelevant in certain parts of the world. It is fair to say that the previous questionnaires have largely focused on forest conditions occurring in Europe but of minor importance in other regions.

It has long been recognized that the statistics presented in the WFI contain many mistakes. Many of these mistakes are caused by the questionnaire approach. One of the main reasons for this is that it is difficult to make clear and precise definitions and another that it is difficult to prepare a questionnaire which is applicable to all the different conditions in the world.

To solve at least these two basic problems the latest WFI started in 1968 was planned to cover one region at a time. Over a five year period the whole world would be covered. A specially tailored questionnaire, taking into account the different forestry conditions occurring in each separate region should be prepared. It was thought that more and better information would be collected by this approach. The definitions of different basic items should naturally be the same in all regions.

This approach unfortunately failed and was dropped long before the whole world was covered. Questionnaires were only sent to Europe, other temperate regions and Africa. The reason for this failure was not only the limitations of the questionnaire approach as such but also lack of resources.

To be really successful a questionnaire approach requires in reality that the forests are covered by relatively comparable inventories. Since only around 15 per cent of the closed forest in Africa for example is covered by any form of inventory it is evident that other sources of information must be utilized as the main source.

Information of the type below is available in most countries:

- a) Vegetation maps
- b) Land use maps
- c) Forest maps
- d) Topographic maps

Such maps have been prepared for many countries. Sometimes they show the areas covered by forest (normally closed forest).

e) Inventories:

Inventories of at least selected areas are to be found in most countries. Summaries of the result from these inventories may give valuable information. An inventory may sometimes be used as an example of the volume in a certain vegetation type.

f) Result from logging operations:

Statistics from such operations can give some information about the volume that is extracted per ha in different areas.

g) Botanical descriptions:

A great amount of botanical work has been done in most countries. This work can sometimes be used for practical purposes. This is mainly the case when the vegetation is described for large areas. From the description of vegetation types information can be picked up about main species, density of vegetation, height of trees etc.

A WFI must be based on the information that really is available in the countries and not on the data that perhaps ought to be available. Consequently information of the above described type must be utilized in trying to give the best possible information.

That few inventories have been executed must not mislead anyone into believing that it is completely impossible to undertake a WFI (or World Forest Resource Appraisal which is the more suitable name recently adopted by FAO for this project). Put together in a suitable form the information available ought to give quite a clear picture of the forest resources in many or most countries.

Discussions how to replace the questionnaire approach by a new and better method had actually been initiated already in 1968. The methods discussed at this initial stage - which included mapping of the forest resources - were anyhow too sophisticated in relation to the resources that could be made available.

Pilot work on a new approach for a WFI was anyhow initiated and done mainly for Latin America. This work proved that it was possible to collect much better information by checking reports, interviewing FAO field experts, study visits and so on than by any questionnaire however well designed. Maps proved also to be a very suitable tool in presenting incomplete information about forest resources in the best possible way.

Due to the lack of resources a complete pilot study for a whole region could not be finalized at FAO Headquarters. In the autumn of 1971 FAO and the Royal College of Forestry in Stockholm therefore agreed that I should be given time and resources to undertake a pilot study of a Forest Resource Appraisal for Africa.

The final writing of the report has been done at the Royal College of Forestry in Stockholm. This was a disadvantage from some points of view as it was not possible to go back to the original sources which were mainly kept at FAO Headquarters. Some of the difficulties were solved during a short visit to Rome.

The work has taken longer than expected. What was originally planned as one single report has been split up into three different parts; Forest Resources of Africa Part I and Part II; and the methodological discussions in another separate report. In addition a report covering the whole world has been published.

1.4. Method used

The investigation started in 1968 with the preparation of a questionnaire specially tailored to the conditions in Africa.

The questionnaire was prepared with great care and differed greatly from the previous questionnaires. It was an honest effort to ask the important relevant questions taking into account the form in which the information was available. The definitions were precise and an effort was made to explain why the different information was needed. This thorough detailed and scientific approach failed. The questionnaire prepared by Mr K. Janz and to some extent myself was sent to 56 countries and territories in 1970, but one year later, in spite of repeated reminders, only 20 replies had been received.

Many of the replies were incomplete and full of misunderstandings, others have proved to contain valuable information when cross-checked with other sources.

At a later stage letters were sent to the Forest Services in the countries asking for information to complement the questionnaires and for maps, inventory results and so on. The response to this effort was also rather disappointing. Few countries replied.

After this stage one can say that the work with a WFI of the traditional type ended and the so-called New Approach started. This initial stage had resulted in very little information.

During the work with the questionnaires a preliminary perusal of material available in the files at FAO Headquarters had been done; interviews had also been undertaken with visiting experts etc. When the questionnaire approach was finally abandoned as the main tool for datacollection I had therefore already managed to collect a good deal of information about the forest resources in Africa.

The next step was a visit to eight countries in Africa. During this travel all available information about the forest resources was collected. This was mainly done through personal contacts.

The travel did not only give information about the forest resources in the countries visited but gave also a better understanding of the general forest conditions in Africa.

The next and perhaps most important step in the work was a detailed final perusal through all the material in country files available at the Forestry Department of FAO. This means FAO reports, mission reports, travel reports, letters, country notes, correspondence with projects and so on.

Short visits were also undertaken to Paris (Centre Technique Forestier Tropicale) Oxford (Commonwealth Forestry Institute) and Reinbek (Federal Research Organisation for Forestry and Forest Products).

From all of these sources the first draft of the "country reports" were prepared and sent to the Forest Service in each country, to FAO Projects and to other persons and institutes which were thought to have knowledge about a country's conditions for checking. This time-consuming stage has been quite successful - about 25 countries have given complementary information or approved the prepared country notes. No answer was interpreted to mean that the country accepted the country note given and had no complementary information to give.

1.5. Objectives of this report

The objective of this specific report (Part I) is to give a detailed description of forest resources country-by-country. For each country of any forestry interest a map showing some main features has been prepared.

The information sought for, is in the first hand the area of different categories of forest and other wooded areas, man-made forests and information about standing volume (crude estimates or inventories).

The objectives may be best understood by reading the planned outlook of the final publication as it was outlined at an early stage in this work. According to this preliminary proposal the following information should be given for each country.

"A. Statistical tables:

These tables should show some of the main features like forest areas, ownership, management plans etc. The data may come from a questionnaire but it is more probable that it will come from other sources. In reality this part will try to give the same information as previous WFI:s.

Note: These tables will be given in Part II.

B. Maps:

A map must be prepared for each of the important forestry countries. This map should if possible show:

- a) Location of forests
- b) Different types of forests (vegetation types)
- c) Location of forest reserves (when applicable)
- e) Exploited areas and/or areas under concessions (when applicable)
- f) Transport system (when this says something practical about accessibility)
- g) Location of plantations

C. Country notes:

These must be prepared for each country. They should explain the map and the tables. Index numbers put on different inventories and/or forest regions relate to the same numbers in the text. These notes should at least contain the following points:

- a) A general description of the forests including a description of the vegetation
- b) Summary of inventory results
- c) Description of accessibility
- d) Information about plantations: areas, species etc.
- e) List with most important species and their possible use
- f) Some notes about exploitation and concessions
- g) Other information of interest

The format may not be standard but will depend completely on what information is available." An important subordinate objective is to describe the accuracy of information about forest resources. In this way gaps in existing knowledge about forest resources can be identified.

2. Vegetation types in Africa

2.1. General

As an introduction a short general description of the vegetation types and some of the ecological principles that determine their distribution is given. The description is of the vegetation types of forestry interest but short comments concerning most of the other major vegetation types found in Africa are included.

The description of the vegetation in the country notes often follow systems of classifying vegetation that do not have categories synonymous with other well known systems. A standard scheme can therefore not be used at present.

The terms commonly in use when describing vegetation are as far as possible explained in this chapter. Confusion is very common; for example "wooded savannas" may mean all types of savannas with trees but could also be confined only to drier types of savanna.

Certain basic ecological principles and terms must also be mentioned in this introduction.

The vegetation type of an area is determined primarily by climate and soil. The climate has a direct influence on the vegetation as well as an indirect influence via the soil.

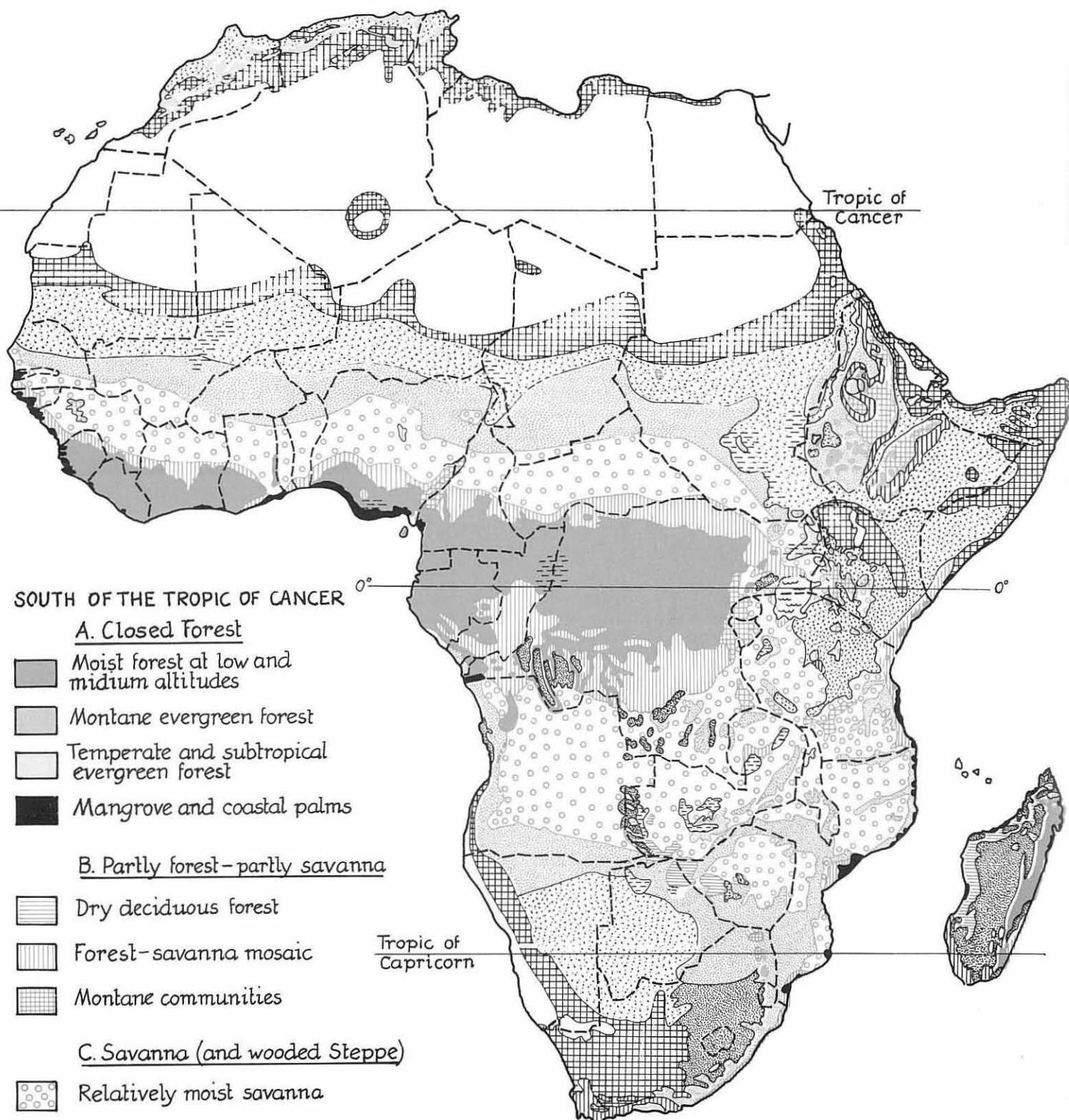
Plant species are capable of existing far beyond their so-called natural distribution areas if they are protected from competition with other species. The natural limits of the species depend on the fact that beyond this limit they cannot compete with other species that are better suited to the existing environment. In these areas the growth of the species is unfavourable influenced by the presence of another.

In a stable plant community the different species are in a certain state of ecological equilibrium with each other and with their environment (climate and soil). This is called a climatic climax vegetation. A zonal vegetation is the type of vegetation the climate indicates should be found in an area. Extrazonal vegetation grows as a result of especially favourable conditions e.g. riverine forest. Azonal vegetation grows where the edaphic factors are more important than the climate.

The limit between two vegetation types is rarely sharp. They normally merge imperceptibly into each other.

Reference is made to the small-scale vegetation map of Africa on page 19 which summarizes the information given on the "Vegetation map of Africa south of the Tropic of Cancer" and in the "World Forestry Atlas". The description of the different vegetation types given in this chapter is partly based on R. W.J. Keay's Explanatory notes to the "Vegetation map of Africa south of the Tropic of Cancer". Keay's notes have been supplemented with information from other publications mentioned in the Bibliography.

It is rather difficult to describe the natural vegetation in Africa as it is so often strongly influenced by man (antropogenic factors). The description can either be done for the existing vegetation or for the climatic climax vegetation. Plant geographers have a tendency to be mainly concerned about the climatic climax vegetation. Vegetation maps normally use both



systems. The map on page 19 shows the existing vegetation but quite naturally the areas occupied by agriculture and so on cannot be shown at this scale. These are therefore marked with the surrounding vegetation types.

2.2. Moist forest at low and medium altitudes

These forests, often called "tropical rainforest", cover a large part of Central Africa from the Congo Basin to Nigeria. This main block is separated from the western block of forest (Ghana to Sierra Leone) by a relatively dry gap in Togo and Dahomey. The isolated blocks of forests in western Uganda are considered to be of the same type. On Madagascar the moist forest grows in a belt along the east coast. From the floristic point of view the Madagascar forest is reputed to be very rich. The forests should contain African, Asian as well as endemic specimens.

The area shown on the map as belonging to this type contains both evergreen and semi-deciduous types at least according to the African use of these terms.

The leaves of the evergreen trees fall gradually over the year. Maximum defoliation may occur at the beginning of the dry season.

In the semi-deciduous type, some of the trees in the upper strata lose their leaves during the dry season. As a matter of fact semi-deciduous seems to have a wider meaning in Africa than in Latin America for instance.

The evergreen tropical rainforest occur in rainy regions of the tropical belt which normally only have a short dry season. The monthly mean temperatures do not fall below 25° C and the mean annual rainfall is always above 1,500 mm and sometimes considerably higher. The mean daily temperature is the same all the year through and the length of the day varies less than one hour. Flat areas normally become waterlogged or inundated. Freshwater swamps occur frequently in the rainforest region.

The soils are usually very old. Freely drained soils have been washed out as precipitation always exceeds evaporation, and laterization has taken place. The soils are very poor in nutrients and are acid. The entire nutrient reserves are actually held in the living trees and plants. There is practically no leaching of nutrients from the soils as the nutrients that become available when a tree dies are quickly absorbed by the living trees.

When on the other hand, the forests are exploited or burnt an intensive leaching of the nutritional reserves takes place. A secondary forest develops normally when such areas are abandoned but according to most ecologists, at least in a typical rainforest, this is never as luxuriant as the original forest. Experience from agricultural work indicates that it is probable that the soils do have a capacity for recovery.

On certain soils cultivation for a long time can produce a lateritic crust on the surface. When such areas are abandoned by the cultivators they are not rapidly re-invaded by forests. Where a thick lateritic crust has been formed the normal pioneer species can not get a foothold and more xerophytic shrubs dominate the area for a long time.

In most cases anyhow the pioneer species invade quickly and form a secondary forest. These pioneer species are often short lived. Large areas of former tropical rainforests are now covered by secondary forest. It is probable that most of these areas would return to a true climatic rainforest if it

was left undisturbed but this takes a very long time. Old secondary forest have a different species composition from true virgin forest. Small clearings in the forest seem to be reforested very quickly and give no deterioration of the soil.

According to many sources untouched or primary forests are extremely rare, at least in West Africa. After about 250 years a secondary forests may be impossible to distinguish from a primary forest.

In a tropical rainforest as many as 100 species can be counted per ha. The tropical rainforests in Asia and Latin America contain in all several thousand different species. Compared to these regions the tropical rainforests in Africa must be considered as relatively poor in species. The reason to this relative poorness is not understood. In Africa Zaire seems to have the richest forest from the floristic point of view.

The forests are often said to have three storeys of trees but these can only be recognized after special investigations. This stratification may be seen as a technical help to describe the forests. It is normally the middle strata which is the dominating (20-40 m high). The upper tree strata reaches a height of 40 to 60 m. This layer is often described as consisting of emergents. The trees may reach an age of 200 to 250 years.

Among the dominant trees the stem is often three times as long as the depth of the crown. The crowns of these dominating trees are sometimes umbrella formed. Trees of the lower strata have relatively longer and more narrow crowns. The bark of the trees is often smooth and thin.

Only a small share of the light which reaches the upper tree layer goes down to the ground (perhaps one per cent). The undergrowth is therefore not abundant and it is actually easy to walk in the forests.

As the soils are always wet the roots do not reach deep into the soil. According to one opinion their buttress roots which reach high up the stem provide the necessary stability.

Only a few species are represented by a large number of trees. One or two species may sometimes be dominating. Often 10 to 15 species make up 50 to 75 per cent of the total. The species are abundant in one area and more or less absent in another. Some trees are always found scattered while others always grow in more concentrated stands and very rarely outside these. Some of the most valuable species occur in this very scattered way and normally only a few trees are exploited per ha. Marshy areas are normally covered by only a few number of species or even a single species.

The regeneration of the species seems to occur in a very complicated pattern which is probably not fully understood. The ground in the forests is well covered by tree seedlings. These seedlings are thought to be dormant and growing very slowly. Many (or most) plants die naturally before they can grow up to trees. When an old tree dies the seedlings grow rapidly up into the opening that have been created. The trees that grow up in this opening are not the dominants but pioneer species that produce a lot of seeds. These are then suppressed by the dominants that come first after 10 to 20 years.

Light-tolerant species normally have winged or tufted seeds which can be carried far away by the wind. The fruits of shade-tolerant species usually have heavy fruits which fall at the root of the mother tree. A true primary

forest is composed of shade-tolerant species with heavy seeds.

It is sometimes argued that seedlings do not grow below their mother trees (or other trees of the same species). Each tree that dies should therefore be replaced by a different one. After some generations the same species may return. This could explain why none of the species in the rainforest become absolutely dominant. According to Richards (1973) it is common for the entire seed crop of a large tree to be destroyed by "host specific" animals. This could explain the theory above.

For some of the well known timber species the regeneration is a problem. Certain species like okoumé and limba are light-tolerant. In Gabon okoumé seems to occur most frequently in areas where the forest have once been cleared for shifting cultivation. As can be expected okoumé (and also limba) can easily be regenerated in pure plantations. For some of the species which grow up in shadow, regeneration, both natural and artificial, is a problem.

The primary production of the tropical rainforest is sometimes assessed as no higher than forest in the temperate zone. In terms of m^3 of wood the production has sometimes been calculated to be as low as 3-4 m^3/ha and year.

The reason for the relatively slow growth of the trees may be that the crowns are pressed so closely to each other that they receive insufficient light. The sky is also often overshadowed. The mean daily sunshine in many areas is only seven hours.

The total wood volume in untouched forest seems normally to be 250-350 m^3/ha . It is often said that 80 m^3/ha of this volume could be utilized in the form of logs but very often the exploitation is at present only 10 m^3/ha (in Africa).

The exploitation is practically always selective i.e. only certain valuable species are harvested. As mentioned earlier it can be difficult to regenerate these species for future exploitation. In certain places in Uganda there is some clear-cutting of the forests with replanting of preferred species afterwards. But planting in tropical rainforests is always very costly due to the necessity for continuous weeding the first years and clearing of the old forest.

Large areas within the rainforest zone are farmed. Of the original forest covering about 250 million ha only about 180 million ha are forest nowadays.

As has been indicated the ecology of the tropical rainforest is not too well understood. Several conflicting opinions about different conditions can be found. This is probably caused by the fact that findings of a detailed investigation in one area are taken as the base for a discussion of a tropical rainforest. It is not unlikely that every species association in the tropical rainforest has its own very special conditions. This makes natural management of these forests very complicated.

Semi-deciduous forest:

Away from the equator the total rainfall decreases and the dry season becomes longer. Some trees loose their leaves during the dry season. This is especially the case with the upper strata of the tree. As has been mentioned this is called a semi-deciduous forest. Other terms frequently used and

meaning more or less the same thing are semi-evergreen forest, mixed deciduous forest, seasonal forest and even occasionally dry dense forest.

There is some confusion as to what is a semi-deciduous forest. Many plant geographers argue e.g. that there is very little semi-deciduous forest left in Africa. This may be true if one accepts their definition of semi-deciduous forest. These forests at one time covered what is now normally called savanna or open woodlands. It is a fact that in many countries, especially in west Africa, a large proportion of the moist forest is said to be semi-deciduous. In Ghana for example, the "true rainforest" (or rather wet forest) in the south is often found on poor soils. Stocking of species of commercial value is actually low in the rainforest compared to the so-called semi-deciduous forest. It also has a poorer height than this and fewer large trees. According to one theory this should be due to less sunshine in the "rainforest" compared to the "semi-deciduous forest".

The "real semi-deciduous forest" (if now meaning the same thing as most plant geographers) can be burned during the dry season. Shifting cultivation has led to a deforestation of the main part of this dry type of semi-deciduous forest. The semi-deciduous forests outside the moist forest zone are therefore mainly replaced by man-made savanna.

2.3. Forest-savanna mosaïc

The moist forest zone as described in 2.2. is surrounded by a belt of forest-savanna mosaïc. In this belt patches of moist forests, not only confined to gallery forests, are surrounded by savanna grasslands. These grass savannas are all man-made.

The flora of these forest patches is more or less the same as in the moist forest. The grass savanna is, on the other hand, poor normally dominated by a few species of grass. The grass savanna is normally burnt every year and only fire tolerant trees and shrubs can survive.

Near the savanna woodland region these grass savannas usually have certain fire tolerant trees and shrubs which are found in the savanna woodlands. If they are situated away from other savanna woodlands they will remain grass savanna as long as it is burnt. If there are no fires in the grass savanna for a number of years it is normally invaded by moist-forest species.

Along the coast in Ghana and on the east coast there is also a coastal forest-savanna mosaïc. The rainfall in these areas is lower than in the moist forest region. The even rainfall and the high humidity gives these areas a vegetation which is different from inland areas with a comparable amount of rainfall.

In Ghana the patches of forest and of evergreen scrub are, in their species composition, related to the moist forest but they also contain some plants which are characteristic of relatively dry inland areas.

The coastal forest-savanna mosaïc on the east is - on the other hand - very different from the moist forest which is at least 1,000 km away.

The forest patches and the grasses are smaller in the coastal mosaïc than in the inland type of forest-savanna mosaïc.

2.4. Open woodlands (savanna region)

The open woodlands are found in extensive areas with moderate rainfall and a severe dry season. Evergreen and semi-deciduous forests occur along streams and other moist areas in the moister types of open woodlands.

Open woodlands as defined in the WFI 1970 (see Appendix I) includes areas which are normally classified as woodland and as savannas of one type or another.

Woodlands should mean "open forest" with a tree stratum of small or medium-sized deciduous trees. The crowns more or less touch each other and the grass is sometimes rather sparse. This type seems to be rare nowadays. It is normally discussed as being a part of the savanna region. The term is also often used in the sense of tree-covered land.

Savannas should mean tropical grasslands with a more or less dense layer of trees. Tropical grasslands without trees should perhaps not be called savannas but grasslands. At any rate they are often referred to as grass savanna. From the forestry point of view only the areas covered by some form of trees are of interest.

Most vegetation schemes describe several different types of savannas. For example, in the so-called Yangambi scheme (see Appendix III) the classification is done according to the density of the tree cover and the height of the grass cover. The grasses vary in height from 0.8 to 4 m. They grow during the rainy season. In the dry season the part of the plant above ground dies.

Other classifications are based more on the climatic conditions and the species that are typical for these conditions.

Certain terms commonly used for describing the savanna are mentioned here:

- a) Savanna woodland has trees which are closely spaced
- b) Tree savanna has trees more widely spaced than in the savanna woodland.
- c) Shrub savanna is areas covered by shrub and grass.
- c) Savanna grassland are tropical grasslands where trees and shrubs are absent. Such areas are often called "savanna" by foresters.

Most scientists believe that originally the areas now occupied by different types of savannas were covered by semi-deciduous tropical forests but that these types have - at least north of the rain forest zone - mainly been transformed into man-made savannas. Some remnants of the original forest are said to remain e.g. in the Casamance region in Senegal. (This area may now be called woodland).

In some areas nowadays a relatively clear boundary between forest and savanna may be found. When the dry season is short and not severe the fire cannot enter into the forest. Under present anthropic conditions the limit for fire-made savanna is said to roughly coincide with three dry months. An annual rainfall of 1,250-1,500 mm is defined as the limit by others.

In sparsely populated areas of the relatively moist types of savannas, the trees usually attain a height of 15-21 m and form a light canopy over grass. The density of the tree cover varies depending on edaphic conditions and

the extent of human influence and often all stages from woodland to grass savanna can be found within a few ha.

In the savannas, fires have led to a selection of fire-resistant species. All trees have a thick bark. Most savanna trees can regenerate by suckers. Few saplings of the trees survive the fire.

The gross wood volume ranges from 10 to 100 m³ per ha. The best stands may have a saw-log content of 5-10 m³ per ha.

The genera *Isoberlinia*, *Brachystegia* and *Julbernardia* dominate over wide tracts of relatively moist savanna. These genera are green during the rainy season. They put out green leaves some weeks before the rain normally starts. This is probably an adaption to the variable time of the start of the rains. In certain relatively moist types in West Africa these genera are rare. The moist savannas in West Africa are called Guinea. In this zone the larger patches of trees contain many evergreen species. The trees that are scattered in the surrounding grass or tree savannas are often more xerophytic.

The Guinea zone has a low population. This is due to poor soils and to the fact that these areas once were subject to intense slave raiding. The southern part of this zone is more cultivated than the north. All Guinea is said to be burnt each year. Savanna woodland occurs where the fire is light.

South of the equator large areas are also dominated by the genera *Brachystegia* and *Julbernardia*. This eastern and southern type of moist woodland is called Miombo. The Miombo is relatively undisturbed in certain areas and is sometimes classified as a tropical deciduous forest (or dry open forest).

In French the best stands of the Guinea (e.g. in Casamance) are sometimes called forêt sèche dense (dry dense forest) or sometimes forêt claire (woodland). The more normal type of Guinea savanna is called forêt sèche ouvert (dry open forests).

Further away from the equator the climate turns more dry. Among the savanna types can be mentioned Sudan savanna in the north. In this zone the evergreen trees become unimportant. Broadleaved deciduous trees are found on more favourable sites. Thorny shrubs and small trees of *Acacia* are very common. The Sudan zone has been heavily populated for a long time. The vegetation in this zone is more influenced by man than the vegetation in the Guinea zone.

In the south *Colophospermum mopane* (Mopane woodlands) is found on ill-drained soils in large river valleys. The better stands of Mopane form woodlands of 15 m or more in height. These dry types of savanna are often referred to as wooded savannas.

Adansonia digitata (baobab) is found along the dry boundary of tropical woodlands all over Africa. It is a succulent species and may carry over 100,000 litres of water in its stem. The species rarely goes above 1,000 to 1,200 m above sea-level.

Wooded steppe with abundant *Acacia* and *Commiphora* is found between the sub-desert and the dry types of woodlands. In West Africa this zone is called Sahel. In Sahel low thorny trees become dominant among the woody plants. In certain places the trees form open or even closed "woodland" or thickets;

in other places the trees are widely scattered. The trees may reach a height of 12 to 15 m. The grass is not as abundant as in the moister types and the fire cannot spread as easily as in these. Overgrazing by animals is considered to be a much more important ecological factor than fire.

In West Africa the climatic climax vegetation is often considered to be the following in the different zones:

Sahel zone - thorn forest

Sudan zone - deciduous forest

Guinea zone - semi-deciduous, dry evergreen and even tropical rain-forest.

2.5. Dry deciduous forest

This type of "forest" is found within certain areas of Angola, Botswana, Rhodesia, Zambia and the Caprivi strip of Namibia. A similar type of forest is also found on the western coast of Madagascar.

Physiognomically this type is similar to the moist forest but the understorey and the larger trees almost completely lose their leaves during the dry season. Floristically they have little in common with the moist forest which are situated at a considerable distance.

Where the trees are widely spaced the understorey forms a dense thicket. Grass is absent or rare but the dry deciduous forest is very susceptible to fire and repeated burning leads to replacement by open savanna types.

This type is situated in hotter and drier regions than the Miombo and from the climatic point of view corresponds more to the dry types of savannas than to forest. That this type is often considered as forest may be due to the fact that it is perhaps less degraded than the open woodlands like Miombo generally are. It is reported to make a dense impression.

On the African continent this type is rich in *Baikiaea plurijuga* (Rhodesian teak). These forests are found on relatively well-drained sites on Kalahari sands. This type attains in the best stands, a height of 15-20 m and log content of as much as 20 m³/ha but normally much less.

On Madagascar, a large part of this type has been degraded. Even on Madagascar these forests contain such valuable timber species as *Hernandia voyroni* and *Myristica voury*.

2.6. Tropical mountain areas

The upland regions contain many vegetation types from tropical montane forests, montane grasslands to alpine deserts. All these different types cannot be shown on small-scale vegetation maps.

The mountains normally receive a lot more rain than the surrounding lowlands. The forests are therefore often rich in epiphytes. So-called cloud forests are found between 1,000 and 2,500 m above sea-level. These forests start at the cloud level. The height of the trees decreases with increasing altitude. The floristic composition of the forest is also different from the lowland moist forest. Many conifers, mainly of the genera *Juniperus* and *Podocarpus*, are present. *Ocotea* and *Olea* are characteristic genera among the broadleaved trees.

At higher altitudes, ferns, lycopods and mosses become very abundant. Sometimes the wettest parts are characterized by dense bamboo groves or even palms.

Above the cloud belt the precipitation decreases and the leaves become more xeromorphic. Podocarpus is sometimes said to be present in this zone. Tree of bushformed Ericaceae are often present at this altitude. At the forest limit a shrub zone starts. In the alpine belt large specimens of Senecio and Lobelia often occur. The upper vegetation limit is between 4,000 and 4,500 m.

The altitude at which one type of montane community is replaced by another also varies according to aspect and from mountain to mountain.

The savannas are also influenced by the altitude. Montane savanna is found above 1,200 m on the Jos plateau in Nigeria for example.

2.7. Thickets

Thickets occur in many vegetation types but only in certain cases cover large continuous areas. They are composed of dense evergreen or deciduous shrubs where the grass is absent or not continuous.

Thickets are found in central Tanzania (Itigi type). The shrubs grow to a height of 5 m. Trees of 8-11 m height occur sometimes.

In Ethiopia thickets occupy a zone between the lowland wooded steppe and the montane forests and grasslands. Here the shrubs are 2-3 m high, some of them are thorny and succulent. Large trees are widely scattered.

Thickets of *Oxytenanthera abyssinica* (bamboo) occur scattered throughout the open woodland types. *Oxytenanthera* grows at low and medium altitudes in contrast to *Arundinaria alpina* which grows in the mountains.

2.8. Grasslands in the tropics

Grasslands of savanna and steppe type occur in many areas. So-called grass savanna covers scattered parts of the savannas for example. More extensive and continuous grasslands occupy the central part of Madagascar. Here scattered shrubs and a few trees occur. A few remnants of the original forest are found in areas which have been protected from fire.

Grass steppe occurs also on the Kalahari sands in western Zambia and eastern Angola and along parts of the northern coast of Angola.

In western Uganda a grass steppe with thicket clumps is found. The clumps of shrubs are surrounded by grasslands with short grass.

The map shows only these more extensive grassland areas.

2.9. Dry vegetation types

Where the rainfall is less than the potential evaporation special conditions occur. There is in dry areas a linear relationship between the rainfall and the production of the plant mass. The drier an area the further apart the plants grow. Large root systems are necessary. There is a continuous reduction of the transpiring area as most of the phytomass is underground. The

root system normally flattens out. Long and deep roots occur only for species that depend on the ground-water. In very dry regions the plants grow only in spots where there is more water (like in depressions). In dry regions certain plants live only on rainwater while others live on ground-water.

Species which can survive droughts are called xerophytes of which the succulents store water in their tissues. Halophytes live on saline soils in arid regions.

The quantity of rain is only of indirect importance. The amount of rain remaining in the soils is of greater importance. Due to evaporation stony and sandy soils contain more water than clay. This is because the water after a rainfall goes deeper in the two first mentioned types of soil.

Deserts are devoid of vegetation except occasionally for widely scattered solitary plants. There are actually few real deserts. Most contain some vegetation after the occasional rains. The semi-deserts or subdesert attain 125-250 mm per year in showers. The vegetation consists of some widely spaced bushes and a ground cover of short grass. Among the bushes thorny and succulent plants dominate.

On the margin of dry areas with 375-700 mm during a short rainy season thorn scrub is sometimes found.

Woody plants can be found in an area when the grasses leave so much water in the ground after the rainy season that the bushes (or trees) can survive the dry season (around 300 mm). When the crowns close the trees are dominant over the grasses.

When the grass is eaten by animals the transpiration decreases. This is an advantage for the woody plants. A thorny shrub can develop which grows so thick that thorny scrub-land is formed. This is useless for grazing. If the woody plants are used for fuelwood a man-made desert can develop which has a coverage of annual grasses during the rainy season.

Deserts or dry areas with deep-lying ground-water can be converted into forest if the soil is irrigated to such an extent in the first year after planting that it is wetted down to the ground-water. The roots can then grow down to the ground-water.

The best known dry (or desert) region in Africa is the Sahara. Summer rains occur in southern Sahara while the central Sahara is practically rainless. In the north the rain falls during the winter (mediterranean climate).

In southern Sahara there are more shrubs than in the north. *Acacia*, *Commiphora*, *Maerua* and *Grewia* are typical genera. Succulent species of *Euphorbia* are found in western Morocco. Shrubs occurring in wet habitats are *Tamarix*, *Nitraria* and *Zizyphus*. *Acacia* are found in the dry valleys carrying ground-water.

In Namibia the coast is rainless 50 km inland. It is a fog desert. Plants grow only in dry valleys where the ground water is present or on slopes receiving condensation water from the fog. The inner parts of Namibia is a summer rain region with shrubs of *Acacia*, *Commiphora* and *Tamarix*. Trees occur in certain valleys. This dry area extends also over large parts of western South Africa.

Extensive arid regions occur also in parts of tropical east Africa for example northern Kenya, eastern Ethiopia and Somaliland.

Most of the information in this sub-chapter comes from Walter 1973.

2.10. Mangroves and other tropical shore formations

Mangrove occurs in the tidal zone of salt water along coasts and river estuaries in the tropics. The different mangrove species usually grow in distinct zones and they are only rarely mixed. The zonation depends upon the tides. The nearer the species grow to the outer edge of the mangrove the longer and deeper it stands in salt water. *Rhizophora* spp. grow nearest to the coast while *Avicennia* spp. grow further inland. Inside this belt of *Avicennia* spp. there is often a bare zone. This depends mainly on the drastic variation in salt concentration. The water is very salt during the dry season due to evaporation while it is completely leached during the rainy season. Such a bare zone does not exist in estuary zones.

On the west coast mangroves are found from the Senegal river to Angola. The most extensive areas are in the Niger delta. On the east coast patches of mangrove occur from the Red Sea to the northern part of South Africa.

One estimate gives the total area covered by mangrove as 6 million ha.

2.11. Temperate and subtropical vegetation types in Southern Africa

In the extreme south evergreen forests floristically related to the tropical montane forests occur. The area covered by this type is around 250,000 ha. *Podocarpus*, *Olea*, *Ocotea* and *Widdringtonia* are some of the main genera.

In the south (Cape province) so-called Cape Machia is also found. This is composed of evergreen shrubs with hard, leathery, and generally small leaves. In this type trees are rare. Forests have once covered at least parts of these scrub areas but the rest is probably "true scrub".

Almost pure grasslands cover parts of eastern South Africa at altitudes from 1,100 to 3,000 m. In the more humid parts of these grasslands (the higher parts) forest may be the climatic climax.

2.12. Mediterranean vegetation types

The Mediterranean region has dry hot summers and cyclonic winter rains. The rainfall tends to increase and the length of the summer drought to decrease from south to north and with increasing altitude. Forest of one type or another, according to the climate, may be developed in an area of 30 million ha.

In the semi-desert north of the Sahara, 25 per cent of the ground is covered by vegetation. With increasing rainfall towards the north isolated trees such as *Pistacia atlantica* in the west and *Juniperus phoenicea* in the east occur.

Most of the vegetation in the region has been degraded over millenia. After burning and grazing the forests disappear completely. The original trees of the hot lower belt is thought to have been *Olea oleaster*, *Certonia siliqua* and *Pistacia lentiscus*. In moister localities *Quercus ilex* seems to have made up the main part of the tree layer. Much of the *Quercus ilex* forests

are now degraded to maquis.

Human interference and different edaphic and climatic conditions determine the various types of forest that can be found to-day.

Pinus halepensis, *Tetraclinis articulata*, *Juniperus phoenicea*, *J. oxycedrus*, *Quercus ilex*, *Q. coccifera* and *Argania spinosa* are found in the drier zones. *Pinus pinaster* and *Quercus suber* grow in moister localities. *Cedrus atlantica* grows in Atlas and the Rif at an elevation of 1,200 to 1,500 m.

Maquis scrub, characterized by *Pistacia lentiscus* occurs both in dry and moist areas. The maquis is normally a degraded form of denser associations but it may be a true climatic climax in certain areas.

The Mediterranean sclerophyllous vegetation is said to contain many species.

3. Country notes

3.1. General

The country notes describe country-by-country the forest land, man-made forests, and inventory results. Other information found and considered to be of interest is given under separate headings (e.g. shifting cultivation, accessibility, exploitation, concessions).

The country notes are not always complete or consistent. This is because they have been compiled from sources that are themselves incomplete or impossible to interpret reliably. The country notes vary too in depth. This again depends on the information available.

The forestry conditions may also have changed or be changing. The recent drought in West Africa can be cited as an example. This drought probably makes part of the description for these countries out of date.

Some of the country notes, those for Uganda, Morocco and Sudan are very detailed and can be taken as an example of what can be done even with incomplete data.

The country notes deal mainly with the forest's role as a wood producer. Of course this does not imply that its role for protection, recreation, scientific value and so on is considered unimportant. It simply means that this report focuses on wood production.

To be complete, the country notes should contain a summary of everything that has been written or in one way or another is known about forestry, vegetation and so on in Africa, and which contributes towards fulfilling the objectives of this report. I have not been so ambitious but have contented myself with what has in any case been a very great deal of material. Some misinterpretations are unavoidable.

That concludes the general discussion of country notes. I now list some further points which ought to be mentioned.

- a) Scientific names of species are not always clear. "Dalbergia" for instance may not always mean "Dalbergia spp.". It may in fact refer to a single species.
- b) The terms and expressions commonly used in different countries have often been used also in the country notes. It has not always been possible to find out precisely what is meant by the different expressions. The same term used in two different countries may mean different things. Terms like "savanna", "commercial volumes" and so on have caused some trouble. These terms should have the meaning given in the "Glossary" but probably this is not always the case. A short discussion of the difficulties in defining forest areas and different volumes is given in 3.2.
- c) It must be pointed out that the sources used in preparing the country notes are not always national. Information has, for instance, been collected from articles in forestry journals, mission reports or from interviews with forestry officers visiting FAO Headquarters. This is one main reason why there are discrepancies in the information presented,

sometimes different areas have been used in different break-downs. The sources used are perhaps not always the best ones available.

- d) When a figure refers to "present time" it normally means 1972-1973.
- e) "Utilized volume" often means the utilizable volume of all trees (or commercial species) of sawtimber size. (For definitions of different volume concepts see the Glossary.) Frankly speaking there seems to be considerable confusion concerning volume concepts.
- f) The figures found in the different sources have only rarely been rounded off in spite of their known unreliability.

3.2. General about definitions

The terms used in the country notes are defined in the Glossary (Appendix I). Certain additional background facts must be given here.

One of the basic reasons for the regional questionnaire approach developed in 1968 was the fact that the definition of "forest" used in the 1963 WFI caused confusion. In Africa, many countries included what is normally called open woodland ("savanna forest"), as forest. The 1970 WFI questionnaire for Africa therefore attempted a more precise definition of forest and open woodland. These concepts had originally been defined in a meeting of forest inventory experts held at FAO Headquarters in 1967. How these definitions were adapted in detail to African conditions can be seen in Appendix I.

Theoretically it is the same basic concepts, forest and open woodlands, which have been sought for in this report. As a matter of fact, the problem what is forest and what is open woodland concerns mainly the summary tables given in Part II.

In the country notes it has often been necessary to use the different concepts and definitions used in the countries themselves. This has been done when it has not been possible to adjust them to the tidy definitions given in Appendix I. Any important differences are mentioned in the text.

When studying the country notes, certain points should be kept in mind. The first priority was to give the area of so-called closed forest. Other expressions like dense forest and high forest have often been used. These terms should be synonymous with closed forest. Often names of certain vegetation types are also used such as moist forest, rainforest, and montane forest. When the word forest is used in another meaning than closed forest (or rather in an uncertain meaning) it is placed within quotation marks thus: "forest".

Forest land has often been used as synonymous with "Forest and other wooded areas" simply because it is easier to write. "Wooded areas" has the same meaning.

"Open woodland" has many synonymous terms of which some have occasionally been used. This may sometimes give additional information.

The definition of forest accepted by FAO in 1967 can certainly be criticized from many points of view. It can therefore be argued that more effort in this report should have been put into improving the definitions of forest and open woodlands but, at the present stage, is considered to be a rather

academic undertaking. Even with "better" definitions the information given in the country notes would not be more comparable.

It has been considered better at the present stage of knowledge to try to identify all areas of forest and other wooded areas and to make as detailed a breakdown of these areas as possible into vegetation types, utilization classes, productive value etc. As information becomes more complete - it will be possible to create several different groups which can be comparable from country to country. These groups will be different depending on the questions to be answered e.g. timber forest, pulpwood forest, forest of protective value, fuelwood forest etc. It will then also be possible to give better figures concerning the area of different vegetation types.

Volume is a much better index than area of resource capacity relative to demand. It is certainly easier to show the importance of the forest resources in a country by making breakdowns of the available woodvolume into different groups than by making different breakdowns of the area.

Unfortunately inventories are so few that information concerning volumes is very scarce for most countries. In addition the definitions of the different volume concepts used in inventories are often so unclear that it is difficult to know exactly what a volume figure means.

The different volume concepts normally used in inventories have been defined in Appendix I (Glossary). When these terms are used in the country notes it is not certain that these terms have exactly the same meaning as defined there. Details like whether bark is included or not, minimum d.b.h. included, species included, minimum top diameter, portions of the trees included, defective parts included or excluded etc. are not always known. It may be that these basic facts are given somewhere in the original inventory reports. In the second-hand reports frequently utilized by me such necessary facts are not always given. It is also quite often impossible to interpret these details in the original documents.

Another serious difficulty when discussing volume information at an international level is that the questions to be answered are different from country to country. Often therefore only one type of volume is given in an inventory. This makes comparisons of the information between countries very difficult.

In "FAO Manual of Forest Inventory" the following different volume concepts are defined: total volume, gross volume, net volume, industrial volume, log volume, other usable volume and branch volume. The term "commercial" can be added to the terms "industrial", "log volume" and "other usable volume" or to specified portions of the volumes and then distinguishes the volume which can be economically removed under given conditions.

In the ideal case most of these volumes should be given in all inventories. The total volume is the concept which most easily can be compared from country to country.

3.3. Comments on items in the country notes

3.3.1. General

Here are a few comments to the main items for which information has been given. Comments are given on the reliability of the information, sources,

intentions, and certain specific points of interest about which the reader ought to be aware. Naturally this discussion must be kept very short.

3.3.2. Geography and climate

To give an overall picture of the conditions, certain general information has been given as an introduction. This information has - in the main - been taken from different country reports prepared by FAO and from "Africa South of the Sahara".

3.3.3. Land use

The information on this item has mainly been taken from FAO Production Yearbook and sometimes from the WFI questionnaire 1970. It is evident that the information quite often is uncertain. This is caused by the fact that the information has been gathered by a questionnaire and the countries have only rarely done any detailed land use studies. As a matter of fact a much more detailed breakdown in different land use classes is necessary to make the information comparable in any way. Now there are too many intermediate categories like bush fallow, open woodlands used for grazing etc. which may be classified differently from country to country.

The information has been given here to show the position of forest land in the countries overall pattern of land utilization.

In the case of forest land, far more detailed information has been given under other headings. Discrepancies between the figure about forest land given in the land use table and figures given under other headings are often caused by different definitions. Forest land as defined in FAO Production Yearbook has a very wide meaning.

3.3.4. Forest and other wooded areas (forest land)

Information on this item is found under different subheadings. In most countries a short description of the natural vegetation is given first. If possible the areas of different vegetation types have been given. Sometimes a description is only given of the areas of the different forest and open woodland types that remain. This is because no suitable description of the vegetation has been found.

The main emphasis is put on identifying the areas of closed forest. With a few exceptions these areas have been investigated and are quite well known in area. It must be noted anyhow that the information is practically always some years old and it is probable that the areas of closed forests are decreasing.

The areas covered by different types of open woodlands are not as well known as the area of closed forest. This is because of the difficulty of clarifying which areas should be shown as open woodlands. They are often strongly influenced by man and even a detailed inventory would have difficulties with its definition. The figures given must therefore be treated with care. Both over- and underestimates are probably to be found.

The main thing is to identify the areas that can produce wood of different quantities and types.

The basic description is normally done for different geographical regions or for different vegetation types.

3.3.5. Man-made forest

The information about plantations is quite complete. It should be noted that the information given is often two to three years old and planted areas may have increased considerably since then. On the other hand, plantations are very often overestimated. This is caused by the fact that the area planted is often calculated from the number of plants that have been sold. Since a lot of plants never get planted and a lot of them die there is an error. Enrichment planting is probably sometimes included in the figures.

Information about man-made forests is rarely consistent. For instance one may compare the total area planted for 1968 and the planted areas given for 1969-1972, with the total area of plantations given at the end of 1972. These different figures rarely work out.

Information about the annual planting rate quite often seems to be of doubtful value while information about the total area seems to come closer to the truth. This is especially the case when the plantations are concentrated in large blocks. Statements about the accuracy refer to the year of estimate.

As for plans for plantations it should be remembered that plans are practically always too optimistic. Some of the figures are also maximum figures.

3.3.6. Results from inventories

Information from all identified inventories has been summarized when results have been available. It is likely that most inventories giving information of interest for a resource appraisal of this type have been identified. The location of the inventories have, as far as possible, been shown on the country maps. The volume of different species has often been given. When this information becomes more complete, interesting studies can be made concerning the volume in certain regions of the volume of valuable species.

It is not always explained clearly to which area a volume refers or to which minimum diameter, species etc. it refers. The information obviously has many limitations.

3.3.7. Standing timber

In only a few cases national estimates concerning standing timber exist and have been given. When such national estimates have been made it is not always said to which kind of volume it refers.

These national totals are normally given in connection with the inventory information.

3.3.8. Other information

If anything of interest has been found facts are also given about shifting cultivation, grazing, accessibility, concessions, exploitation, future plans for exploitation and so on. Some of these points will be further discussed in Part II.

3.4. General about the maps

The initial work was done at FAO Headquarters and was completed at the College in Stockholm. Initially the objectives were twofold:

- a) The maps should facilitate the reading of the country notes.
- b) The maps should be a working tool. It is normally easier to find mistakes in cartographic information than in tables. This fact would make it possible to have a continuous improvement of the cartographic information.

Due to the small scale used and the lack of time and resources the second point is somewhat reduced in importance and the map must be seen mainly as informative. To be of real importance as a working tool the map must contain a complete roadnet, names of places etc. so that it is possible to locate all the information exactly.

A disadvantage is that practically all maps are of the same size. This means that it is possible to give more information for small countries than for large. But then more details is actually available for small countries.

The maps summarize as far as possible the best available cartographic information. They have the disadvantage that they often contain somewhat outdated information. Information of basic interest, like the actual distribution of forest, areas under concessions etc. are not always given because sometimes no such information has been traced. Not all existing information of interest has been shown. This is because the amount of information that can be shown at one map is limited.

It has for technical reasons not been possible to utilize the same legend, for all maps. The dark green colour means e.g. different things from country to country.

What we have tried to show is as follows:

Actual cover of closed forest (and other types of wooded areas)

This is the basic information. In cases when it has been impossible to show this information, vegetation types or Forest reserves have been shown instead.

Vegetation types

Sometimes there may be a difference between the vegetation types described in the text and vegetation types given on the map. This is because in both cases the best available information has been utilized. It has not always been possible to find good descriptions of the vegetation types shown on the map or vice versa, nor has it been possible to utilize the most detailed vegetation maps as this would have required far too much work and resources. The information given in the original maps has very often been simplified.

Forest reserves

When Forest reserves are of basic importance we have tried to show them. Sometimes the Forest reserves cover practically all the remaining closed forest areas.

Exploited areas and concessions

Where these categories cover large continuous areas they have if possible been shown. Often they cover scattered areas here and there and in such cases it has been impossible to show them.

Man-made forest

When the locations of the main plantations are known information on this item has been given. When the plantations are scattered in small blocks they have not been shown.

Main roads, towns and rivers

Information on these items is normally given to provide some information about accessibility and population density. This information is not always comparable from country to country; partly because of the base-maps used, partly because of limitations in the amount of information that can be shown on a map.

Inventoried areas

When the exact location of the inventory is known it has been shown on the map. It has been impossible to show small and scattered inventories.

Names

As many as possible of the names used in the text have been shown on the map. This makes it sometimes possible to roughly locate an inventory, plantations or other information given in the country notes.

Regional sub-divisions

Certain regional sub-divisions like exploitation regions have been shown.

Late comments to the maps

On several maps of West African countries where the vegetation description is based on the Vegetation Map of Africa the moist types of woodlands have been broken down in two types:

Relatively moist types of (woodlands and) savannas
Guinea savanna

As a matter of fact both these types are in West Africa called Guinea. What is called Guinea savanna on the maps is the type where *Isoberlinia doka* and *I. dalzielii* occur abundantly.

The different vegetation types, which on the Vegetation map of Africa are called "Woodlands, Savannas (and Steppes)" of one type or another are in the legends often only called savannas (e.g. Rel. moist types of savannas).

The Miombo is on the other hand called woodland (as is common in East Africa) although even this type belong to the group "Woodlands and Savannas".

"Moist forest at low and medium altitudes" is often called only "Moist forest".

3.5. COUNTRY NOTES

ALGERIA

General

The country covers an area of 238.2 million ha. The northern part is occupied by the northern range of the Atlas mountains which is parallel to the sea. Between this coastal range and the Saharaatlas in the south is the slightly undulating "Shottplateau". The major part of Algeria is a wide desert region within Sahara. In southern Sahara some mountain ranges reach close to 3,000 m.

The coastal area has a mild mediterranean climate with rainy winters. The Sahara region has hot summers and cool winters with very little rain.

According to the FAO Production Yearbook 1971 the land use is as follows (information from 1968):

Land use	Area, 1000 ha
Arable land and land under permanent crops	6,787
Permanent meadows and pastures	37,416
Forest land	2,424
Other land	191,547
Total area	238,174

Natural forest land

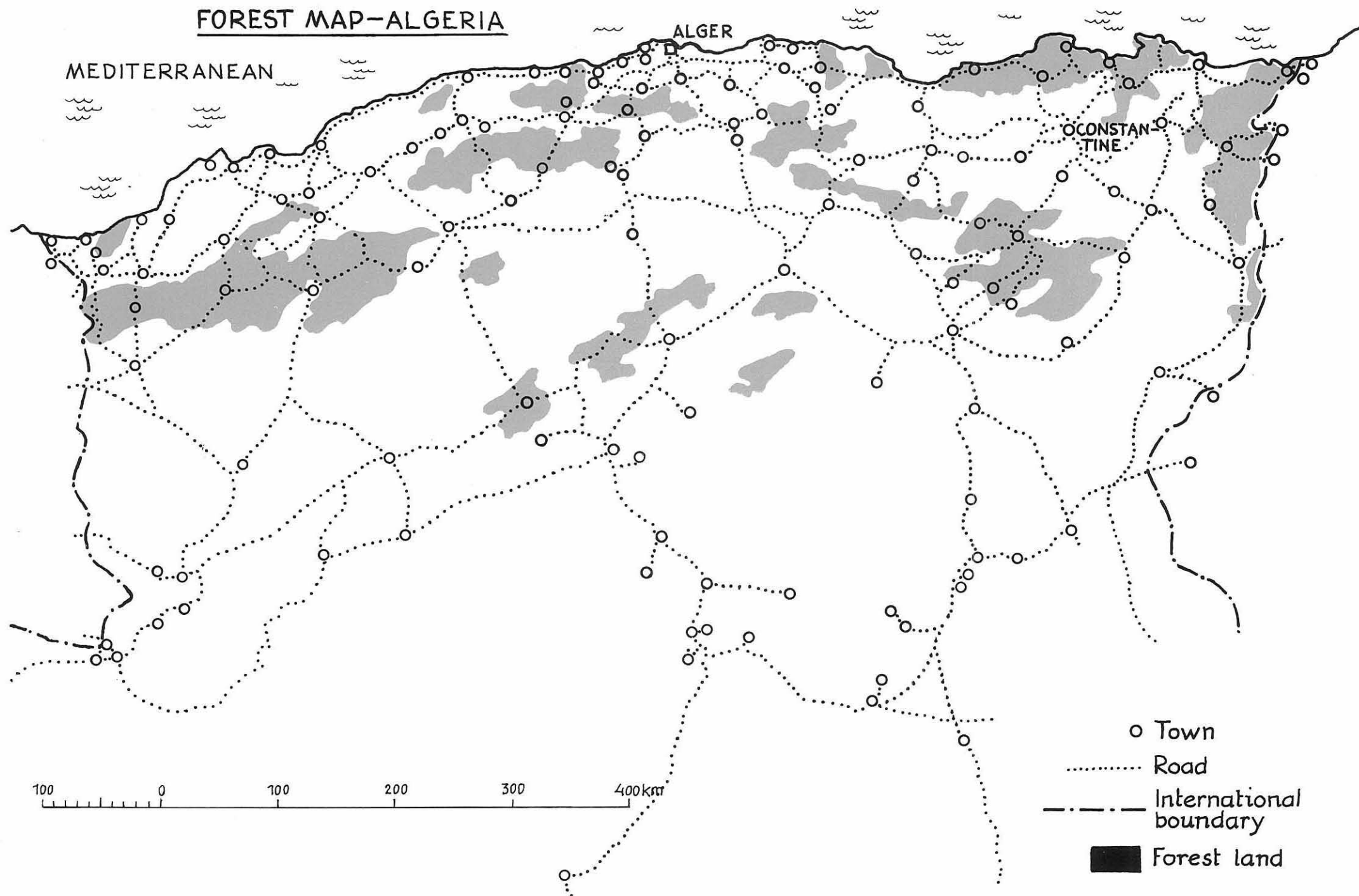
The remaining forests are found in the Atlas mountains. On the high plateau between the mountain ranges alfa grass covers extensive areas. It is estimated that the total area of productive forests, scrub and brushlands extends over 2-3 million ha. At the end of the nineteenth century the productive forests covered 4 million ha. The climax vegetation is formed mainly by *Quercus ilex*, *Cedrus atlantica*, *Abies numidica*, *Pinus* spp., *Juniperus* spp. and *Tetraclinis articulata*.

A large part of the area given as forest land above is degraded (perhaps up to 80 per cent); large areas were destroyed during the liberation war and now contain very young forests. A first estimate of potential commercial forest land that can sustain forest industries during the next 30 years is as follows:

Dominating species	Area, 1000 ha
<i>Pinus halepensis</i>	400
<i>Pinus pinaster</i>	10
<i>Cedrus atlantica</i>	20
<i>Quercus suber</i>	60
Total	490

It is not known how much of this forest land is covered by exploitable forest at present.

FOREST MAP-ALGERIA



Man-made forests

The total area of plantations in Algeria is not known. In 1955 it was reported that 100,000 ha of plantations existed. The present area can actually be more than 200,000 ha.

According to a recent paper 43,000 ha were planted during the years 1965 to 1970, of which around 35,000 ha were afforested. Species distribution of these plantations was as follows:

Species	Percentage of area
<i>Pinus halepensis</i>	60
<i>Cupressus</i> spp.	13
<i>Pinus pinea</i> , <i>P. pinaster</i>	5
<i>Eucalyptus</i> spp.	7
<i>Acacia</i> spp.	4
<i>Cedrus atlantica</i>	2
Other spp.	9

The present plan for planting was - according to the same paper - 10,000 ha per year. Another and still more recent source claims considerably more intensive planting efforts. Between 1945 and 1969 an area of 163,000 ha should have been afforested - 145,500 ha between 1963 and 1969. In the 1971-1972 season an area of 27,600 ha was actually planted while an area of 45,000 ha was intended to be planted during the 1972-1973 season. It is not known if all the plantations are successful.

Some of the differences between sources may be caused by the fact that considerable areas of protection plantations (or areas under protection measures) are included in some of the figures, but not in others.

Inventories

The UNDP/FAO project ALG 15 has carried out a reconnaissance survey of 106,300 ha of natural forests in the Aurès mountains south of Constantine. Of this area 93,500 ha is covered with *Pinus halepensis* and 12,500 ha with *Cedrus atlantica*. Thirty per cent of the pine forests have 75-175 trees/ha and a standing volume of 50-125 m³/ha. The pine forests in this area are over-mature; eighty per cent of trees being 90-120 years old.

In the project area 18,000 ha has been covered by a detailed inventory.

Exploitation

In 1971, 150,000 m³ of industrial wood was exploited. A sustained yield of 400,000 m³ of sawtimber and other industrial wood is calculated to be possible (in natural forest?).

Other

- 1) All "forest" areas are publicly owned.
- 2) Large areas of forest and other wooded areas are destroyed by fire each year (in the sixties 40,000 ha per year was quoted as an average).

ANGOLA^{a/}General

Angola has a total area of 124.7 million ha. Two-thirds of the country is a plateau, with an average height of 1,000 - 1,400 m, but with higher massifs reaching above 2,000 m (especially in the marginal mountains in the west). The coastal plain along the Atlantic is separated from this high inland plateau by a low plateau with broken topography, which varies in width from about 160 km in the north to about 25 - 40 km in the centre and south.

Angola has a tropical climate which is locally tempered by altitude. The cold Benguela current along the coast influences and reduces the rainfall in that part of the country which is arid or semi-arid.

According to the FAO Production Yearbook 1971 the land use is as follows (information from 1953):

Land use	Area, 1000 ha
Arable land and land under permanent crops	900
Permanent meadows and pastures	29,000
Forest land	43,200
Other land	51,570
Total area	124,670

Natural forest land

Of Angola's total area, land under tree cover makes up about two-thirds. The "forest" vegetation is distributed among the following types (information from 1963):

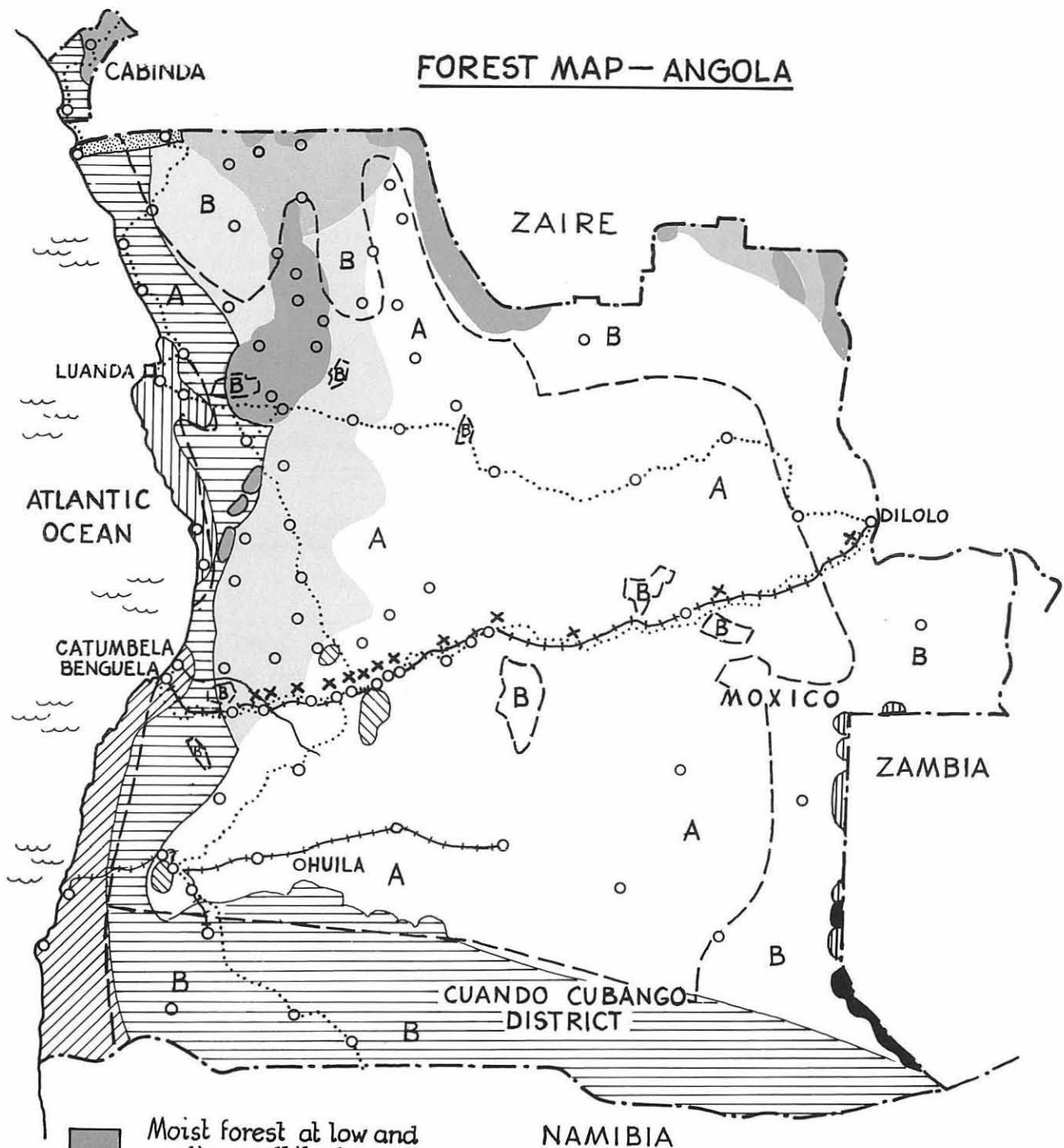
Vegetation type	Area, 1000 ha
Moist evergreen forest	250
Moist semi-deciduous forest	2,760
Miombo woodlands	58,500
Colophospermum and Adansonia woodlands	10,400
Riparian and mangrove forest	750
Total	72,660

The moist evergreen forest is restricted to the Cabinda enclave and small portions in the north of the province. It is mainly the Cabinda district which supplies the valuable veneer logs for export.

The moist semi-deciduous forest occupies around two per cent of the land area in a narrow belt along the northern part of the western escarpment. This forest contains a considerable number of valuable timber genera (e.g. Ekebergia, Khaya, Entandophragma, Pterocarpus, Chlorophora, Albizia, Syzygium). Its main importance, however, lies now in its shelter function for the coffee plantations and not in timber production. According to many

a/ For detailed map of Cabinda see page 50

FOREST MAP — ANGOLA



- Moist forest at low and medium altitudes
- Forest-savanna mosaic
- Relatively moist types of woodlands and savannas
- Dry deciduous forest
- Montane vegetation (partly montane evergreen forests)
- Grass steppe
- Relatively dry types of savannas (mainly Mopane)
- Mangrove
- Subdesert and desert
- Woodlands (mainly Miombo)

- [A] Areas under exploitation
- [B] Areas for future exploitation

- Town
- Main road
- Railroad
- International boundary
- Plantations

100 0 100 200 300 400 500km.

vegetation maps these areas are classified as moist savannas and not as moist semi-deciduous forest.

The savanna woodlands never completely cover an area but are found in a mosaic with tree savanna and sometimes grass savanna.

Man-made forests

Areas:

In 1970 an area of 120,000 ha was covered by man-made forests. They were distributed as follows:

a) The Benguela Railway Company:

These plantations which in all cover 38,000 ha are found in 20 spots along the railway Benguela - Dilolo. The main species are *Eucalyptus saligna* (24,000 ha) and *E. camaldulensis* (13,000 ha).

b) Ultramar Cellulose Company:

<i>Eucalyptus saligna</i> and <i>E. grandis</i>	20,500 ha
<i>Pinus patula</i>	7,500 ha

The mill belonging to this company is situated at Alto Catumbela.

c) Different private plantations occupy 41,450 ha. Most of these plantations are for the supply of light construction timber, posts and poles, fuel and other domestic needs. *Eucalyptus saligna* occupy 80 per cent. *Cupressus lusitanica* and *Pinus patula* are some other species.

d) Plantations by Forest Service:

Species	Area, ha
<i>Eucalyptus</i> spp. ^{1/}	10,000
<i>Cupressus lusitanica</i>	2,275
<i>Casuarina equisetifolia</i> and others	175
Total	12,450

1/ In decreasing order *E. saligna*, *E. grandis*, *E. camaldulensis*, *E. alba*, *E. globulus*, *E. citriodora*, *E. bicolor* etc.

Plans for planting:

Ultramar Cellulose Company:

a) 1971	<i>E. saligna</i> and <i>E. grandis</i>	8,000 ha
1972-1974	" "	36,000 ha

The total area of plantations exclusively for cellulose in 1974 will be 72,000 ha.

b) Plans are to install two new cellulose units with an annual capacity

of 200,000 ton each. The planting programme is 6,250 ha/year during the years 1974-1981.

The total area planted in 1981 will be 50,000 ha for each of these units.

c) Forest Service:

1971 E. saligna and Pinus patula	1,849 ha
1972 "	3,000 ha
1973 "	3,000 ha

In the fourth development plan (1974-1981) it is intended that 10,250 ha/year be planted. The main species will be Eucalyptus saligna, Pinus patula, P. elliottii and P. kesiya.

Total area planted in the period will be 82,000 ha.

d) Along the railway Benguela - Dilolo there are plans to plant 5,000 ha of Eucalyptus and 2,000 ha of Pinus patula each year. These areas may eventually be included in some of the earlier mentioned plans. (Probably under Ultramar Cellulose Company.)

Inventories

In 1970 it was reported that 2.9 million ha were covered by extensive inventories. A summary of some of the basic results for different vegetation types are given below.

A. Moist evergreen forest:

Of the 250,000 ha of moist evergreen forest in Cabinda 198,000 ha have been extensively inventoried. In all 55 species were selected for measurement due to their abundant occurrence and/or commercial value. The mean value was found to be 55 m³/ha above d.b.h. 50 cm.

For the ten most frequent species the following results are given:

Species	Volume, m ³ /ha
Gossweilerodendron balsamiferum	8.4
Terminalia superba	8.0
Ricinodendron africanum	5.6
Dacryodes pubescens	4.8
Oxystigma oxyphyllum	2.7
Entandophragma spp. ^{1/}	) 2.3
Khaya anthotheca	
Piptadeniastrum africanum	1.9
Klainedoxa gabonensis	1.7
Guibourtia arnoldiana	1.5
Staudtia stipitata	1.7

^{1/} E. utile, E. angolense, E. cylindricum

B. Moist semi-deciduous forest:

No inventories have been undertaken of this vegetation type. Exploitation-licences are given for limited areas, quantities and timeperiods.

C. Miombo woodland:

The inventory results have been given for a couple of districts:

a) Cuando Cubango district:

A reconnaissance of 8,278,000 ha has been undertaken of which 2.5 million ha were covered with open woodlands. The inventory gave a mean exploitable volume per ha of 4 m³ and a growing stock per ha of 8-45 m³. The exploitable volume was, in all, 10.2 million m³.

Commercial and potentially commercial species show the following values per ha:

Species	Volume, m ³ /ha
<i>Berlinia baumii</i>	2.46
<i>Baikiaea plurijuga</i>	2.30
<i>Berlinia</i> spp.	2.18
<i>Guibourtia coleosperma</i>	1.43
<i>Brachystegia</i> spp.	1.40
<i>Pterocarpus angolensis</i>	0.48
<i>Burkea africana</i>	0.65
<i>Erythrophleum africanum</i>	0.36

b) Moxico district

In the Luena Forest reserve 55,000 ha have been inventoried for exploitable volume of two commercial species with a d.b.h. between 40 and 60 cm (?). The following volumes were found:

<i>Guibourtia coleosperma</i>	2.5 m ³ /ha
<i>Marquesia macroura</i>	3.3 m ³ /ha

D. Colophospermum (mopane) and Adansonia woodlands

In the Huila district certain inventories have recently been undertaken. No results are available as yet.

Exploitation

In Angola all natural "forests" are state-owned.

The forest operations in dense forest areas are regulated by the Government mainly through forest concessions. The area covered is 65,000 ha. In open woodland no concessions are given. Exploitation-licences are granted for limited area and volume and for fixed timeperiods.

Between 1962 and 1971 the following volumes have been exploited in different vegetation types:

Vegetation type	Production, 1000 m ³
Moist evergreen forest	1,490
Moist semi-deciduous forest	457
Miombo woodland	1,626
Colophospermum (mopane) and Adansondia woodlands	7
Total	3,580

In 1969 the recorded production was as follows (the timber species are given by order of their importance):

Species	Production, m ³
Guibourtia coleosperma	71,979
Gossweilerodendron balsamiferum	56,555
Terminalia superba	30,550
Marquesia macroura	24,925
Guibourtia arnoldiana	23,945
Berlinia spp.	20,376
Entandophragma cylindricum	16,312
Chlorophora excelsa	12,332
Baikiaea plurijuga	9,605
Oxystigma oxyphyllum	9,520
Brachystegia spiciformis	8,058
Pterocarpus angolensis	7,673
Entandophragma angolense	6,583
Khaya klainei	7,632
Mimusops djave	5,230
Piptadeniastrum africanum	4,805
Mimusops congolensis	4,960
Aningeria superba	4,755
Antrocaryon klaineianum	4,525
Antiaris toxicaria	6,869

Other

The following estimates concerning crown-density were given to the WFI 1970:

Type of forest and other wooded areas	Good 1.0-0.7 1000 ha	Medium 0.69-0.4	Poor-less than 0.4	Temporarily unstocked
Natural closed forest	280	2,170	800	130
Man-made forest	119	0.3	0	0
Open woodland	4,000	22,000	30,000	4,395

B O T S W A N A

General

Botswana occupies 60 million ha of the Kalahari basin of the southern African plateau. In Botswana the plateau has an average altitude of 900 m above sea-level. Slightly undulating to flat terrain is characteristic of most of the country. The east is more hilly and broken than other parts. Most of southern Botswana is without surface drainage. The rest of the country's drainage is to a great extent interior and does not reach the sea. Extensive swamps are found in the north. The large Okavango swamps are fed by the Okavango river coming from Angola. The Kalahari desert dominates southern and western Botswana. From the semi-desert conditions in the south-west with an average annual rainfall around 225 mm there is a gradual increase in rainfall towards the north (625 mm) and east (375-500 mm). The associated natural vegetation change from sparse thorn bush in the Kalahari desert to dry woodland savanna in the north and east.

Most of the population is to be found in the eastern third of the country. The population is concentrated in large villages. They spend the winter in these villages and move out to arable lands in the spring.

FAO Production Yearbook 1971 gives the following information about land use (information from 1970):

Land use	Area, 1000 ha
Arable land and land under permanent crops	429
Permanent meadows and pastures	39,508
Forest land	958
Other land	19,142
Land area	54,441
Lakes, swamps etc.	5,496
Total area	60,037

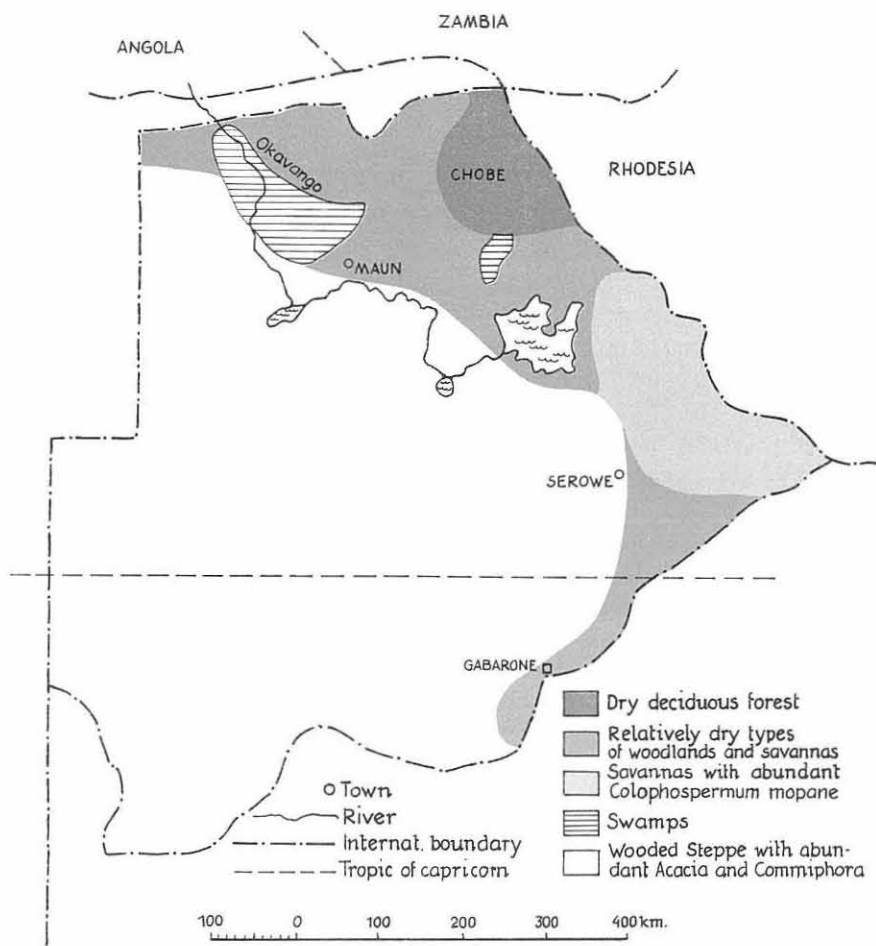
Natural vegetation

Much of the western part of the country is a part of the Kalahari desert which consists of undulating sandhills with stretches of grass shrub and woodland. The eastern part of the country is covered with Acacia and Mopane woodland.

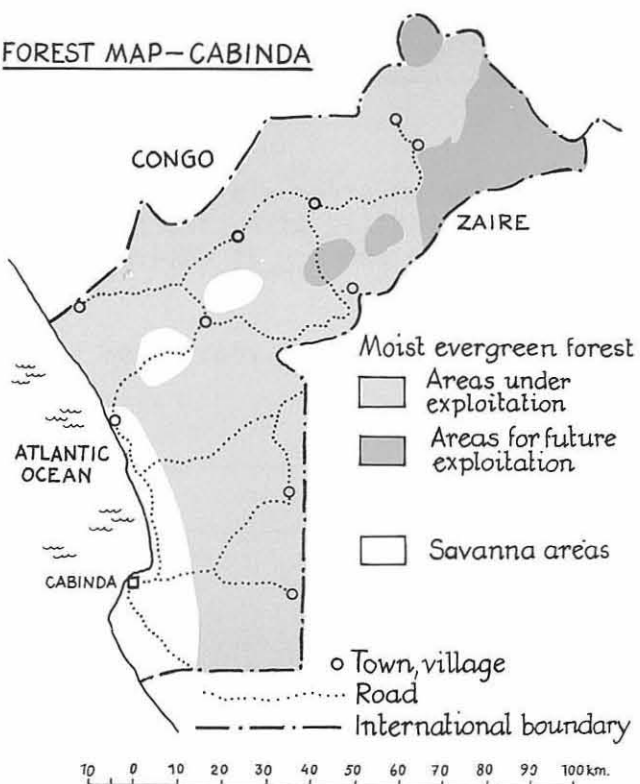
The distribution of the area in different vegetation types has been reported to be as follows:

Vegetation type	Area, million ha
Woodland of varying density	32.6
Open country with some low scrub-cover	22.6
Grasslands	1.8
Swamps and water	3.1

FOREST MAP - BOTSWANA



FOREST MAP - CABINDA



The only forest resource of any importance is to be found in the Chobe district in the northern part of the country. Here can be found so-called Rhodesian teak (*Baikiaea plurijuga*) in an area of 1 million ha. Other timber-species are *Pterocarpus angolensis*, *Entandophragma caudatum* and *Azalia quanzensis*. The dominant trees reach a height of 10-12 m. These forests are very open. The yield in exploited stands is 3-20 m³/ha. These forests are very different from area to area.

The Chobe district has been covered by an enumeration survey. In an enumerated area of 518,000 ha 55 per cent of the area was classified as productive. In this area was found only 260,000 m³ o.b. of timber. Of this volume 56 per cent was *Baikiaea plurijuga*, 41 per cent *Pterocarpus angolensis* and 3 per cent other species.

At this stage the creation of some Forest reserves in the Chobe region had been proposed. Since 1967 there has however been no commercial exploitation of indigenous species.

Man-made forests

In the south-eastern part of the country there exist some small plantations mainly of *Eucalyptus*.

Ownership

There are eight tribal territories with an area of 28 million ha, six freehold farming blocks of 1,554,000 ha and 28 million ha of crown-land.

B U R U N D I

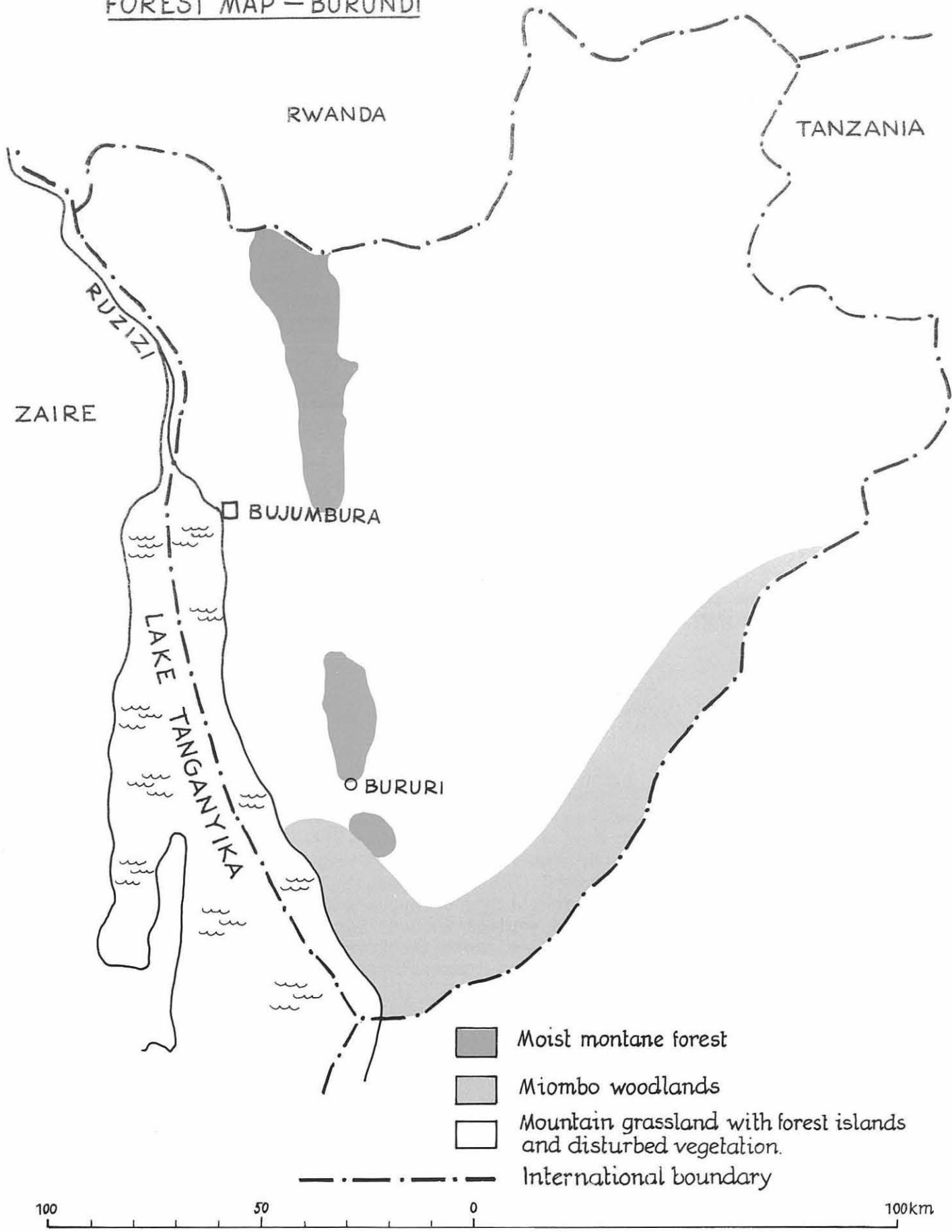
General

Burundi occupies only 2.8 million ha but has a large population for its size of 3.34 million (135 inhabitants per km²). Eastward from the Lake Tanganyika (at 780 m above sea-level) and the Ruzizi river the land rises sharply up to around 1,800 m in a range (the Congo-Nile divide) which stretches north into the much higher and volcanic mountains of Rwanda. In Burundi the highest peaks reach 2,600 m. This mountain range was once forested but nearly all of this forest has disappeared. Away from the Rift valley elevations are lower, and most of Burundi consists of an undulating plateau of between 1,350 and 1,800 m. Here the average temperature is 20° C, and rainfall 1,150 mm. In lower areas temperatures averages 23° C, while the rainfall is around 750 mm.

According to FAO Production Yearbook 1971 the land use is as follows (information from 1970):

Land use	Area, 1000 ha
Arable land and land under permanent crops	1,200
Permanent meadows and pastures	434
Forest land	70
Other land	1,079
Land area	2,565
Total area	2,783

FOREST MAP — BURUNDI



Natural forest land

There are still some natural forest areas in the Congo-Nile divide. The figure given about the extent of these varies. The maximum figure is 100,000 ha and the minimum 10,000 ha. The first figure quoted is the one most commonly used but the last one is given to the WFI 1970. The different estimates probably depend on the chosen definition of forest.

Most of these forests are at high altitudes, rather inaccessible and mainly needed for protection purposes. Of the maximum area given above, 50,000 ha is estimated to be protective forests while the rest could be used for production. All these natural forests are reserved. Since 1968 all exploitation in natural forests has been forbidden.

The main exploitable species are the following:

<i>Carapa grandiflora</i>	<i>Entandophragma excelsum</i>
<i>Podocarpus milanjanus</i>	<i>Alangium chinense</i>
<i>Strombosia scheffleri</i>	<i>Conopharyngia bequaertii</i>
<i>Newtonia buchananii</i>	<i>C. johnstonii</i>
<i>Schefflera abyssinica</i>	<i>Xymalos monospora</i>
<i>Polyscias ferruginea</i>	<i>Ficus sp.</i>
<i>Symphonia globulifera</i>	<i>Albizia</i>
<i>Chlorophora excelsa</i>	<i>Croton</i>
<i>Maesopsis eminii</i>	<i>Macaranga</i>
<i>Podocarpus usambarensis</i>	<i>Neoboutonia</i>
<i>Syzygium parvifolium</i>	<i>Parinari</i>
<i>Olea hochstetteri</i>	<i>Prunus</i>
<i>Galineria coffeoides</i>	<i>Dracena</i>
<i>Ficalhoa laurifolia</i>	

In the natural forest there are five to six exploitable trees per ha. In the 3,000 ha large Bururi forest there are 20 - 30 exploitable trees per ha.

In the eastern and southern part of the country wooded savannas also exist. All forests are publicly owned.

Man-made forests

At present there are about 25,000 ha of plantations. At the end of 1967 the species distribution was as follows:

Species	Area, ha
<i>Eucalyptus</i> spp.	15,787
<i>Cupressus</i>	2,422
<i>Grevillea robusta</i>	939
<i>Acacia</i> spp.	2,445
Other spp.	2,098
Total	23,691

The Forest Service is trying to increase these areas. Recently 250 ha have been planted each year. The area that can be planted depends completely on

the budgetary situation. Plantations have been established in the whole country, normally in small patches varying from 5 to 100 ha. It has been estimated that it will be necessary to establish around 50,000 ha with plantations to meet the need for wood in the year 2,000. Another 50,000 ha ought to be planted for protection purposes.

Erosion problems

The lack of forests causes enormous erosion problem in this mountainous country. The most serious erosion takes place in the Congo-Nile divide. This erosion is the cause of inundation in low-lying areas down to the Tanganyika lake. This inundation is said to decrease agricultural productivity.

C A M E R O O N

General

The country has a total area of 47.5 million ha and has a 700 km long coast on the Gulf of Guinea. In the south, coastal plains and plateaus with dense forests dominate. Moving up to the central part, the country gradually becomes dominated by savanna which in the north turns into vast plains with semi-arid conditions. Parts of these plains are periodically inundated. The west has mountains with peaks over 4,000 m. This mountain range continues through central Cameroon.

In Cameroon the climate varies from ever-humid equatorial in the south to semi-arid tropical with a very long dry season (8 months) in the extreme north. The temperatures are stable (22-30°C) on the southern plateaus while the north has high peaks with temperatures of up to 45°C. The annual rainfall is above 1,500 mm in the south while it is about 600 mm in the north.

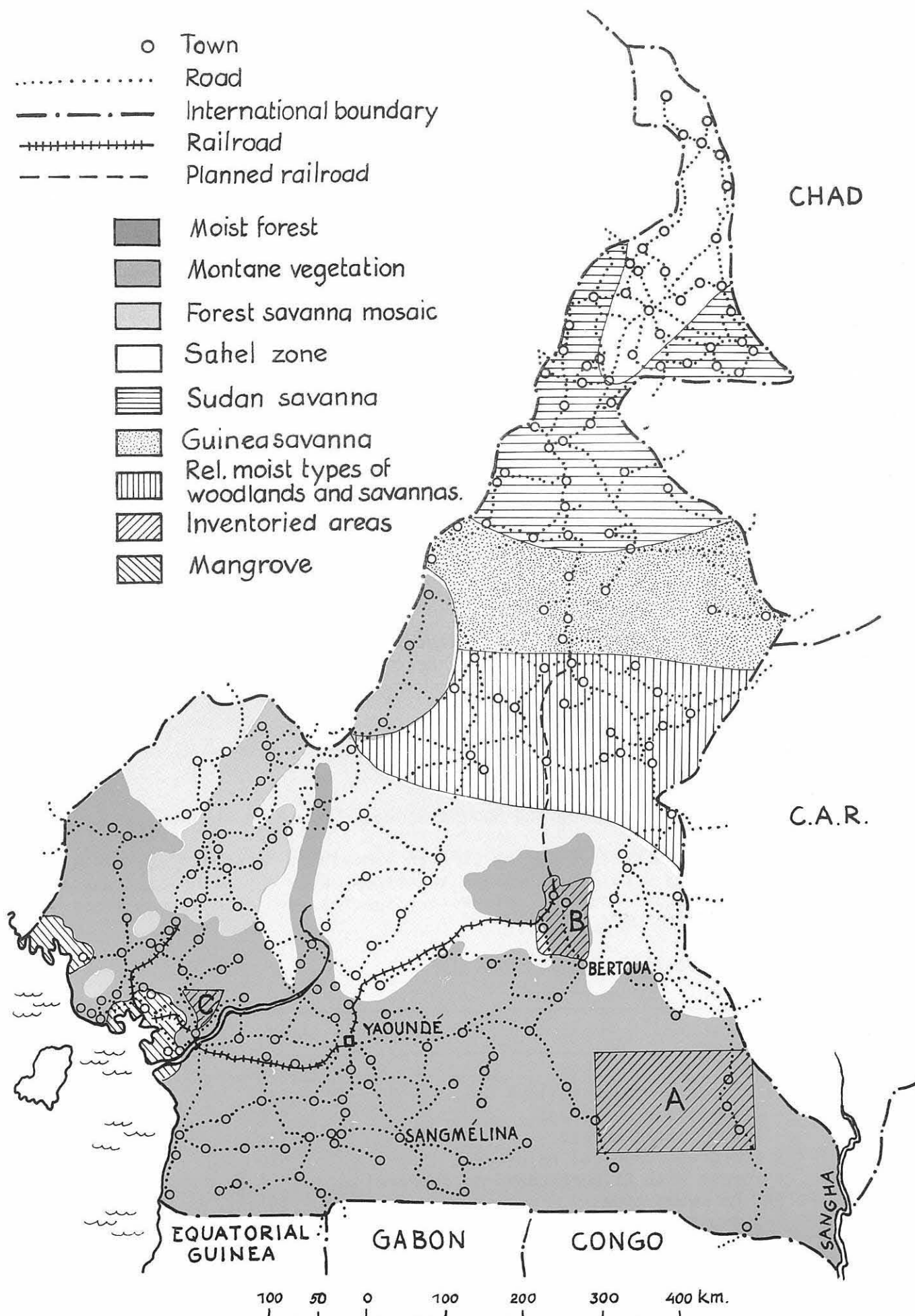
FAO Production Yearbook 1971 gives the following information about land use (information from 1970):

Land use	Area, 1000 ha
Arable land and land under permanent crops	7,300
Permanent meadows and pastures	8,300
Forest land	30,000
Other land	1,944
Land area	46,944
Total area	47,544

Natural forest land

According to the "Vegetation Map of Africa south of the Tropic of Cancer" the whole southern part of Cameroon is covered with tropical rainforest. This region can also be further sub-divided into several different subtypes.

North of the rainforest region comes a region with forest-savanna mosaic. The northern part of the country is covered with savannas of Guinea, Sudan and Sahel type.



FOREST MAP - CAMEROON

Large parts of the naturally forested region have been cleared. The estimates of how much forest really remains are quite unreliable. A recent estimate gives the total forest area as 17.5 million ha.

The main forest types are: dense forest on solid soil; forest on marshy soil; degraded and second-growth forest. Only dense forest on solid soil is of interest for forest exploitation nowadays. It is not known how much of the total forest area really is covered with forest of this type. Probably it is most of it.

Along the coast approximately 100,000 ha of mangrove are to be found. These forests contain 300 m³/ha.

Man-made forests

At present the total area planted is 9,000 ha. The main species being okoumé (around 3,000 ha) and Eucalyptus. Pines have also been planted, mainly on a trial basis. Of the plantations 5,500 ha is in dense forest while 3,500 ha is on savanna.

In dense forest the main species are: *Aucoumea klaineana* (okoumé), *Terminalia ivorensis* (framiré), *Pycnanthus angolensis* (ilomba), *Tarrietia utilis* (niangon), *Triplochiton scleroxylon* (ayous), *Entandophragma utile* (sipo), *Entandophragma cylindricum* (sapelli), *Afzelia bipindensis* (doussié), *Lophira alata* (azobé), *Baillonella toxisperma* (moabi) and ngollon.

In savanna the main species are: *Eucalyptus*, *Pinus*, *Khaya senegalensis* (cailcédrot), *Melia indica* (neem), *Dalbergia*, *Tectona grandis* (teak), *Cassia*.

For the period 1972-1976 it is planned to plant 6,500 ha.

Inventories

A. Inventory in Haute Nyong and Boumba-Ngoko. (Code A on the map.)

This inventory was carried out by CTFT in 1966-1967. An area of 2.2 million ha was covered by a rather extensive inventory. Fourteen principal species, 16 secondary species and 16 complementary species were enumerated. Trees above 62 cm d.b.h. were measured.

The land was classified as follows:

Land class	Area, 1000 ha
Forest	2,175
Dense forest on solid soil	1,875
- Semi-deciduous forest	585
- Transitional forest	712
- Evergreen tropical rainforest	576
- Forest with <i>Gilbertiodendron dewevrei</i>	1.6
Forest of swamp types	187
- Swamp forests	124
- <i>Raphia</i> palms	63
Degraded stages and regrowth	114
Non forested areas	23
Total	2,198

Results from the inventory are given below (for the area of dense forest on solid soil):

Species	Gross volume ^{1/}		Exploitable volume ^{1/}	
	Per ha	Total	Per ha	Total
	m ³ /ha	1000 m ³	m ³ /ha	1000 m ³
<u>Principal species</u>				
Limba	27.82	51,530	22.40	41,480
Ayous	22.78	42,180	18.70	34,630
Sipo	0.17	320	0.16	300
Sapelli	11.73	21,720	10.89	20,170
Dibétou	0.31	570	0.28	520
Acajou	0.17	310	0.14	260
Kosipo	0.70	1,300	0.67	1,250
Tiama	0.27	500	0.24	450
Iroko	0.82	1,510	0.63	1,170
Moabi	0.27	500	0.24	440
Azobé	-	-	-	-
Ilomba	0.73	1,360	0.61	1,130
Doussié	0.29	530	0.25	460
Tola	1.24	2,300	1.18	2,200
14 principal species	67.30	124,630	56.39	104,460
<u>Secondary species</u>				
Aiélé	0.39	730	-	-
Abale	2.73	5,050	-	-
Bilinga	0.30	560	-	-
Dabema	1.53	2,840	-	-
Fromager	2.04	3,770	-	-
Bossé	1.13	2,090	-	-
Mukumari	2.36	4,370	-	-
Emien	17.43	32,280	-	-
Bahia	-	-	-	-
Movingui	2.01	3,730	-	-
Eyong	1.37	2,540	-	-
Landa	0.44	820	-	-
Nkanang	-	-	-	-
Bété	1.42	2,630	-	-
Kokrodua	0.03	50	-	-
Noudougou	1.00	1,860	-	-
16 secondary species	34.18	63,320	-	-
Principal species + secondary species	101.48	187,950	-	-

1/ Volumes above d.b.h. 62 cm

B. In 1965 CTFT made an inventory of 300,000 ha in the Deng Deng forest in eastern Cameroon (the Departments Lom and Kadei). (Code B on the map.)

The main results concerning volume are shown in the table below:

Species	Volume, 1000 m ³ 1/
Ayous	5,739
Limba	3,599
Sipo, Sapelli, Kosipo)	
Tiama, Dibétou, Acajou)	2,500
Doussié, Tola, Iroko)	
Aiélé, Abale, Bilinga, Dabema)	
Azobé, Fromager, Mukumari)	
Bossé, Emien, Bahia, Movingui)	10,000
Eyong, Landa, Nkanang, Bété)	
Noudougou	

1/ Volumes above d.b.h. 62 cm

The mean volume per ha is as follows:

Species	Mean volume ^{1/} , m ³ /ha
Ayous	20
Limba	10
Sipo etc. ^{2/}	8
All species	70

1/ All species above 62 cm d.b.h.

2/ See the previous table

The terrain in this region makes logging very easy.

FAO has undertaken a complementary inventory of 76,000 ha in the Deng Deng forest. The gross volume over bark of the 25 species of greatest commercial importance was 8.28 million m³ (6.24 m³ net over bark) while the gross volume of the 17 potential commercial species was 3.9 million m³.

C. CTFT has carried out an inventory of 100,000 ha around Edea. This inventory was done for a pulp and paper project and all species (in all 342) above d.b.h. 15 cm were enumerated. (Code C on the map.)

The total volume available was 41,283,000 m³ of which 35,558,000 m³ was utilizable in the form of logs.

In dense forest the following information was given per ha:

Total available volume	396 m ³ /ha
Volume utilizable in the form of logs	341 "
No. of stems per ha	253 "

D. From the above-mentioned inventories and other information, the UNDP/IBRD Regional Transport Survey made an evaluation of available quantities of timber in the eastern part of the Cameroon forest region (the different sub-divisions are not shown on the map but they are roughly situated in the closed forest east of Yaoundé). Results from inventoried sub-divisions have been used to describe the conditions in non-inventoried sub-divisions with similar forest conditions.

The figures given concern the counted trees with a diameter of 62 cm and over.

Sub-division	Total area	Exploitable area	Total (principal spp.)	Sapelli	Other red-wood ^{1/}	Limba	Ayous	Others ^{2/}
	1000 ha		m ³ /ha					
1)		578	70.9	13.6	2.2	26.0	26.7	2.3
2)	2,198	704	70.9	13.6	2.2	26.0	26.7	2.3
3)		570	23.9	4.8	1.9	14.3	0.7	2.2
4	590	200	70.9	13.6	2.2	26.0	26.7	2.3
5	130	110	70.9	13.6	2.2	26.0	26.7	2.3
6	1,120	800	46.0	9.9	2.0	13.9	16.6	3.6
7	550	360	23.9	4.8	1.9	14.3	0.7	2.2
8	870	500	23.9	4.8	1.9	14.3	0.7	2.2
9	390	114	70.9	13.6	2.2	26.0	26.7	2.3
10	270	149	44.0	3.2	4.3	12.3	22.9	1.4
11	650	300	23.9	4.8	1.9	14.3	0.7	2.2
12	370	225	70.9	13.6	2.2	26.0	26.7	2.3
Rest	600	600	16.7	-	-	-	-	8.0

1/ "Other red-wood" comprises the species: Sipo, kosipo, dibétou, acajou, iroko and tiama.

2/ "Others" as far as the category "principal species" is concerned.

Shifting cultivation

Shifting cultivation is very intensive in certain areas. One source gives 4.5 million ha as being under shifting cultivation and bush fallow.

Exploitation and accessibility

The exploitation at present goes up to Sangmelina - Yaoundé-Bertoua - Mouloundou. Generally speaking the forests become less easily exploitable with increased distance from the coast except in the far south-east, where - at least in theory - logs can be transported on rivers through Congo. The 3 million hectares reserve of Haute Nyong and Boumba-Ngoko is particularly inaccessible given present infrastructural development. The Deng Deng forest area is now accessible as a result of the extension of transcameroonian railway.

Of the total forest area 8.5 million ha have already been exploited. In recent years at least 6 million ha have been given away as concessions. The unexploited area is reported to be 9 million ha. At present 16 species are exploited. It is not known what the plans are for forest exploitation in Cameroon.

Forest areas - inventoried or not - has often been reserved and closed to exploitation pending the development of suitable plans.

CENTRAL AFRICAN REPUBLIC

General

The Central African Republic (CAR), as its name implies situated in central Africa, is completely land-locked. With an area of 62.3 million ha, it forms a vast plateau running from west to east at an average altitude of 600 to 700 m. Only the Fortit massif in the north-east and the Yadé mountains in the west reach 1,400 m. The capital Bangui is at an altitude of 350 m.

The country has a tropical climate with a dry and a wet season. The average rainfall in the southern part is 1,500 - 1,800 mm per year combined with a high humidity, while the north is less humid and has an average rainfall of 800 mm per year. The temperature varies according to season and the yearly average is about 26° C.

According to the FAO Production Yearbook 1971 the land use is as follows (information from 1968):

Land use	Area, 1000 ha
Arable land and land under permanent crops	5,900
Permanent meadows and pastures	100
Forest land	7,400
Other land	48,898 ^{1/}
Total area	62,298

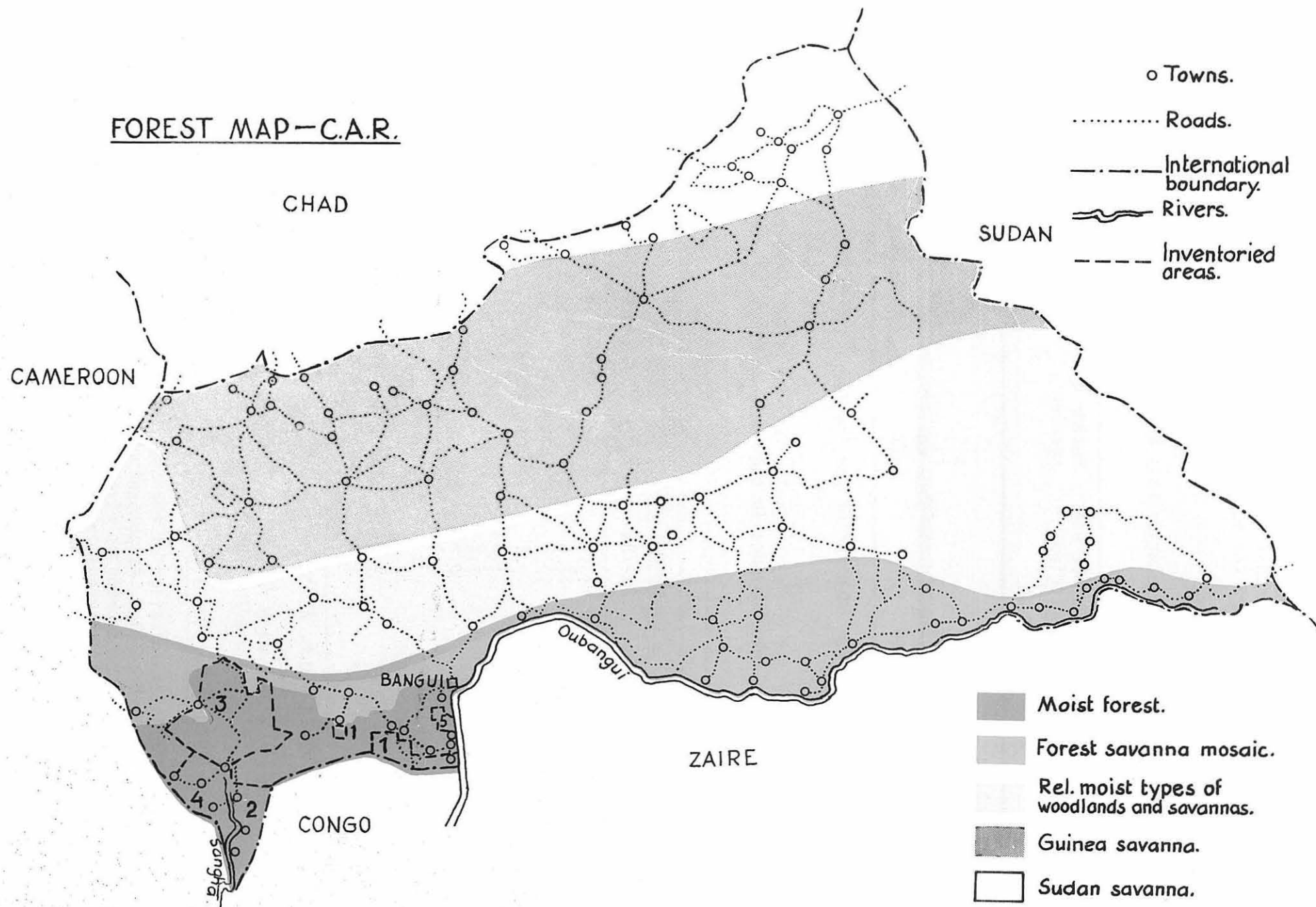
1/ Including rough grazing

Forest land

In the southern part of the country there are roughly 3 million ha of dense high forest. The northern part of this forest is semi-deciduous while the southern part is a transition towards the evergreen tropical rainforests. Some parts of the Central African forests appear to be exceptionally rich in Meliaceae, mainly *Entandophragma cylindricum* (sapelli). North of this high forest there is a belt of "derived Guinea savanna" of *Terminalia*, *Lophira*, *Daniellia*, with gallery forests containing *Khaya senegalensis* and *Chlorophora excelsa*. These gallery forests and the islands of forest in the forest-savanna mosaic area are concentrated mainly around the Mambere river. One-quarter to one-third of the country is covered by this type of association (the more densely populated area). One-quarter lies under woodland of *Isoberlinia* and *Anogeissus*. In the northern part there is Sudan savanna containing *Azelia bipindensis*, *Khaya* and *Oxytenanthera abyssinica*.

The high forests of the country are almost untouched by exploitation and still rich with exploitable species. It is also reported that the forest area is steadily decreasing. The savanna areas have a forestry interest as supplier of fuelwood, poles etc. for local consumption.

FOREST MAP—C.A.R.



The total area of plantations is around 1,000 ha. *Terminalia superba* (limba), *Cassia* and *Eucalyptus* are the main species planted.

Inventories

In CAR the following inventories have been undertaken:

Inventory	Area of forest inventoried	Number of species	Minimum diameter
	1000 ha		cm
1. Lobaye	100	all	20
2. M-Baere	195	all	20
3. Haute Sangha	255	all	20
4. Nola	755	69	20
5. Bimbo	55	all	..

For location of these inventories see the map (same number on the map as in the table).

Below are summarized the main results from completed inventories (per ha figures) and the total volumes in the whole country (estimate for 3 million ha).

Species	Gross volume ^{1/}	
	m ³ /ha	1000 m ³
Ayous	13.3	39,750
Limba	16.0	48,000
Sapelli	10.9	32,760
Sipo	1.1	3,330
Tiama	1.3	3,810
Kosipo	1.2	3,480
Acajou	0.5	1,350
Dibétou	1.1	3,360
Makulunga	-	-
Doussié	0.5	1,560
Iroko	1.3	3,870
Bété	1.8	5,520

1/ Trees above d.b.h. 62 cm

Inventories in the high forest have given a mean total gross volume of all species of 275 - 300 m³/ha (above d.b.h. 20 cm).

Accessibility and exploitation

The industrial exploitation of the country's forests is severely limited by the transport problem. At present all forest products for overseas export have to be transported on rivers to Brazzaville (1,300 km from Bangui) and by railway from Brazzaville to the harbour in Pointe-Noire (515 km). The rivers, the Oubangui, the Sangha and the Lobaye penetrate the forest only peripherally. The Sangha cannot be used for transportation all year long.

The logging conditions are generally favourable. The terrain is plain and the climate allows logging the year around.

Until 1965, only the eastern part near Bangui was exploited and this by less than ten logging firms of only small or medium size. Production was mainly of sawnwood for local consumption and for exportation to Chad. After 1965 concessions were granted to three to five relatively big logging firms scattered in the whole high forest region. The most important firm has a contract to exploit 100,000 m³/year. The exploitation should only be of trees with a d.b.h. more than 80 cm.

C H A D

General

Chad occupies 128.4 million ha. From 240 m in the Lake Chad depression in the south-west the country rises northwards to the mountainous Saharan region of Tibesti with peaks of 3,400 m. In the east heights of 1,500 m are attained in the Ennedi Massif. In the south the watershed area around the Chari river is of moderate relief and only slight elevation. Extensive areas with inundated land are found here.

Chad has three well defined climatic zones. The southern third of the country has a rainfall in excess of 500 mm a year rising in the extreme south to 1,200 mm. The central part of the country has a rainfall between 250 and 500 mm a year. The northern third of the country has negligible rainfall.

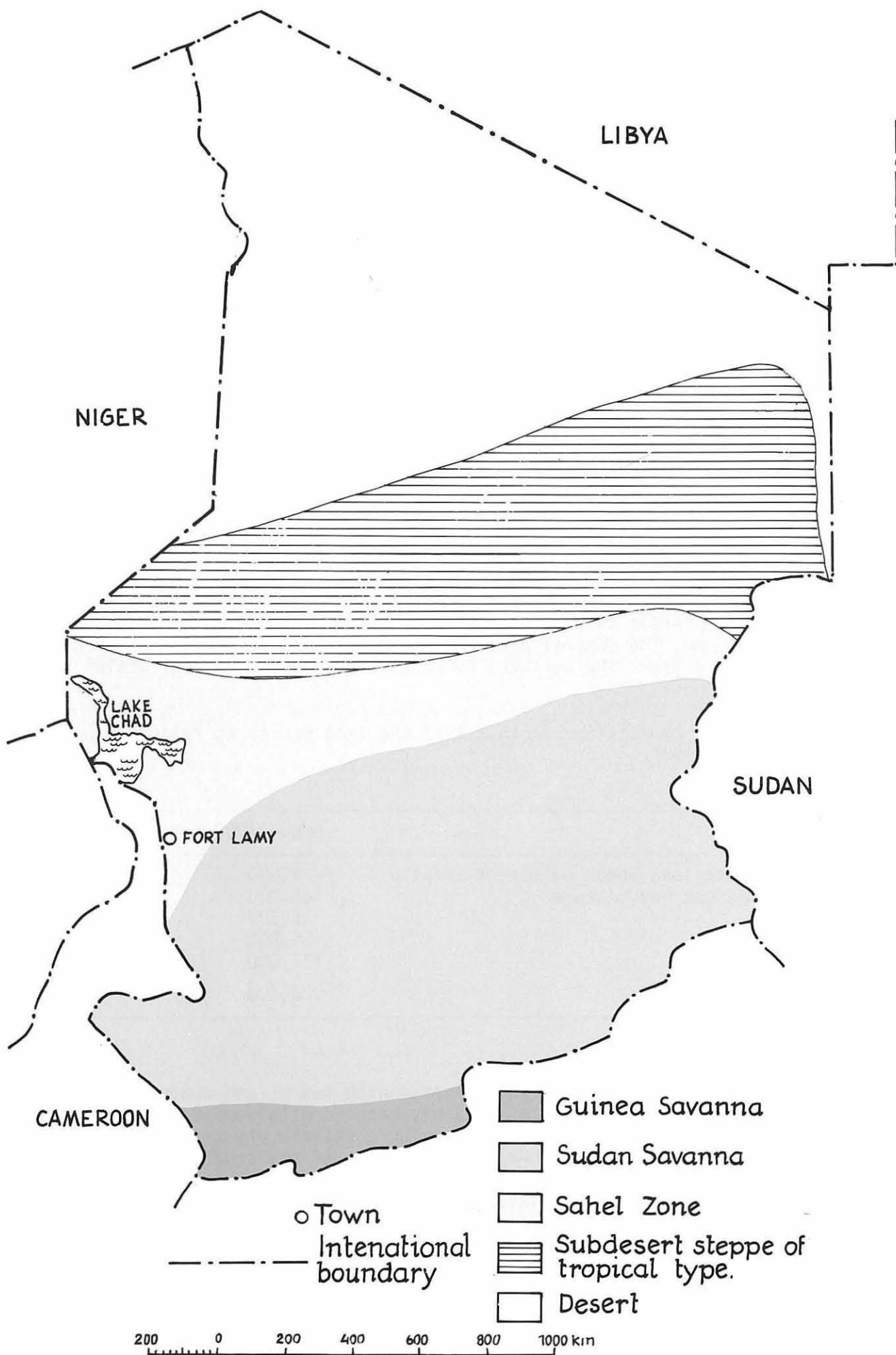
According to FAO Production Yearbook 1971 the land use is as follows (information from 1968):

Land use	Area, 1000 ha
Arable land and land under permanent crops	7,000
Permanent meadows and pastures	45,000
Forest land	16,500
Other land	59,900
Land area	127,000
Total area	128,400

Forest land

The northern half of the country is covered with desert and subdesert steppe. The southern half of the country is mainly covered with wooded steppe with abundant *Acacia* and *Commiphora* (Sahel), and relatively dry types of woodlands and savannas (Sudan savanna). A small part of the southern corner of the country is covered with woodlands and savannas with abundant *Isoberlinia doka* and *I. dalzielii* (Guinea savanna).

Wooded areas are exploited for fuelwood, building poles, canoe logs (especially from *Khaya senegalensis*). All industrial timber is imported from the Central African Republic.



FOREST MAP—CHAD

The exploitation for fuelwood causes degradation of the vegetation in densely populated areas. Due to the dry climate it is difficult to find suitable species for the necessary afforestation. There is some afforestation around Fort Lamy with *Khaya senegalensis*. Trials with *Eucalyptus* and *Dalbergia* species have not been too successful. Afforestation with natural *Acacia* species has also been tried, but these species grow very slowly. As in many dry countries, natural regeneration is difficult due to a high grazing pressure.

In Chad *Acacia nilotica* exists, from which one gets gum arabic.

Acacia albida is found in the whole Sahel zone. It is an evergreen tree with edible fruit. The yield of agriculture is shown to be higher in the shade of this tree.

It is unlikely that Chad will meet any demands for sawnwood in the future.

COMORO ISLANDS

Land use

Information from FAO Production Yearbook 1971 (data from 1965):

Land use	Area 1000 ha
Agricultural area	105
Forest land	35
Other land	77
Total area	217

Forests

The islands have the following areas of forest (information from 1964):

Island	Forest area, ha
Grand Comore	16,838
Anjouan	12,827
Mayotte	6,555 ^{1/}
Moheli	5,829

^{1/} In addition 8,779 ha of isolated degraded forests.

There are some very small areas with plantations.

In Grand Comore and Anjouan there is a lot of erosion.

C O N G O

General

The country has a total area of 34.2 million ha. A narrow coastal plain does not rise above 100 m. Rising abruptly from the coastal plain are the high-rainfall forest covered ridges of the Mayombe range. These are parallel to the coast and rising to a height of 800 m. Eastwards the Niari valley has lower elevation.

The forested mountainous region north-east of Niari, is the Congo basin's western watershed. North-eastwards from this are a series of drier plateaus. East of the Likoula river is a zone of numerous water courses, with seasonal inundation and dense forest vegetation.

The following approximate figures concerning land use have been given in FAO Production Yearbook 1971 (information from 1963):

Land use	Area, 1000 ha
Arable land and land under permanent crops	630
Permanent meadows and pastures	14,300
Forest land	16,250
Other land	3,020
Total land	34,200

Natural forest land

All the forest of any importance is classified as moist tropical forest. The remaining part of the country is classified as a forest-savanna mosaic. A detailed vegetation map prepared by L'ORSTOM for "Atlas du Congo" recognises 19 different vegetation types.

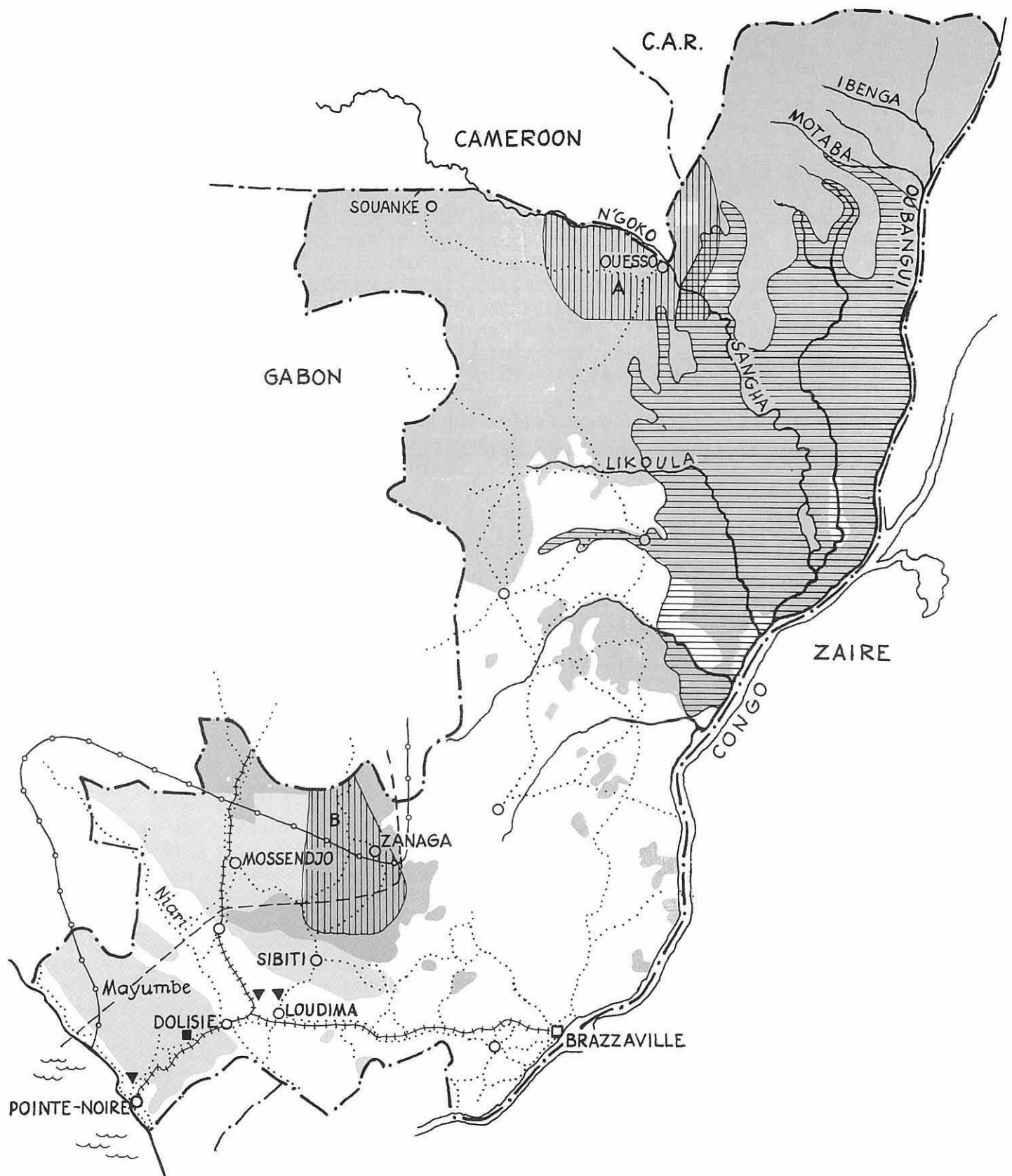
Of the 17 million ha given as forest 12 million ha is reported to be productive while 5 million ha is reported to be non-productive (inundated and non-exploitable).

The forests can be sub-divided into three regions. It should be noted that all volume figures given below are rough estimates. They are from 1970.

A. The coastal area (Mayumbe):

This region covers five per cent of the forest area but gives 19 per cent of the production. Fourteen per cent of the region is covered by concessions. Limba (*Terminalia superba*) has been the dominating species but all resources of limba have been exploited more or less completely. Only islands of limba remain. The limba in this region is of very good quality. At present, secondary logging is taking place. In all, 20 species are extracted. The major species - other than limba - are *Oxystigma oxyphyllum* (tchitola), *Staudtia stipitata* (niové), *Tieghemella africana* and spp. (douka) and *Khaya* spp. (acajou).

It is estimated that 850,000 m³ (in 1970) of exploitable wood exists in this region. With the present rate of exploitation (170,000 m³ in 1969) this resource would last two to three years. The exploitation must in any



Forest exploited and under exploitation

Unexploited forest

Inundated areas

Inventoried areas

Savanna areas, agricultural land, etc.

○ Town

..... Road

+++++ Railway

- - - - - International boundary

- - - - - Okoumé west a. north of this line

- - - - - Limba east a. south of this line

▼ Plantation of Pine and Eucalyptus

■ Plantation of Limba

100 0 100 200 300 400 500km.

event diminish considerably in coming years. The terrain of the region makes exploitation difficult.

B. The region Divenie - Mossendjo - Sibiti - Zanagá:

This region comprises 17 per cent of the forest area and gives 71 per cent of the forest production. Sixty-five per cent of the region is covered by concessions. Okoumé (*Aucoumea klaineana*) is dominating in the north while limba is dominating in the southern part. In the middle of the region both species occur. An area of 650,000 ha has been creamed of okoumé and limba. The exploitation has mainly been done on both sides of the railway Makabana-Mossendjo. In those areas there remain 2 million m³ of exploitable volume (four years production).

In the unexploited Sibiti-Zanaga region there is estimated to be 7 million m³. Of this volume, 4 million m³ is estimated to be okoumé. The unexploited area is given as 1.2 million ha. In this unexploited area no concessions have been given.

C. Northern Congo:

Large areas of unexploited forests can be found in this region. Seventy-eight per cent of the forest area is situated here but only five per cent of the production comes from this region.

The exploitable forests comprise two zones:

- | | |
|-----------------------------|----------------|
| a) The zone Sangha - N'Goko | 3.5 million ha |
| b) The zone Ibenga - Motaba | 3.2 million ha |

The exploitable volume per ha has been found to be 10 m³ in the first zone. No inventories has been undertaken in the second zone but a figure of 10 m³ per ha has been accepted for this zone although it is probable that the actual volume is higher. Inventories in the neighbouring CAR have given over 20 m³/ha of red-woods. The minimum disposable volume of valuable wood is now given as 60 million m³ in the 6 million ha considered to be exploitable.

The main species being "red-woods" (*Entandophragma cylindricum - sapelli*), and "white woods" (*Triplochiton scleroxylon-ayous*) and - in the Ouessou region - patches of *Afrormosia elata* which is a very valuable species. Ayous, the main species, is of rather low value and the return hardly covers the high transport costs. The substantial stretches of inundated areas in this region dominating the eastern portion cannot be exploited due to difficult access. Parts of the region situated north-east of Ouessou are of considerable interest; the Ouessou region and large regions south-west of Ouessou are also considered promising for exploitation. It is known that the south-western part of the northern region is of little interest for exploitation but it is not known if the north-western corner, west of Souanké, is of any interest.

The timber from this region must be taken by river down to Brazzaville after which it must be taken by rail to Pointe Noire. At present this railway does not have enough capacity to allow an increased exploitation in the northern region.

Man-made forests

A. Between 1949 and 1961 6,000 ha were planted with limba west of Dolisie. Of this total area, 3,000 ha are considered to be of good quality. No plantations of limba have been undertaken during the last years.

One thousand ha of limba is planned to be planted in the Niari region from 1974 and onwards for 35 years. These plantations are expected to give 350,000 m³ per year from the thirty-fifth year.

B. The total area planted with pines (mainly *P. caribaea*) and *Eucalyptus* is reported to be at least 6,000 ha (1972).

- (a) The main area planted is situated at Loudima. There are plans to build a pulp mill here. In this area, 100,000 ha is available for plantations. According to the 1970 plans 800-1,000 ha of *Eucalyptus* (mainly *E. tereticornis* and *E. orofila*) and 100-200 ha of pines was to be planted every year. Later information gives the planting programme in the Malolo-Dihesse area as 2,200 ha of pine per year during a ten year period (1974-1984) and 2,750 ha of *Eucalyptus platyphylla* per year over 5 years. These plantations should give an annual production of 1.12 million m³. A five year rotation for *Eucalyptus* and ten year for pine is planned. The *Eucalyptus* plantations should be replanted, every 15 years.
- (b) In the region north and north-west of Pointe Noire 40,000 ha are available for plantations. The growth rate is lower than at Loudima. Around 800-900 ha of *Eucalyptus* and 150 ha of pines have been planted in this area.
- (c) Planting, although on a small scale, has also been done 45 km north of Brazzaville. At present, 100 ha of pines is planned to be planted each year.

Inventories

A. CTFT has carried out an inventory of 1.17 million ha in northern Congo. (Code A on the map.)

Result, see page 70

The number of trees per ha with a d.b.h. above 60 cm reported to be as low as 17 (8 m³ per tree).

B. The UNDP/SF Project No. 542 (FAO) has done an inventory of 828,600 ha of forest in the Sibiti - Zanaga region. (Code B on the map.) Okoumé is found in an area of 551,200 ha. The main results are shown on page 71.

C. The Forest Service has also carried out several smaller inventories of blocks of 10,000 to 20,000 ha in the southern Congo; most of them with enumeration of commercial species only. Detailed results were not available for this note.

Result from CTFT inventory in northern Congo:

Species	Gross volume ^{1/}	Total gross-	Commercial
	m ³ /ha	volume 1000 m ³	volume ^{1/}
Sapelli	8.1	9,468	6,514
Sipo	1.0	1,206	854
Kosipo	1.0	1,194	833
Tiama	0.5	550	386
Diambi	0.1	164	92
Bossé	0.3	339	190
Douka	0.3	328	236
Acajou	0.3	316	210
Red-woods (8 spp.)	11.6	13,565	9,306
Kokrodua	0.4	468	241
Dibétou	0.6	737	486
Tchitola-Tola	0.1	164	94
Doussié	0.1	117	81
Iroko	0.2	246	178
Ayous	6.1	7,186	3,205
Limba	5.3	6,191	4,148
Bété	0.1	82	66
Other principal species (9 spp.)	12.9	15,191	8,499
Principal species (17 spp.)	24.5	28,756	17,805
Secondary spp. (16 spp.)	33.7	68,096	..
Complementary spp.	75.4	88.224	..

1/ Above 60 cm d.b.h.

Result from inventory in Sibiti-Zanaga region:

Species	Mean gross volume per ha		Total gross- volume ^{1/} 1000 m ³	Total commer- cial volume ^{1/}
	above 20 cm d.b.h.	above 60 cm d.b.h.		
	m ³ /ha			
<u>Principal spp. 1</u>				
Okoumé	12.1	7.9	6,567	3,658
Dibétou		0.3	241	156
Moabi		0.4	355	241
Avodire		0.5	399	258
Tiama		0.1	89	62
Douka		0.1	87	61
Kosipo		0.2	133	92
Iroko		0.1	48	22
Doussié		0.1	39	25
Limba		0.1	41	27
Sapelli		0.0	2	1
Menge		0.1	96	65
Sipo		0.1	52	36
Bossé		0.1	42	28
Izombé		0.0	15	10
Pau-rosa		0.1	58	41
Zingana		0.2	185	129
Sub-total	15.9	10.2	8,448	4,912
<u>Principal spp. 2</u>				
Olon		0.3	256	167
Tchitola		0.3	271	185
Ilomba		1.0	799	399
Niové		0.3	223	133
Padouk		0.5	430	270
Movingui		0.3	265	160
Aiélé		0.5	426	222
Faro		0.1	106	56
Bilinga		0.3	223	151
Ozigo		0.02	17	9
Bahia		0.07	590	299
Limbali		1.5	1,251	624
Sub-total	16.1	5.9	4,858	2,674
Secondary spp. (11 spp.)	21.8	9.7	8,074	-
Complementary spp.	..	30.1	24,897	-

^{1/} Above 60 cm d.b.h.

Present exploitation and future plans

At present the following species are exploited: okoumé, bilinga, dibétou, douka, doussié, iroko, acajou, kosipo, limba, longhi, moabi, mutenye, N'Tene, pau-rosa, padouk, sapelli, sipo, tchitola, tiama, tola. Some of these species are exploited in very small quantities.

In 1970 the total production of sawlogs was 801,000 m³. Of the export of sawlogs, okoumé made up 326,000 m³, limba 122,000 m³ and other species 202,000 m³.

In the five-year plan, 1970-1974, the following figures were given for the expected exploitation:

1974	780,000 m ³
1980	950,000 "

In December 1972 the following estimates were given concerning development of wood exploitation:

Region and species	Expected exploitation, 1000 m ³				
	Year				
	1972	1975	1980	1984	1986
<u>South</u>					
Okoumé	450	300	200	200	200
Limba	110	80	80	80	200
Other species	200	220	120	120	100
Total	760	600	400	400	500
<u>North</u>					
Total	80	290	1,000	1,400	1,500
Grand total	840	890	1,400	1,800	2,000

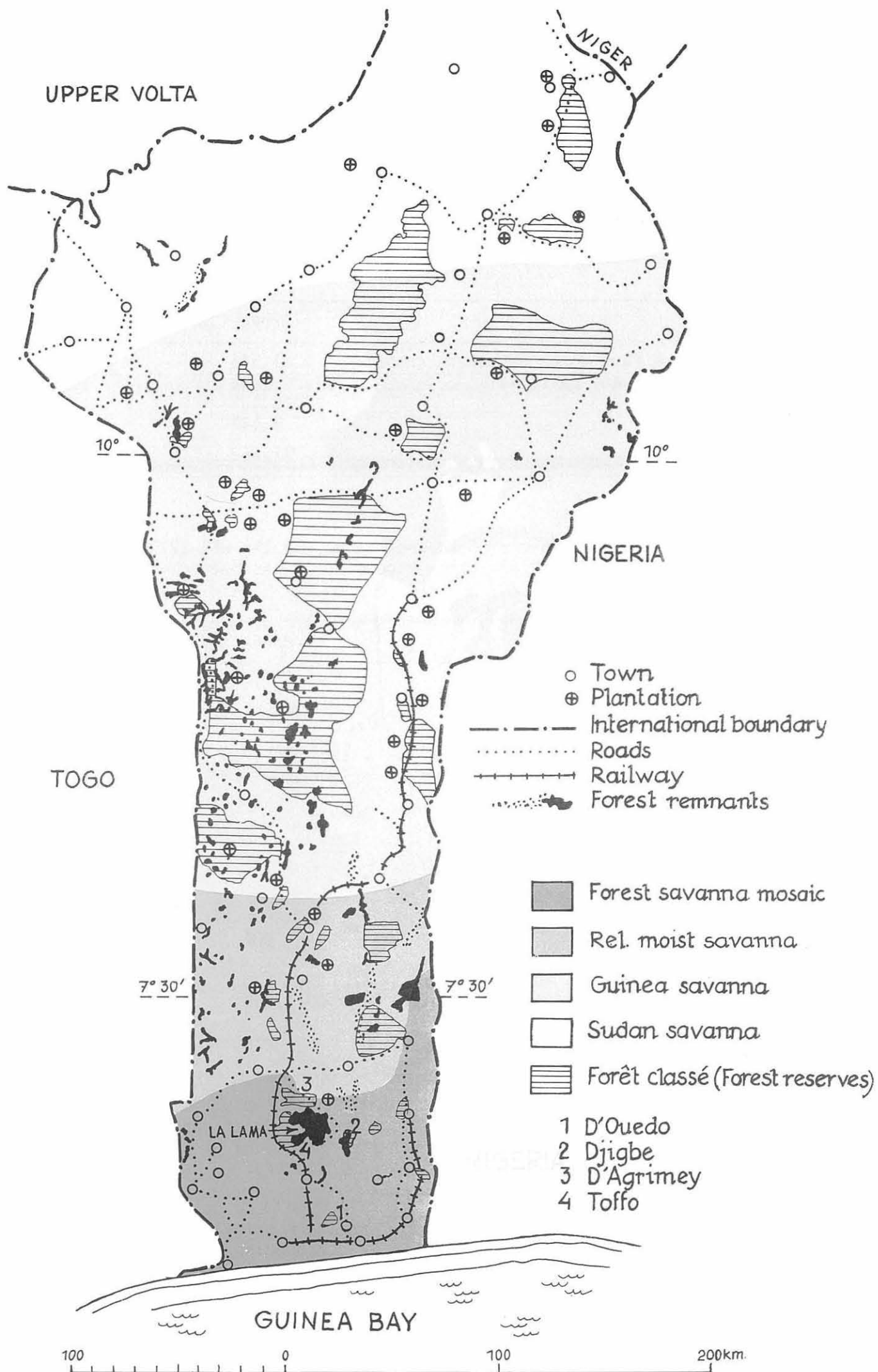
Timber resources in the southern part of the country are diminishing. This will cause difficulties as many of the sawmills are concentrated in this area. Many enterprises will have to move towards the north of the country. It may be possible to exploit the forests a second time if they are protected. In due time the plantations will be exploitable.

D A H O M E Y

General

Dahomey has an area of 11.3 million ha. From a coast-line of some 100 km on the Gulf of Guinea the country extends inland about 660 km to the Niger river. The country is rather flat and mostly covered with different types of wooded savannas (mainly tree savanna).

Southern Dahomey has an equatorial climate, most typically along the coast, though with a low rainfall of only some 1,250 mm. Away from the coast the



FOREST MAP — DAHOMEY

dry months increase. Over the northern half of the country a dry season alternates with a wet one. The latter being of seven months in the centre and four months in the north; the rainfall still averaging 1,200 mm.

According to the FAO Production Yearbook 1971 the land use is as follows (information from 1963):

Land use	Area, 1000 ha
Arable land and land under permanent crops	1,546
Permanent meadows and pastures	442
Forest land	2,157
Other land	7,117
Total area	11,262

Natural forest land

The vegetation consists mainly of savanna types. To the WFI 1970 the following breakdown of the forest and other wooded areas has been given:

Type of woodland	Area, 1000 ha
A. Forests	16
B. Wooded savannas	2,128
a) with <i>Combretum glutinosum</i> , <i>Parkia</i> , typically Dahomian bush of type <i>Albizia</i> , <i>Afraegle</i> , <i>Fagara</i> , <i>Trema</i> , <i>Lonchocarpus</i> with galleries of <i>Chlorophora</i> , <i>Khaya</i> , <i>Terminalia superba</i> , <i>Antiaris</i> , <i>Triplochiton</i> and <i>Anogeissus</i> ;	42
b) with <i>Daniellia</i> , <i>Isoberlinia</i> , <i>Pterocarpus erinaceus</i> , <i>Parkia</i> and <i>Hymenocardia</i> ;	507
c) with <i>Hymenocardia</i> , <i>Combretum velutinum</i> and <i>Terminalia albida</i> ;	1,100
d) with <i>Butyrospermum parkii</i>	479

The above areas are for the classified forests in Dahomey. "Classified forest" here means an area belonging to the public forest domain and officially protected. Included in these areas are 775,000 ha of National Parks set aside as game reserves in the north of the country.

Closed forest formations of the sub-equatorial type made up of tall trees occurred once in the south up to the 7°30' northern parallel. These were dense, semi-deciduous tropical forests with such species as *Chlorophora excelsa* (iroko), *Khaya* spp. (acajou), *Khaya senegalensis* (cailcédrat), *Azelia bipindensis* and spp. (doussié), *Triplochiton scleroxylon* (samba), *Terminalia superba* (fraké) etc.

Today one single important complex of this forest type remains in the 16,000 ha large "Forêt Classée de la Lama" of which about 10,000 ha are still well stocked. Fragments of this same forest type are disappearing at the few places where it remains. Further north and less under pressure, the closed forest persists in scattered stands along the western frontier; stands are normally small, at most a few hundred hectares, and access almost always difficult.

Closely related to the sub-equatorial forest are the riverine forests which occur throughout the country, mainly as narrow strips along rivers. Almost always they are difficult to exploit for reasons of access.

The area between 7°30' and 10° northern parallel was once occupied by "dry dense tropical forest" (Guinea type) or rather a pattern of this type and tree savanna. This "forest" type can still be found in certain areas in central Dahomey. It occurs as islands of taller trees in surrounding tree savanna. This type has certain commercial species but as tree species of this vegetation type are relatively sensitive to fire it has been replaced by savanna to a large extent. Remaining parts are often situated in inaccessible areas.

North of the 10° latitude the tree savanna becomes more open and gradually gives way to thorny savanna and, eventually, grass savanna. Gallery forests penetrate also along the permanent streams.

Altogether some 60 per cent of the land area is wooded in some form but the commercial value of this tree cover is small. At most, two per cent of the land area is covered with forest types of commercial interest, i.e. sub-equatorial high forest, riverine forests or dry tropical forests. These forests occur as scattered islands or narrow bands along the streams. Access is almost always a problem. A crude estimate puts the combined commercial forest area at 250,000 ha with a total reserve of merchantable timber (suitable for sawlogs) - commercial and potentially commercial species together - 5 million m³. The Forest Service gives felling permits for exploitation in the forests.

Man-made forests

Industrial forest plantations were first commenced in 1949. At present (1972) there are 18,375 ha of man-made forests, nearly all of them on classified forest land. The following breakdown can be given:

Ownership and species	Area, ha
a) State-owned plantations. Teak and other timber species	6,954
b) State-owned plantations. Casuarina, Cassia, Hymenaea ^{1/}	2,955
c) State-owned plantations. Anacardium	4,495
d) Private plantations: Anacardium	3,971
Total	18,375

1/ Mainly for fuelwood and roundwood

Most of the Government plantations are located in the south but there are also some plantations in the centre and the north of the country, mainly of *Anacardium*.

Land is said to be available for plantations. Toffo, Djigbe, D'Agrimey, D'Ouedo are forest development or plantation areas.

Studies made in some teak plantations show an increment of 20 m³/ha and year. The average annual increment of all teak plantations has been estimated to be 10 m³/ha. Expected rotation of teak, for sawlogs, is 40-50 years.

E G Y P T

The Nile valley makes a depression from north to south. The desert plateaus on both sides are mainly made up of rocks. On the eastern side towards the Suez-Bay the mountains reach over 2,000 m. The western side is lower and flatter.

In the north there is a mediterranean climate with winter-rains and summer-drought. Toward the south the climate becomes still more arid. These areas receive only occasional showers.

FAO Production Yearbook 1971 gives the following information about land use (information from 1970):

Land use	Area, 1000 ha
Arable land and land under permanent crops	2,843
Permanent meadows and pastures	..
Forest land	2
Other land	97,300
Total area	100,145

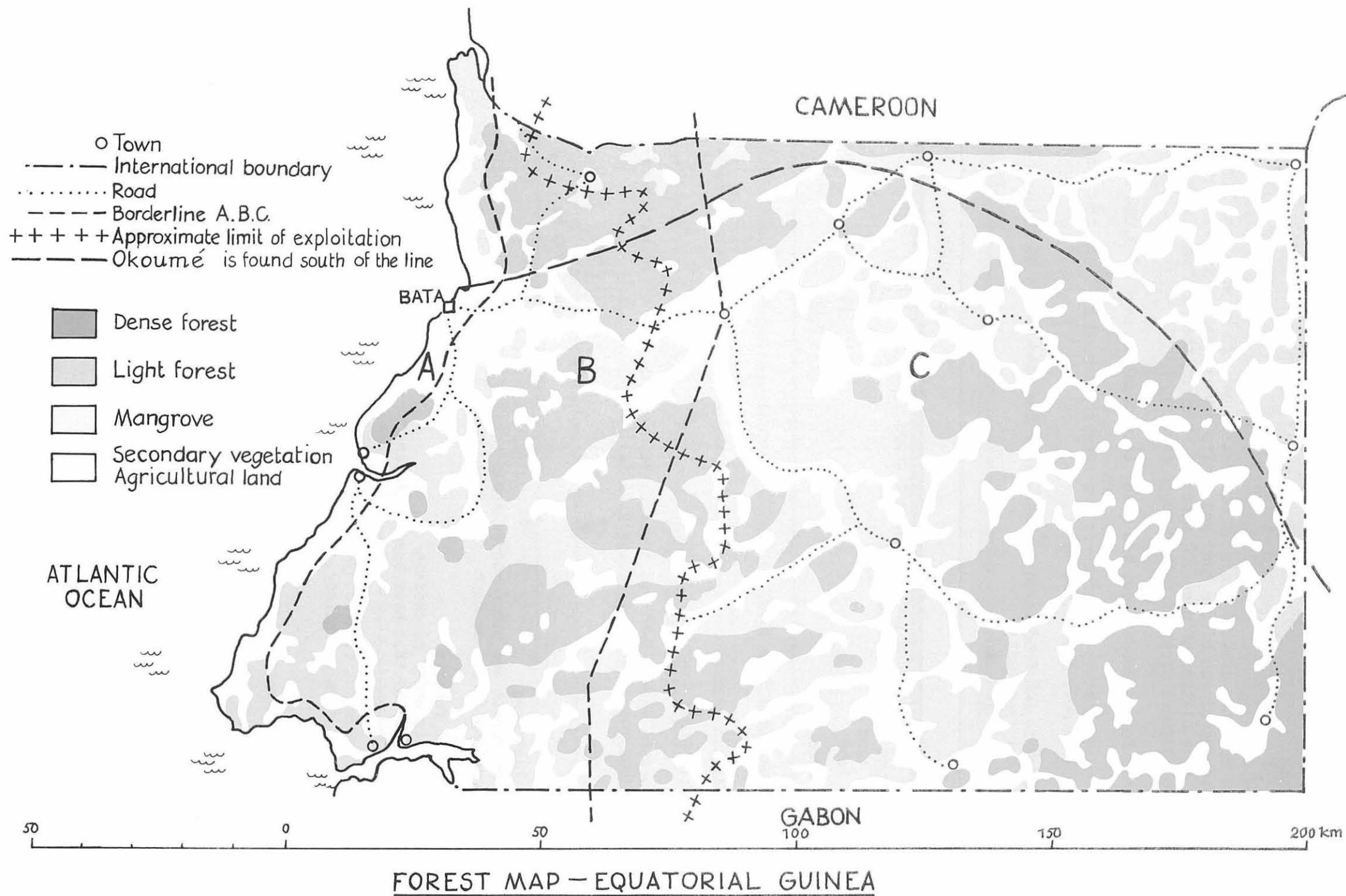
The petrified forests found in Egypt show that forests once formed a part of the natural vegetation of the country. With the discovery of iron and fire forest clearing started. Further civilization led to a complete destruction of natural stands.

The small plots classified as forest today are all man-made. The total forest area is often given as 600 ha. In 1965 there was reported to be 200 ha of solid blocks of *Eucalyptus* and *Casuarina* forests in Jebel Akhdar and Kom Oushim. There should also be 10,000 km of linear tree plantations of *Casuarina* and *Eucalyptus* in the Nile valley and the delta. In 1969 the total number of trees was reported to be 10 million. The row-plantations should correspond to an area of 10,000 ha.

E Q U A T O R I A L G U I N E A

General

Equatorial Guinea is made up of Rio Muni and the islands of Fernando Poo and Annobon.



In Rio Muni the coastal plain is narrow, roughly 20 km wide, and contains the wide estuaries of the Muni and Benito rivers. In the interior the land rises to a plateau of over 500 m height. Part of this plateau, especially in the southern part, is rather rough country.

Fernando Poo is mountainous and rises to a mountain peak of 3,000 m.

The average monthly temperatures are normally around 25°C and the annual rainfall is more than 1,500 mm.

According to FAO Production Yearbook 1971 the land use is as follows (the data dates from 1963):

Land use	Area, 1000 ha
Arable land and land under permanent crops	221
Permanent meadows and pastures	104
Forest land	2,289 ^{1/}
Other land	191
Total area	2,805

1/ Information from 1960

I. Rio Muni

Natural forest land

The forests in Rio Muni are tropical rainforests. The distribution of forest and other wooded areas is roughly as follows:

Type	Area, 1000 ha
Total land area	2,600
Total of forest and other wooded areas	2,100
Secondary forest or bush	1,100
Forests	1,000
- Virgin forests	740
- Forests under concession	-
- Concessions that have been exploited	260

The land area not covered by forest and other wooded areas is agricultural land in one form or another. There are also some savanna areas along the coast.

Shifting cultivation is common but the rotation period is reported to be very long.

Estimates vary widely, but there is probably more than 700,000 ha of virgin forest remaining in Rio Muni. How much of this that can profitably be exploited is not known.

The forests are similar to those in Gabon. Okoumé is found in most parts of the country (little in the north) while limba is only found in the northern part.

The map shows the approximate location of logged over and unlogged areas in Rio Muni. No accurate records are available, but it is known that considerable areas of unlogged forest remain in the generally cut-over lands in the western part of the country.

To give an example of the forests information from inventories in areas that have been under concessions has been summarized below:

a) Northern Rio Muni (inventoried area: 9,679 ha)

Grade ^{1/}	Mean volume ^{2/}
1st	0.9
2nd	29.1
3rd	19.6
4th	44.9
Total	94.5

1/ Example of grading:

1st grade - *Aucoumea klaineana* (okoumé), *samanquila*, *Entandophragma cylindricum* (sapelli), *Khaya* spp. (acajou).

2nd grade - *Terminalia superba* (limba), *Canarium velutinum* (abe), *Lovoa trichilioides* (m'bero), *elondo*

3rd grade - *Akoga*, *Copaifera religiosa* (anzem)

4th grade - *Pycnanthus angolensis* (ilomba, calabô), *Desbordesia glaucescens* (alep), *Pterocarpus soyauxii* (padouk, paloraja)

2/ Allowable cut, utilizable dimensions

The average number of trees per ha is 10.8.

b) Middle Rio Muni (inventoried area: 9,679 ha)

Grade	Mean volume, m ³ /ha
1st	25.2
2nd	13.8
3rd	4.6
4th	25.1
Total	68.7

Twenty-five per cent of the volume is okoumé. The average number of trees per ha is 11.

c) Southern Rio Muni (inventoried area: 30,000 ha)

The volume per hectare of all grades was 52.7 m³. Thirty per cent of the volume was okoumé. Forty-five per cent of allowable cut was considered to remain as commercial cut. The average number of trees per ha was 10.6.

Exploitation

The major species of commercial value are the following. (The normal share of the total extracted volume during the sixties is given in percentage:)

Species	Percentage of extracted volume
<i>Aucoumea klaineana</i> (okoumé)	20
<i>Pycnanthus angolensis</i> (calabô)	15
<i>Terminalia superba</i> (akom)	12
<i>Tetraberlinia bifoliata</i> (ekaba)	10
<i>Coelocaryon klainei</i> (ecun)	5
<i>Lovoa trichilioides</i> (m'bero)	5

Other species reported are *Canarium schweinfurthii*, *Dacryodes edulis* and *D. buettnerii*.

Nearly a hundred were utilized in one way or another but only 34 were of real importance. Among these 18 were used for plywood manufacture and 16 for sawn wood. As a mean value 25 m³/ha were exploited.

Roughly 10 per cent of the country is considered to be inaccessible.

All forests are state-owned.

All the large forest companies that were previously operating in Rio Muni left the country within a three year period after Independence and the areas they held under concessions have since reverted to the state.

The country was sub-divided into three exploitation zones (see the map):

Zone	Size of concessions, ha
Zone A - coastal	500 - 2,500
Zone B - transitional	1,500 - 10,000
Zone C - interim	over 10,000

The maximum time for concessions is (or was) 20 years. A concessionaire could exploit all species above 60 cm d.b.h.

Up to the end of 1968 an area of 231,977 ha had been exploited and concessions on another 295,893 ha had been issued. An additional 30,000 ha of concession were logged after 1968 and before all the large forest companies left Rio Muni. It is impossible to say, without having more accurate information on the forested area and the commercial volume thereon, how long it would take to cut over the entire province of Rio Muni at the maximum exploitation rate attained in 1968. However, from information presently available, it is apparent that the annual cut will have to be reduced from the 1968 high if the province is to sustain continuous logging operations on, say, a 50 to 60 year rotation.

In 1968, 377,000 m³ were exported, of which 58,000 m³ were okoumé.

There is logging being done in Rio Muni at present and the annual cut is estimated at some 25,000 m³. No concessions are currently in operation and logs come from unalienated state land where four trees are granted to each Guinean adult as a traditional right.

All logs are processed locally, principally in Bata, and practically all the sawtimber is used locally, however some 1,500 m³ of okoumé veneer are exported annually.

II. Fernando Poo

The total area is 200,000 ha of which 120,000 ha is forest. The forest is nearly unexploited due to difficult terrain. Main species to be found are: *Chlorophora excelsa*, *Khaya* spp., *Lovoa trichilioides*, *Pycnanthus angolensis*, *Coelocaryon* spp. and *Daniellia* spp. (faro). In 1968 15,000 m³ were exported.

ETHIOPIA

General

Ethiopia, situated in the north-eastern "Horn" of Africa, has a total area of 122.2 million ha. The heart of the country is occupied by a vast mountain mass between 2,100 and 2,500 m in altitude with some peaks rising to 4,500 m. The massif is divided into two plateaus (Central and Galla-Somali) by the deep Rift valley. In this lie, in the south, several lakes, and in the north, the River Awash which is vital for irrigation.

The climate shows considerable local variation, principally because of the different altitudes. The lowlands up to 1,650 m towards the Red Sea and Somalia are very hot and dry with almost desert-like conditions. In the highlands the climate gets cooler and more humid and heavy rainfalls are frequent in the wet season.

According to the FAO Production Yearbook 1971 the land use is as follows (information from 1968):

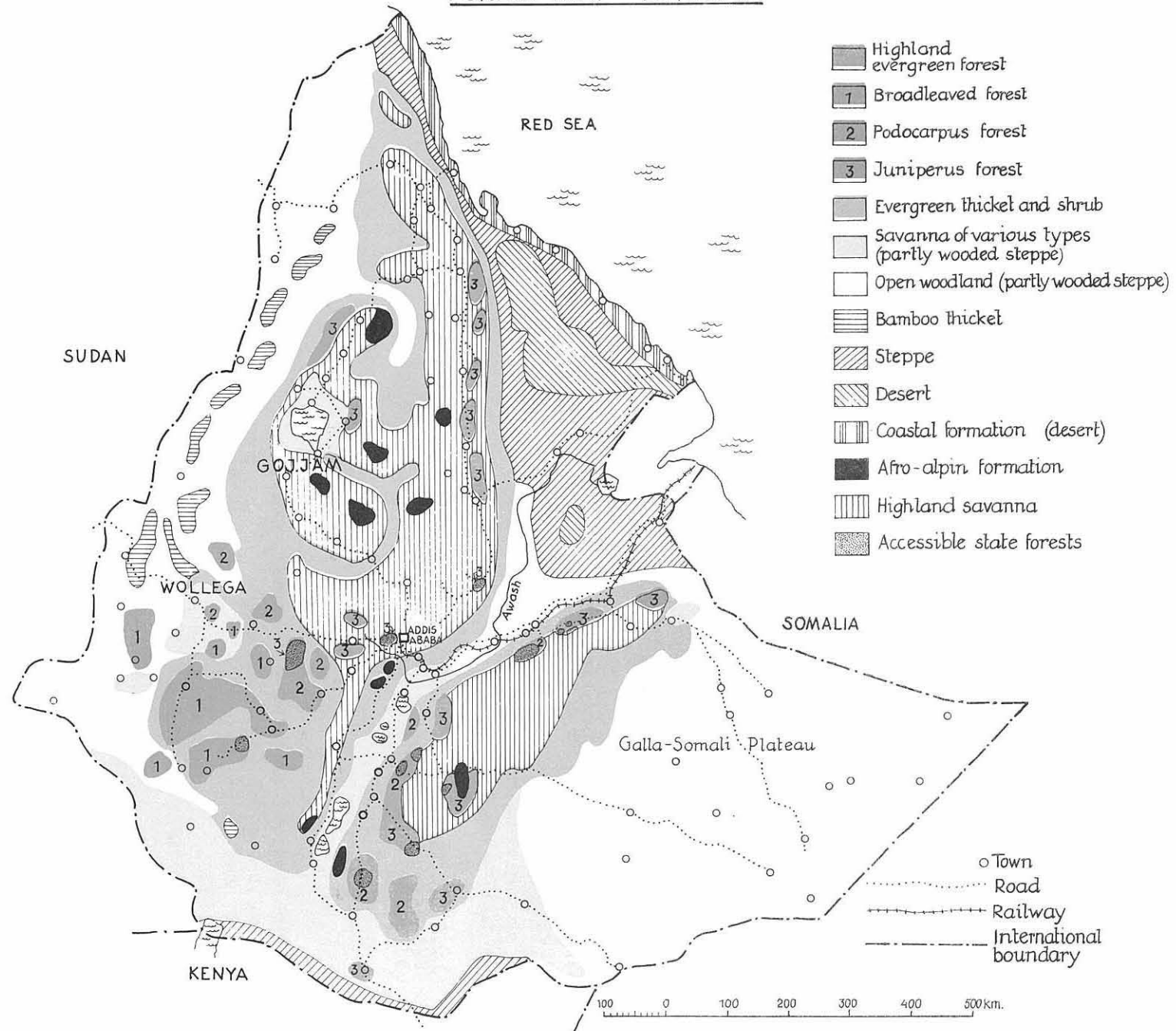
Land use	Area, 1000 ha
Arable land and land under permanent crops	12,900
Permanent meadows and pastures	66,000
Forest land	8,800
Other land	34,490
Land area	110,090
Total area	122,190

Natural forest land

Of the total land area three per cent is estimated to be covered by closed forest while twenty-two per cent supports dry savanna vegetation.

Centuries of intensive agriculture have almost completely destroyed the indigenous forests in the populous highlands and this to such an extent that fuelwood is so scarce that cow dung is used as fuel in the rural areas.

FOREST MAP - ETHIOPIA



The following breakdown of the total area under a wooded cover can be given:

Vegetation type	Area, million ha
Closed montane forest	4
Woodland	3
Wooded grassland, scrub, thickets	25

Figures similar to the ones in the table had been reported by Vernede as early as 1955. In recent years there has been much clearing in the forest and woodland areas. As much as 200,000 ha has been estimated to be cleared annually. The degradation is probably most serious in the open woodland and scrub areas.

Below are given some figures and botanical descriptions which summarizes the present knowledge of the Ethiopian forest and woodland area. The information comes partly from Vernede (1955).

A. Natural closed forests:

Estimates of the total area vary from 2.5 million ha to 7 million ha. The currently accepted figure is about 4 million ha. (WFI 1970 gives 5 million ha of which one million ha bamboo.)

The distribution in coniferous and broadleaved is as follows:

Forest type	Area, 1000 ha
Coniferous forests	850
Broadleaved forests	3,150 ^{1/}

1/ Including 630,000 ha with an admixture of coniferous.

Reliable data concerning growing stock is lacking. As a rough working guide until systematic inventories are undertaken, the following estimated yields of merchantable logs have been used in calculations:

Coniferous forest: 40-100 m³/ha

Broadleaved forest: 20- 40 "

The total volume in closed forests has been estimated to be 200 m³/ha. Twenty-five per cent of the total volume in closed forests has been estimated to be conifers.

The forests are said to be composed of close to two hundred different kinds of subtropical trees. At present only the following species are utilized for sawtimber or plywood:

Juniperus procera	Podocarpus gracilior	Cordia africana
Hagenia abyssinica	Ekebergia capensis	Pouteria ferruginea
Pygeum africanum	Olea spp.	Croton macrostachys
Celtis africana	Polyscias ferruginea	Apodytes dimidiata
Syzygium guineense	Albizia schimperiana	Millettia ferruginea

Three principal types of forest are to be found, their position closely related to climatic conditions. All of them belong to the so-called "tropical mountain forests", and are within the altitudinal range 1,500 to 3,000 metres. They can briefly be described as follows:

a) The broadleaved rainforests of the south-west:

When fully developed, these forests are dense and with a relatively large variety of species. The large trees are generally rather scattered. They grow to heights of 40-50 m. The total area of this type has been estimated to be about 2.5 million ha.

The most common species are:

<i>Pouteria ferruginea</i>	<i>Apodytes dimidiata</i>
<i>Albizia schimperiana</i>	<i>Celtis africana</i>
<i>Pygeum africanum</i>	<i>Schefflera abyssinica</i>
<i>Ekebergia capensis</i>	<i>Syzygium guineense</i>

At high altitudes, large bamboos (*Arundinaria alpina*) occur locally in the forest. This bamboo is also found in the region of the *Podocarpus* forest.

b) *Podocarpus* rainforests of the west and the western ridge of the Galla-Somali plateau:

This type is not as dense as the preceding type and is more uniform. It is characterized by the presence of the conifer *Podocarpus gracilior*. The most frequent associated species found are:

<i>Pygeum africanum</i>	<i>Olea hochstetteri</i>
<i>Ekebergia capensis</i>	<i>Polyscias ferruginea</i>
<i>Croton macrostachys</i>	<i>Apodytes dimidiata</i>
<i>Celtis africana</i>	<i>Pouteria ferruginea</i>

The area has been estimated as 1.3 million ha.

c) The Juniper forest of central Ethiopia:

This forest type is relatively dry. In its most favourable places the large trees reach 35 to 40 m in height. *Juniperus procera* is dominant. Common associated species are:

<i>Podocarpus gracilior</i>	<i>Olinia aequipetala</i>
<i>Pygeum africanum</i>	<i>Olea africana</i>
<i>Bersama abyssinica</i>	<i>Hagenia abyssinica</i>
<i>Rapanea simensis</i>	

Only remnants of this forest remain now. The total area has been estimated to be 200,000 ha.

The species mentioned above are not all found together, but vary between different associations.

B. Woodland and thicket formations

a) Woodland:

A vegetation formation of medium-sized trees, mostly deciduous, forming an almost closed canopy, with ground vegetation composed of grasses and herbs. The main concentrations are found in the western lowlands and in central areas of the Rift valley.

b) Wooded grassland and scrub:

This formation is composed of small trees and/or shrubs, mostly deciduous. The ground vegetation is composed of grass. This formation is widespread in dry lowland areas. A variant, of similar physiognomy but different floristic composition occurs at high elevations on mountains above the zone of closed montane forest.

c) Evergreen thickets:

Low thickets, in which grass is sparse, mainly composed of evergreen species of shrubs and small trees occur in large areas. It is restricted to narrow belts on the plateau escarpments between the montane forests of the highlands and the woodland and wooded grassland of the lowlands.

These three formations are sources not of industrial wood but of fuelwood, charcoal, rough building poles and minor forest products. They produce the main bulk of the poles and fuelwood consumed.

C. Bamboo stands

Scattered, very localized concentrations of *Arundinaria alpina* occur at very high elevations. Their total area is unknown and their economic potential is small.

Stands of *Oxytenanthera abyssinica* at lower elevations in western districts are a potential source of pulp. The main concentrations are reported to cover an estimated 544,000 ha in western Wollega and 130,000 ha in western Gojjam, but recent aerial reconnaissance indicated that the stands are in fact much less extensive. The access by dry-season roads is limited. Ownership position is uncertain.

The probable yield of air dried culms, on a four years rotation, has been variously estimated as 4.86 to 12.16 metric tons per hectare.

Man-made forests

a) Privately-owned *Eucalyptus* plantations (*E. globulus*) around Addis Ababa cover approximately 15,000 ha. They are utilized mainly for fuel and poles, but also fulfil a protective role.

b) Privately owned *Eucalyptus* plantations (mainly *E. globulus* and *E. camaldulensis*) forming scattered blocks elsewhere cover 20,000 - 25,000 ha.

c) Government plantations (various species) in state forests or on other state lands cover around 850 ha, while state-financed plantations on communal lands cover an estimated 800 ha.

Of the above plantations 22,000 ha are classified as easily accessible.

Thirty-five per cent of the *Eucalyptus* plantations are reported to be in single rows or narrow belts.

It has been calculated that the potential yield from Eucalyptus stands with a rotation period of 10-15 years is 200-350 m³/ha. Actual yield is probably much lower.

Pinus patula and *Cupressus lusitanica* may in the future become important for afforestation in the highlands.

Ownership:

Ownership conditions are very complicated. In the absence of clearly defined boundaries several persons may claim ownership of the same land. A recent estimate gives 2 million ha as state-owned and 2 million ha as privately owned.

Accessibility

The following table giving accessibility in different types of forests has been found:

Type of forest	Area, 1000 ha
Accessible coniferous	170
Inaccessible coniferous	680
Accessible broadleaved	100
Inaccessible broadleaved	3,050

The term "accessible" includes all those forests (state and private) which have some prospect of becoming accessible in the not-too-distant future.

The actual area of state forests currently classed as accessible is only 56,450 ha. These are located mostly in mountainous terrain and this is likely to be the main limiting factor in future reforestation. Climatic conditions are favourable, with mean annual rainfall ranging from 800 to 1,800 mm, and there are extensive areas of soils suitable for intensive timber production. In assessing the productive potential of these accessible state forests, it would be advisable to regard one-third of the total unexploited area as unproductive (glades, and poorly-stocked relatively inaccessible forests at the highest elevations). Their total productive area is therefore likely to be in the region of 32,000 hectares, as a total area of 6,000 ha is already under exploitation.

FRENCH TERRITORY OF AFARS AND ISSAS^{a)}

The "Vegetation Map of Africa south of the Tropic of Cancer" shows practically the whole country as desert. A few remnants of forest, totalling about 6,000 ha are reported to exist in the Goudah mountains.

The dominant species are said to be *Juniperus procera*, *Boxus hildebrandii*, *Olea* spp., *Ficus* sp. There are also at least 100,000 ha of poor tree vegetation - good only for fuelwood and low-quality poles. The dominant vegetation is of *Acacia* species.

a) Map see page 97

G A B O N

General

Gabon has an area of 26.8 million ha and comprises the entire drainage basin of the westward-flowing Ogooué river, together with the basins of several smaller coastal rivers such as Nyanga and Como.

The low-lying coastal zone is narrow in the north and south but broader in the estuary regions of Gabon and Ogooué. The interior consists of a series of plateaus at heights from 450 to 600 m and dissected by a river system into a number of distinct blocks.

Gabon has an equatorial climate with uniformly high temperatures, high relative humidity and mean annual rainfalls from 1,500 to 3,000 mm.

According to the FAO Production Yearbook 1971 the land use is as follows (information from 1962):

Land use	Area, 1000 ha
Arable land and land under permanent crops	127
Permanent meadows and pastures	5,100
Forest land	20,000
Other land	1,540
Total area	26,767

The forest

In the table on page 89 a breakdown of the total area in the three exploitation zones into vegetation types, and certain exploitation classes is given.

The information in this table has been taken from FO:SF/GAB 6: Technical Report No. 1 "Développement forestier Gabon-Évaluation des I et II zones forestières". The information is in the main from 1970.

Most of the forest in Gabon can be described as a tropical rainforest.

There are two subtypes of importance:

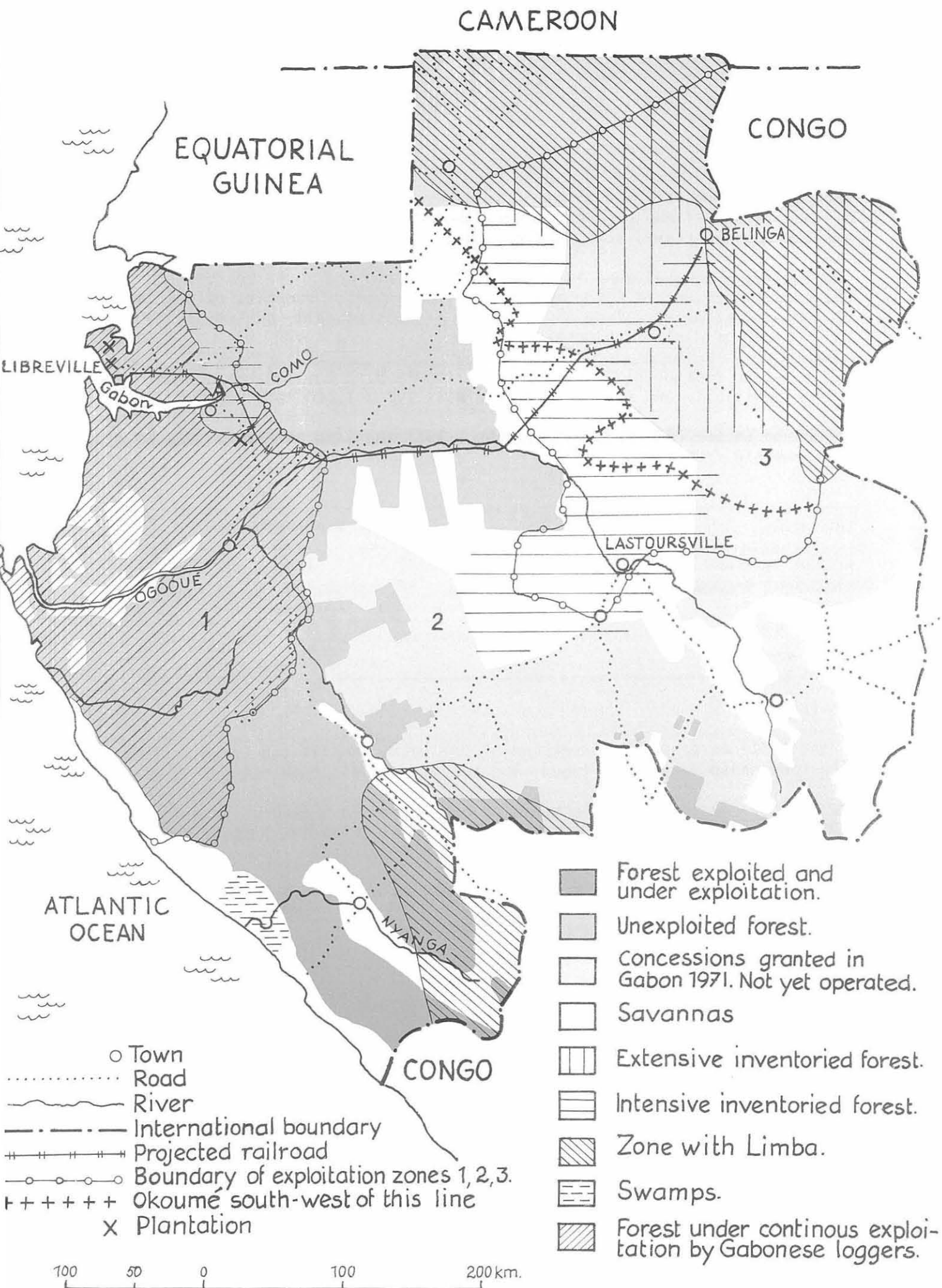
(1) Forest with okoumé

- a) Okoumé with ozigo and alep
- b) Okoumé with ozouga

(2) Forest without okoumé (presence of limba and ayous)

The latter type, which is found in the eastern part of the country, is often described as an intermediate type between evergreen forest and semi-deciduous forest.

In the southern part relatively large areas are shown on the map as savanna. These areas are normally a forest-savanna mosaic with the savanna predominating. Scattered savanna areas are found also in areas shown as forest.



FOREST MAP — GABON

Breakdown of the total area into vegetation types and exploitation classes

Type of land	Exploitation-zones ^{1/}			Total
	1st zone	2nd zone	3rd zone	
	1000 ha			
A. Dense forest	3,365	11,420	5,600	20,385
a. With okoumé	3,365	8,835	1,605	13,800
(i) Exploited or covered with concessions	3,365	4,715 ^{2/}	0	8,075
(ii) Not exploited and without concessions	0	3,130	270	3,400
(iii) Zone around the railway	0	990	1,335	2,325 ^{3/}
b. Without okoumé	0	2,590	3,995	6,585
(i) Exploited or covered with concessions	0	20	0	20
(ii) Not exploited and without concessions	0	2,570	3,995	6,565
B. Plantations of okoumé	25	0	0	25
C. Humid formations (Swamp forest, mangrove)	425	280	390	1,095
D. Denuded areas	120	785	500	1,405
E. Savanna	305	2,770	0	
a. Zone with okoumé	305	2,000	0	2,305
b. Zone without okoumé	0	770	0	770
F. Swamp, internal waters	580	70	60	710
Total	4,825	15,325	6,550	26,700

1/ These zones are shown on the map.

2/ Include considerable areas with forest under concessions but still unexploited. Most concessionaires want to have reserves for 10 to 20 years exploitation.

3/ This is the situation concerning signed contracts at October 1st 1972. Contracts under discussion but not signed at that time covered 350,000 ha in the 2nd zone and 50,000 ha in the 3rd zone.

Man-made forests

An area of 25,000 ha of okoumé has been planted in some blocks in the neighbourhood of Libreville. These plantations are estimated to give 300 m³/ha. Most of them have been established since 1960 though planting ceased in 1971. Eucalyptus and pine plantations have also been tried.

Inventories

- a) 8.08 million ha are or have been under concessions. Most parts have been inventoried, but the results are normally not available.
- b) UNDP/SF Project GAB 6 (FAO) has done an extensive inventory of 3.3 million ha in the eastern part of the country.
- c) GAB 6 has done an intensive inventory of 1.2 million ha.
- d) GAB 6 will make an inventory of another 550,000 ha, and will probably also make a complementary inventory of another 1.5 million ha. By the first of October 1972 the inventory covered 0.5 million ha and the complementary inventory 0.6 million ha.

Results from the inventories:

A. The potential in zone 1 and zone 2

The results shown in table on page 94 are not based on a complete inventory but on scattered inventories. The results from these inventories have then been used to calculate results for the whole area.

The information is from FO:SF/GAB 6, Technical Report No. 1, "Développement forestier Gabon-Évaluation des I et II forestières" (FAO).

B. Preliminary results from inventories undertaken in zone 3 by GAB 6:

The table shows approximate estimates of the volume of standing timber for four categories of species (situation at 1st August 1971):

Species group ^{2/}	Volume ^{1/} , 1000 m ³		
	A. Intensive ^{3/} inventory (about 1,200,000 ha)	B. Extensive inventory (about 3,300,000 ha)	C. Intensive ^{3/} inventory (about 440,000 ha)
1. Okoumé	3,400	0	4,100
2. Other principal species	7,410	19,600	3,430
3. Secondary species	9,720	22,000	4,000
4. Complementary species (i.e. other utilisable species)	18,550	50,220	..
Total	39,080	91,820	..

Foot-notes: See next page

1/ m³ over bark actually utilizable after removal of the waste. Only logs with a diameter of more than 50 cm and without severe defects are taken into consideration.

2/ Definition of species groups:

Group 1: Okoumé (*Aucoumea klaineana*)

Group 2: Species of usual commercialisation and of easy sale in Gabon, even if prices are sometimes low.

Group 3: Species of rare and occasional commercialisation, even if certain amounts sometimes reach high prices.

Group 4: Species of practically no commercialisation at present but sometimes used locally, and of which the quality may allow their utilisation in the future.

3/ Results are given only for part of the area shown as intensive inventoried on the map.

The table below gives a breakdown in species of the previous table. Only the two first columns are included.

Species	Volume			
	In intensive inventoried area (1.2 million ha)		In extensive inventoried area (3.3 million ha)	
	m ³ /ha	1000 m ³	m ³ /ha	1000 m ³
<u>GROUP 1</u>				
<u>Okoumé</u> (only found on 360,000 ha)	9.45	3,400	0	0
<u>GROUP 2</u>				
<u>Agba</u>	0.30	360	0	0
Douka + Moabi	0.48	175	0.20	660
Ilomba	2.11	2,540	1.55	5,120
Doussié + Iroko	0.18	215	0.30	1,000
Olon	0.39	470	0.46	1,520
Ozigo	2.20	2,640	2.25	7,400
Meliaceae	0.55	660	0.98	3,240
Tchitola	0.29	350	0.20	660
Total group 2		7,410		19,600

Cont.

Species	Volume			
	In intensive inven- toried area (1.2 million ha)		In extensive inven- toried area (3.3 million ha)	
	m ³ /ha	1000 m ³	m ³ /ha	1000 m ³
GROUP 3				
Āiēlē	0.65	780	0.81	2,670
Awougha	0.70	840	0	0
Azobé	0.80	960	1.15	3,800
Bahia	0.40	480	0.36	1,300
Bilinga	0.10	120	0.12	400
Ekoune	0.70	840	0.20	660
Izombé	0.18	220	0.12	400
Kévazingo	0.16	190	0.15	500
Kotibé	0.09	110	0.14	460
Movingui	0.99	1,190	0.95	3,140
Niové	1.40	1,680	0.98	3,230
Oken	0.13	160	0.14	460
Ossabel	0.31	370	0.28	920
Ovangkol	0.28	340	0.19	630
Padouk	1.20	1,440	1.04	3,430
Total group 3		9,720		22,000
GROUP 4				
Angoa	0.12	140	0.08	260
Alone	0.01	10	0.01	50
Andoung	2.00	2,400	3.70	12,200
Anzem	0.12	140	0.14	460
Dabema	1.16	1,390	1.17	3,860
Ebiara	0.43	520	0.48	1,580
Edoum	1.28	1,540	1.45	4,780
Ekop	0.26	310	0.18	590
Emien	0.61	730	1.27	4,200
Essessang	0.02	20	0.01	50
Fromager	0.45	540	0.92	3,040
Irvingiaceae	1.50	1,800	1.38	4,550
Ossimiale	0.30	360	0.29	960
Ossol	0.11	130	0.09	300
Soghol ^{1/}	6.50	7,800	6.40	10,200
Tali	0.60	720	0.95	3,140
Total group 4		18,550		50,220

1/ In the zone of the extensive inventory found only on 1.6 million ha;
non-existent elsewhere.

Detailed results from the intensive inventory of 0.44 million ha around Lastoursville are given in the table below:

Species	Volume	
	m ³ /ha	1000 m ³
GROUP 1		
Okoumé	9.30	4,100
GROUP 2		
Agba	0.80	350
Douka + Moabi	0.45	200
Ilomba	1.85	810
Doussié + Iroko	little	little
Olon	0.40	180
Ozigo	2.41	960
Méliaceae	0.32	140
Tchitola	1.80	790
Total group 2	8.03	3,430
GROUP 3		
Aiélé	0.38	170
Awougha	3.50	1,540
Azobé	0.70	310
Bahia	0.15	70
Bilinga	0.17	80
Ekoune	0.65	210
Izombé	0.12	50
Kévazingo	0.46	200
Kotibé	little	little
Movingui	0.71	310
Niové	0.90	400
Oken	little	little
Ossabel	0.28	120
Ovangkol	little	little
Padouk	1.05	460
Total group 3	9.07	4,000
GROUP 4		
Results under calculation		

The potential in zone 1 and 2:

Species	Commercial volume ^{1/} , 1000 m ³	
	Zone 1	Zone 2
Okoumé	13,350-13,850	40,700-41,200
Ozigo	6,802	13,740-14,440
Aiélé, Ossabel	792	2,519
Ilomba	1,917	14,900-18,600
Sogho	1,950	3,387
Méliaceae	505	1,900- 3,400
Légumineuses with soft wood	3,929	7,941
Ayous		500- 2,000
Limba		2,000- 5,000
Olon	69	313
Tchitola, Agba		650- 1,050
Emien, Essessang, Evino	531	387
Fromager and other Bombacaceae	431	118
Afo	328	203
Bahia	6,286	2,756
Douka, Moabi, M'bebame	2,070- 2,570	6,861
Niangon	39	74
Iroko, Doussié, Ossol	173	46
Bilinga, Movingui, Izombé	1,120- 1,320	1,018
Ebana, Kévazingo, Ovangkol	1,737	817
Kotibé	14	8
Oken	82	27
Awougha (Beli)	2,970	3,559
Niové	1,060	1,829
Angoa	2,778	146
Dabéma, Ossimiale	847	1,416
Edoum, Miama, Tali	3,894	1,974
Irvingiaceae	7,523	7,187
Azobé, Padouk	2,970	3,559
Total	62,000	124,000

^{1/} m³ over bark. Extracted logs from exploitable trees. Minimum d.b.h. 50 cm.

The potentially exploitable volume of other species than okoumé has been estimated as 22 million m³ in zone I and 40 million m³ in zone 2.

Gabon cellulose

In 1962-1963 a zone of 100,000 ha was inventoried (code A on the map) to investigate the possibility of locating a pulp mill in the Kango area. Some experimental logging was also undertaken. Only some scattered results are available. Total wood volume (including branches above 7 cm) is 300-350 m³/ha; volume that can be utilized for pulp, 100-150 m³/ha. The natural regeneration can be used for pulpwood production. With a rotation period of 30 years, this will give 100 m³/ha in the second cut. The pioneer species is said to be excellent for pulping.

An adjacent area of 50,000 ha has recently been inventoried. The information seems to have changed compared to the original report. Total wood volume (including branches above 7 cm) is now given as 260 m³/ha. They have counted on utilizing more species than in the original report. The potential utilizable volume (for pulp) per ha is given as 160 m. In addition big okoumé trees (10 m³/ha) will be utilized for timber. It is thought that the project area (200,000 ha) could supply enough wood for a pulp mill of 250,000 ton. One million m³ of wood is needed each year (4 m³/ton). The project area will be clear-cut in a 30 years period. At least 2,500-3,000 ha (probably more) of okoumé will be planted each year. A pulp mill is actually under projection in this area.

Ownership

Practically all forests are owned by the state. It was estimated that private forests covered 26,000 ha.

Shifting cultivation

Due to the low population pressure, shifting cultivation is not a problem in Gabon. The areas given as forest are estimates, but they are quite accurate.

Concessions

Forest areas are given away as concessions. The whole coast area has been cut over (zone 1). These areas are now given as concessions to local concessionaires for a renewed cutting. The logging is normally done by foreign firms on sub-contracts. In zone 2, the logging is normally done by foreign companies. At present (1969) 3,612,000 ha are under concessions or licences. The length of the concessions is from 1 to 20 years, depending on the area. In the first zone 339,000 ha and in the second zone 3,273,000 ha are covered by concessions. Concessions given to companies which have promised to start forest industries are given at a reduced fee. The fees are normally paid according to area. There is also a small fee according to the number of trees. Along the proposed railway Libreville-Belingua (in zone 3), provisional concessions covering an area of 2,325,000 ha have already been signed (Oct 1st, 1972). These concessions will become valid when the railway starts to function.

Exploitation

At present 10 m³/ha is as a mean value extracted with logging operations. It is a selective cutting of trees above 70 cm d.b.h. (some species 60 and 80 cm). Eighty-five per cent of the exploitation is okoumé.

If including roadbuilding, waste etc. the total volume felled is 50 m³/ha (out of a total of 300-350 m³/ha).

Below are given crude meanvalues showing the decrease in extracted volume between sequent exploitations:

1st cut gives 10 m³/ha
 2nd cut (20 years later) gives 5 m³/ha
 3rd cut (20 years after) gives 3 m³/ha

The exploitation has now reached the concession line shown on the map. The future exploitation will depend on the opening up of the railway and other main roads.

The whole area under exploitation is accessible at present. The rest of the country can be made accessible without any difficulty. The proposed railway Libreville-Belingha will open up large areas for exploitation.

In the western part some rivers can be used for floating. All other transport must be undertaken with trucks.

An area of 8,075,000 ha has been exploited or is under concessions. There is no planned management of the forests, only exploitation.

G A M B I A

General

Gambia is Africa's smallest state, for its area is only 1.13 million ha. Apart from a very short coastline, it is an enclave in Senegal. The Gambia is essentially the valley of the navigable Gambia river. Around the estuary and the lower river the state is 48 km wide and extends eastward on either side of the navigable river for 470 km. In most places the country is only 24 km wide. Mangrove extends 160 km upstreams.

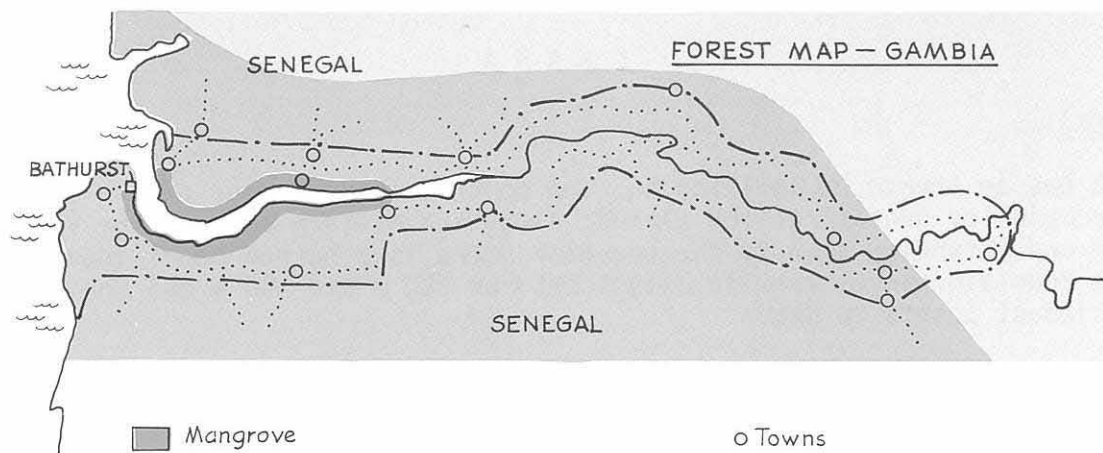
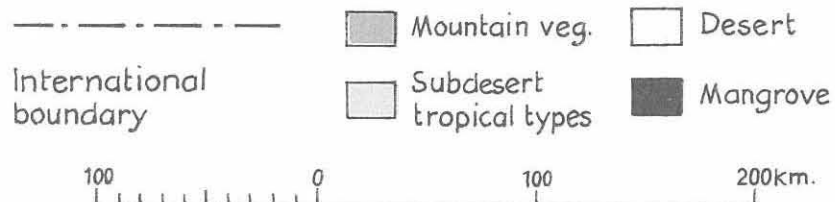
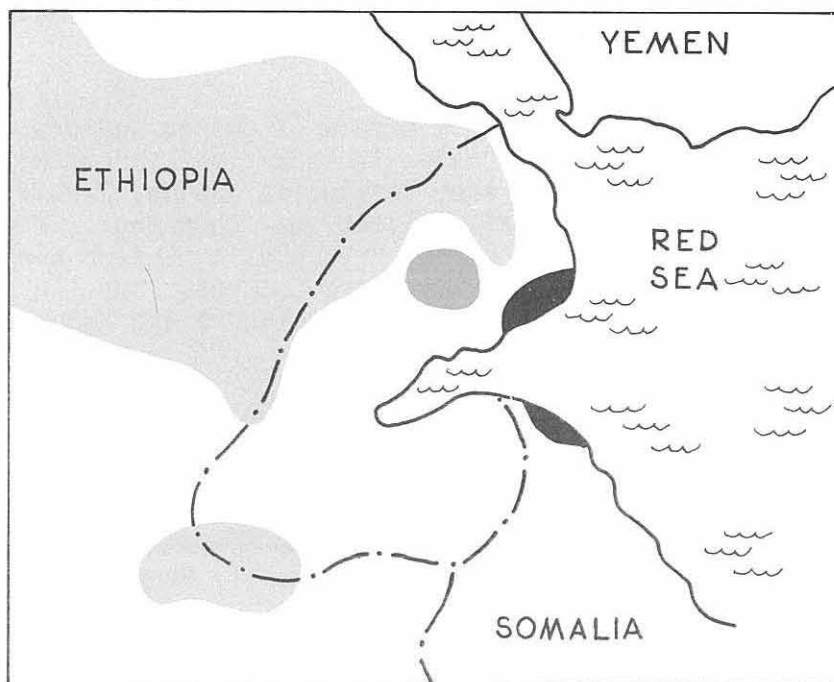
Annual rainfall in the Gambia averages 750 to 1,100 mm.

According to FAO Production Yearbook 1971 the land use is as follows (information from 1967):

Land use	Area, 1000 ha
Arable land and land under permanent crops	200 ^{1/}
Permanent meadows and pastures	400
Forest land	303
Other land	227
Land area	1,000
Total area	1,130

1/ Estimated area of shifting cultivation and of bush fallow.

FOREST MAP — FRENCH TERR. AFARS — ISSAS



Natural vegetation

The natural vegetation of lower and middle Gambia is Guinea savanna which changes to Sudan savanna in the upper basin. It is a light canopy with a height of 7 to 20 m. The main species are: *Terminalia albidia*, *Parkia biglobosa*, *Daniellia oliveri*, *Acacia senegal*, *Piliostigma thonningii*, *Pterocarpus erinaceus*, *Cassia sieberiana*, *Annona chrysophylla*, *Guiera senegalensis*, *Dichrostachys cinerea*, *Prosopis africana* and *Combretum* spp. In cleared and cultivated areas, *Adansonia digitata*, *Ceiba pentandra* and *Mangifera indica* are found.

True forest does not exist. The term forest is used where farming and wood cutting are forbidden. At present there exist 40 gazetted Forest parks with a total area of 40,000 ha. There is no management or exploitation of Forest parks in Gambia.

The wooded vegetation is used for fuelwood and charcoal. *Pterocarpus erinaceus* and *Prosopis africana* are the two species most used. In Gambia the gathering of dead wood is a traditional right but the cutting of living trees is illegal. Scattered timber trees like *Khaya senegalensis* and *Chlorophora regia* occur where there is sufficient water.

Along the coast there is 25,000 ha of mangrove.

All "forests" are publicly owned.

Man-made forests

Planting of *Gmelina arborea*, *Tectona grandis* and *Eucalyptus citriodora* started in Nyambi around 1960. The present planted area is 800 ha.

Shifting cultivation

Shifting cultivation is the normal agricultural practice. The pressure for more agricultural land is high. Some estimates give the area under bush fallow as 200,000 to 360,000 ha. As the fallow period becomes shorter and shorter Forest parks come under pressure.

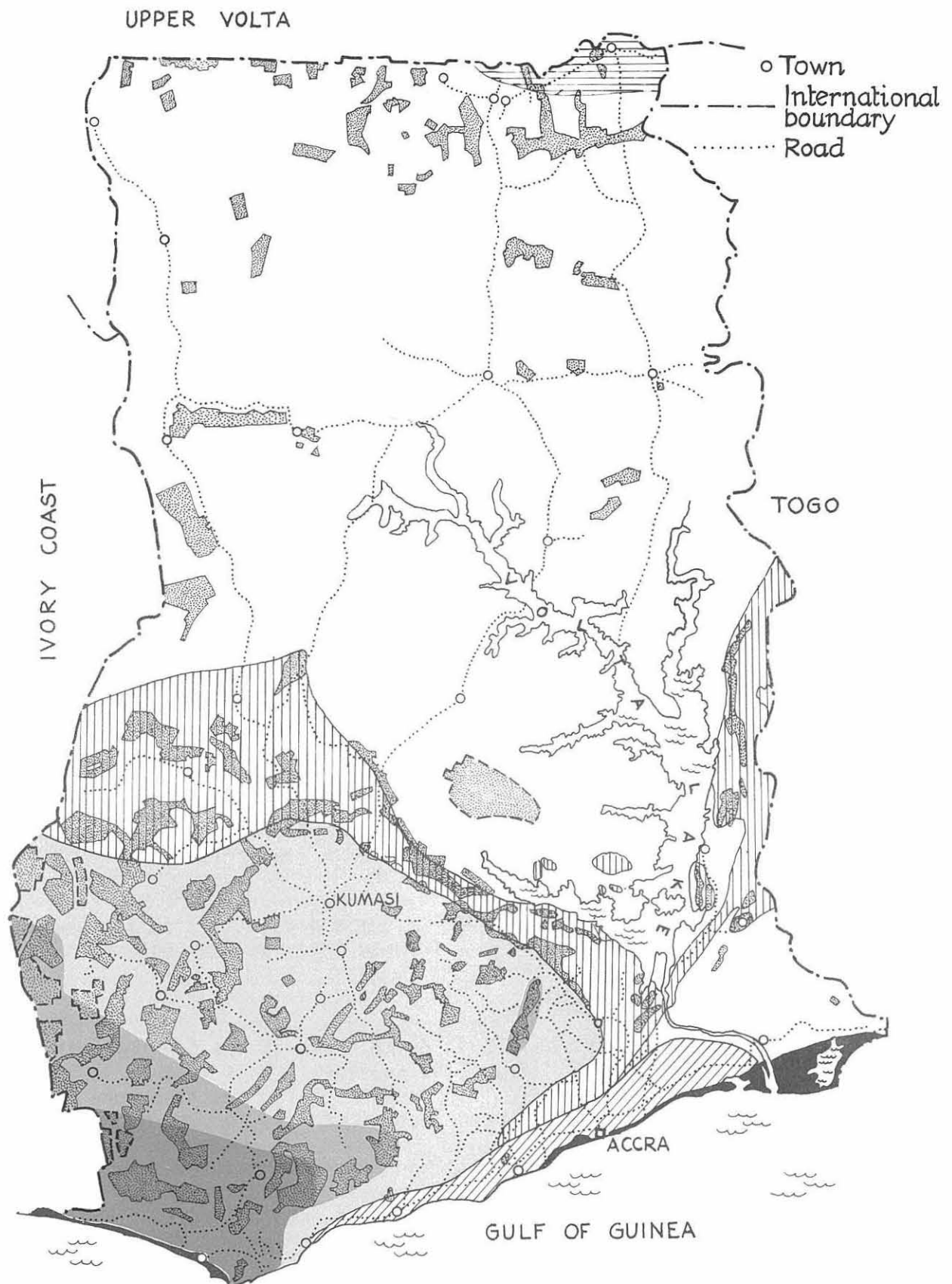
G H A N A

General

Ghana has an area of 23.8 million ha. The south-eastern corner of the country is occupied by gently rolling plains. Along the eastern edge of the Voltaian basin and extending down to the sea near Accra is a narrow mountainous zone. These mountain ranges vary in height between 300 m and 900 m and contain the highest points in Ghana.

The drainage is dominated by the Volta system which include a vast artificial lake of over 770,000 ha.

In the southern part of the country where the highest rainfall of between 1,250 and 2,150 mm occurs in the south-west, there are two rainy seasons (April-July and September-November). The south-east has also two rainy seasons but a low total annual rainfall (750 mm). In the northern part, with totals of between 1,100 and 1,250 mm, rainfall occurs in a single season (April-September) followed by a long dry season.



- | | |
|---------------------------------|----------------------------------|
| Forest reserve | Antiaris-Chlorophora association |
| Proposed forest reserve | Guinea savanna |
| Rainforest | Sudan savanna |
| Transition zone | Coastal thicket and grassland |
| Celtis-Triplochiton association | Strand vegetation and mangrove |

100 0 100 200 300km.

FOREST MAP - GHANA

The mean annual temperatures in Ghana average between 26 and 29° C.

FAO Production Yearbook 1971 gives the following information concerning land use in Ghana (information from 1968):

Land use	Area, 1000 ha
Arable land and land under permanent crops	2,835
Permanent meadows and pastures	11,237 ^{1/}
Forest land	2,447
Other land	7,335
Land area	23,002
Total area	23,854

^{1/} Savanna

Natural vegetation

The closed forest zone in the southern part of the country covers 8,226,000 ha while the savanna zone north of this covers 15,627,000 ha.

The vegetation can be separated into the following types:

A. Rainforest

The country is generally low-lying, with numerous freshwater swamps. It is typified by the *Cynometra* - *Lophira* - *Tarrietia* association, and by the complete absence of *Celtis* and *Triplochiton*.

The annual rainfall is 1,750 to 3,000 mm but the forest is still relatively poor. The policy is to convert these forests into man-made forests.

B. Moist semi-deciduous forest

The rainfall in this type is 1,250-1,750 mm. Much of the country lying within this forest type is over 150 m above sea-level. This type of forest is actually more luxuriant than the rainforest. It also contains more useful timber trees. Three associations are recognized:

a) Lophira-Triplochiton association: This is the transition zone between the rainforest and the moist semi-deciduous forest. In this type *Celtis* and *Triplochiton* are to be found in mixture with *Cynometra* and *Lophira*. The policy is to convert these forests into man-made forests.

b) Celtis-Triplochiton association: Here *Celtis adolfi-friderici*, *C. mildbraedii*, *C. zenkeri* and *Triplochiton* are common. *Entandophragma utile* makes an appearance and there is a complete absence of the rainforest trees - *Cynometra* and *Tarrietia*.

c) Antiaris-Chlorophora association: This is the driest part of the zone. The forest is slightly different in structure from the rest of the high forest, the upper storey being uneven and broken. *Celtis* and *Triplochiton* are still common and *Antiaris toxicaria*, *Chlorophora excelsa* and *Afrormosia elata* achieve their maximum frequency whilst *Khaya ivorensis* gives way to

K. grandifoliola except in the southern strip of this association where *K. grandifoliola* does not occur.

C. Savannas (open woodlands)

The savannas occupy the northern two-thirds of the country. Two-thirds of this area, or 9,842,000 ha is still classified as forest land.

The savannas have no value as timber producer at present but they supply fuel and poles as well as charcoal wood for local consumption.

Large tracts of the southern part of the savanna are almost uninhabited. The population increases rapidly towards the north and the land becomes much more exploited agriculturally.

Natural closed forest

In December 1970 the area of formally constituted Forest reserves was:

Forest reserves	Area of reserves, ha		
	Productive	Unproductive ^{1/}	All reserves
Closed forest zone			
Under working plans	1,379,693	264,957	1,644,650
Not yet planned	94,017	46,620	140,637
Savanna woodland	-	653,198	653,198
All Forest reserves	1,473,710	964,775	2,438,485

^{1/} Under protection, inaccessible, or for other reasons not at present yielding commercial timber.

The distribution in forest types of the Forest reserves in the closed forest zone is as follows:

Forest type	Productive	Unproductive	Total
	Forest reserves	Forest reserves	
	1000 ha		
Rainforest	161	9	170
Lophira-Triplochiton	259	-	259
Celtis-Triplochiton	558	230	788
Antiaris-Chlorophora	372	208	581
Total	1,351	447	1,798

Outside the reserved areas in the closed forest zone there are other areas in which the vegetation has not yet been severely disturbed by agricultural activities. According to one estimate there should still be 580,000 ha of such unreserved closed forest. The share of the wood production coming from these unreserved forests is decreasing but is still as much as 50 per cent. In these unreserved forests no girth limits are enforced. Most of them are expected to disappear in a few years' time (by 1980). It is calculated that all presently merchantable species (class I and II) in forests

outside reserves will be cut over within the next 6 to 10 years.

Development of closed forest area according to different estimates (probably found in annual reports of the Forest Service):

Year of estimate	Area, 1000 ha
1947	4,377
1957	2,745
1970	2,072

It was once estimated that 50,000 ha are lost annually to shifting cultivation. This figure - which seems to be based on conditions pertaining during the 1960:s - has since appeared in all reports.

Man-made forests

The total area planted is 21,478 ha (October 1972). At the end of 1969 13,787 ha were planted. In 1971, the plan was to plant 6,000 ha. From 1972 onwards, the plan is to plant around 6,000 ha annually; 1969-1970 7,500 ha was planted; 7,691 ha 1970-1971. (If this means one year planting seasons some figure must be wrong.) Main species: *Triplochiton scleroxylon*, *Terminalia ivorensis*, *Mansonia altissima*, *Tectona grandis*, *Tarrietia utilis*, *Cedrela mexicana*, *Nauclea diderrichii*, *Khaya ivorensis*, *Mitragyna inermis*, *Dalbergia sissoo*, *Ceiba pentandra*, *Cassia siamea*, *Melia indica*, *Eucalyptus* spp., *Gmelina arborea*, *Albizia lebbeck* and *Anogeissus leiocarpus*.

In the closed forest zone, the policy is to clear cut and then plant the rainforest and the poorly stocked areas in the *Lophira-Triplochiton* and *Antiaris - Chlorophora* associations. This means an area of over 500,000 ha.

Inventories

A 100 per cent enumeration are always carried out before exploitation in selection working areas after the acquisition of a concession by working timber operator.

Stratified random sample enumerations have been carried out in almost all the Forest reserves in the closed forest zone. The inventory work started in 1952 and hopefully will be completed in 1973.

The results from these inventories have been summarized in a way which makes it possible to use the data at a country level. Below are shown a couple of tables which give some information about volume, stocking and species.

The enumeration data indicates that the all species frequency figures for the four forest types in the closed forest zone show the normal J-distribution curve for all-aged natural forests. Details are given in the table below which gives the per ha stocking figures for these types by 2 ft girth classes. (60.96 cm girth classes or d.b.h. classes of 19.4 cmm).

Diameter class cm	Forest type			
	Rainforest	Lophira- Triplochiton association	Celtis- Triplochiton association	Antiaris- Chlorophora association
No. of trees per ha				
9.7- 29.1	147.8	117.8	315.5	258.1
29.1- 48.6	55.0	65.6	63.6	59.6
48.6- 68.0	11.6	14.4	13.4	15.2
68.0- 87.5	4.3	6.2	6.8	6.7
87.5-106.9	1.4	2.7	3.1	3.1
106.9-126.3	0.3	0.9	1.2	1.3
126.3-145.8	0.05	0.3	0.5	0.5
145.8+	0.05	0.2	0.4	0.3

Because of the sampling method used the stocking figures for the diameter class 9.7-29.1 cm are open to suspicion.

The present timber resources from the productive areas (1.5 million ha) are estimated at a figure of 330 million m³ which does not include curls. The details are given in the table below:

Yield class 1/	Standing timber, 1000 m ³		
	Immature stock ^{2/}	Mature stock ^{3/}	Total
Class I	11,455	50,262	62,681
Class II	18,405	32,942	51,347
Other species	153,789	59,713	213,504
Total	183,652	142,920	327,529

1/ These classes can be classified as follows:

Class I: *Chlorophora excelsa*, *Entandophragma angolense*, *E. cylindricum*, *E. utile*, *Khaya anthotheca*, *K. grandifoliola*, *K. ivorensis*, *Tieghemella heckelii*, *Nauclea diderrichii*, *Afrormosia elata*, *Lovoa trichilioides*, *Terminalia ivorensis*, *Triplochiton scleroxylon*, *Tarrietia utilis*.

Class II: *Entandophragma candollei*, *Guarea cedrata*, *G. thompsonii*, *Lophira alata*, *Piptadeniastrum africanum*, *Antiaris toxicaria*, *Mansonia altissima*, *Mitragyna stipulosa*, *Nesogordonia papaverifera*, *Turraeanthus africana*.

Other species: Those species of possible future economic value number about 310.

2/ Diameter classes 9.7 to 68.0 cm

3/ Diameter classes above 68.0 cm

Ownership

The forests are owned by the "stools" (tribal chief doms). These forests are managed by the Government (Forest Service) on behalf of the "stools".

Accessibility

For the most part the forest is reasonably accessible by road. For primary extraction, however, it is almost invariably necessary to construct roads into exploitation areas from the nearest existing public road. Floating of logs has ceased and logs are now carried by lorries to the nearest railway siding or to the mills and harbour.

Some of the Forest reserves have very rough terrain. It is comparatively much as the first reserves were set off for protection in mountainous regions.

Concessions and exploitation

Exploitation in a Forest reserve is based on the prescriptions of a working plan. In selection working areas the yield is controlled by area, species and girth limits. No girth limits are imposed in unreserved areas where the farmers are active.

Nearly all Forest reserves (95 per cent) in the closed forest zone are under concessions or licences. Forest areas outside the Forest reserves are also under concessions (or leases and short-term felling agreements) to a large extent (80 per cent).

In three reserves they have cut a whole cycle and started a second cycle. In all other reserves they are still in the first cycle. Within 15 years the first cycle will be cut over in all reserves.

The concessions are granted for a period of 5 to 99 years (normally 25 years). When giving concessions they favour operators who process the timber in Ghana. Some years ago it was suggested that part of the concession should be taken away from those who had not started processing.

The maximum aggregated area that can be kept by one company is 62,160 ha.

It has been calculated that the Forest reserves could give a sustained yield of species presently of commercial interest of 1.0-1.2 million m³ per year. In addition they could give a sustained yield of potentially commercial species of 250,000 m³ per year.

Of 360 recorded timber species only 40 have a market. Twelve are regularly exploited but eight of them make up about 90 per cent of the production and they are classified into primary and secondary species. At present 28 species are exported. *Triplochiton scleroxylon* (wawa) makes up about one-third of the production.

Maximum production of logs was reached in 1960. Since then the exploitation has decreased by about 15-20 per cent.

There is probably an over-exploitation going on of some of the main commercial species.

G U I N E A

General

Guinea has an area of 24.6 million ha. Its coast is part of the extremely wet south-western sector of West Africa, which has a monsoonal climate (3,000 mm in six months). Along the coast there are vast areas with mangroves and swamps.

Behind the swamps a coastal plain, around 650 km wide, is found. The west-centre of the country is occupied by the mountainous Fouta Djallon. Much of it is over 900 m high. The total rainfall in this area is around 1,750 mm but it is more evenly distributed than along the coast.

The Niger plains and the Guinea highlands are situated, east and south-east respectively of the Fouta Djallon. On the Liberian boarder the Guinea highlands rise to 1,700 m at Mount Nimba. In this area only two to three months of the year are without significant rain.

FAO Production Yearbook 1971 gives the following information concerning land use:

Land use	Area, 1000 ha
Agricultural area	
Forest land	1,046 ^{1/}
Other land	..
Land area	..
Total area	24,586

1/ Information from WFI 1963

Natural vegetationA. Mangrove:

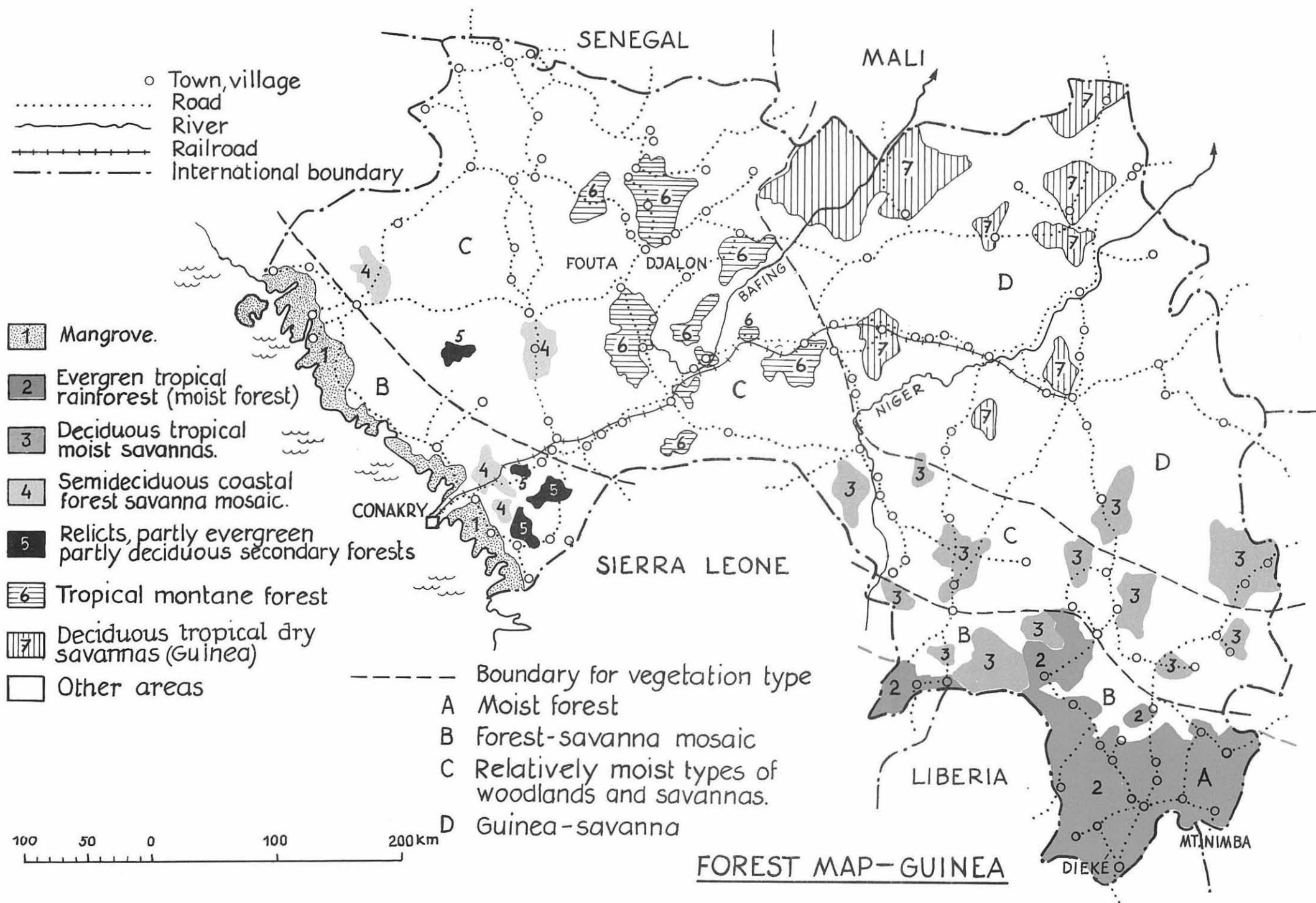
This vegetation type covers around 400,000 ha and is exploited for fuelwood and poles. It has been degraded around Conakry. The most common species are *Rhizophora racemosa* and *Avicennia nitida*. Utilizable volume is reported to be 90-150 metric tons/ha.

B. Evergreen rainforest:

This forest is found in the south-eastern corner of the country. Main species: *Chlorophora excelsa* (iroko), *Khaya ivorensis*, *K. anthotheca*, *Azizelia africana* (lingué), *Tarrietia utilis* (niangon), *Entandophragma utile* (sipo), *Lourea tri-chilioides* (dibétou), *Guarea cedrata* (bossé), *Entandophragma cylindricum* (aboudikron), *Lophira alata* (azobé), *Nauclea diderrichii* (bilinga), *Daniellia thurifera* (faro).

C. Forest-savanna mosaic or deciduous tropical forest:

Forest-savanna mosaic is found in scattered areas in a 80 km belt along the coast and north of the rainforest region. Main species: *Parinari excelsa*



(sougué), *Anisophyllea zaurina*, *Pentadesma butyracea*. In the coastal region of old secondary forests with *Pycnanthus kombo* (ilomba) and *Chlorophora regia* (iroko) are also found.

D. Montane tropical rainforest:

This type is found mainly in central Guinea at an altitude of 800 - 1,300 m. Main species are *Khaya senegalensis* and *Chlorophora regia*.

E. Open woodland:

The whole eastern part of the country is covered with open woodland and other savanna types. The western part of the savanna zone is relatively moist. In the east the type changes to Guinea savanna with abundant *Isoberlinia doka* and *I. dalzielii*.

Forest resources

Some sort of inventory, probably in the south-east, is reported to have been undertaken with Bulgarian assistance.

A recent estimate gives the total area of "forest" as 1.2 million ha. Of this area 0.6 to 0.7 million ha is estimated to be exploitable. For this area the following breakdown was given:

Forest type	Area, 1000 ha	Volume, million m ³
Dense forest	200	5
Intermediate	110	2.2
Open forest	400	2.4
Total	710	10 ¹ / ₂

1/ Of this volume 1 million m³ is estimated to be of export quality.

Another source gives the area of dense forest as 80,000 ha. Of this area only 30,000 ha is said to be covered with stable high forest, the remaining area being covered with dense high forest where degradation is in progress. It is being depleted by cutting and fire.

Stable savanna has been estimated to cover around 6 million ha. It can produce both fuelwood and industrial wood. Isolated *Khaya senegalensis* and *Azizelia* are exploited for industrial wood. Savanna, where degradation is in progress, was estimated to cover 10 million ha. This area is degraded by too many fires or too frequent exploitation.

The most recent source gives the area of savanna with some woodcover as 14.2 million ha.

All the "forests" are reported to be state-owned.

Man-made forests

The present species distribution is as follows:

Species	Area, ha
<i>Gmelina arborea</i>	500
<i>Tectona grandis</i>	700
<i>Pinus</i> spp.	600
<i>Terminalia</i> spp.	150
Bamboo	60

The following programme for afforestation has been given.

a) In lower and middle Guinea *Gmelina*, *Tectona grandis*, *Cedrela* and *Eucalyptus* will be planted. The plan is to plant 250 ha/year; rising to 500 ha/year.

b) On the high plateaus of Fouta-Djallon pines (and some teak) will be planted. The plan is to plant 300 ha/year; increasing to 1,000 ha/year.

c) In the forest region in the south 200 ha/year of *Terminalia superba*, *T. ivorensis*, *Cedrela mexicana* and *Tarrietia utilis* will be planted; to rise to 300-400 ha/year.

Exploitation

In 1968 the main exploitation areas were the Diéké area (40,000 ha) and the Ziamá area (110,000 ha).

GUINEA BISSAU

General

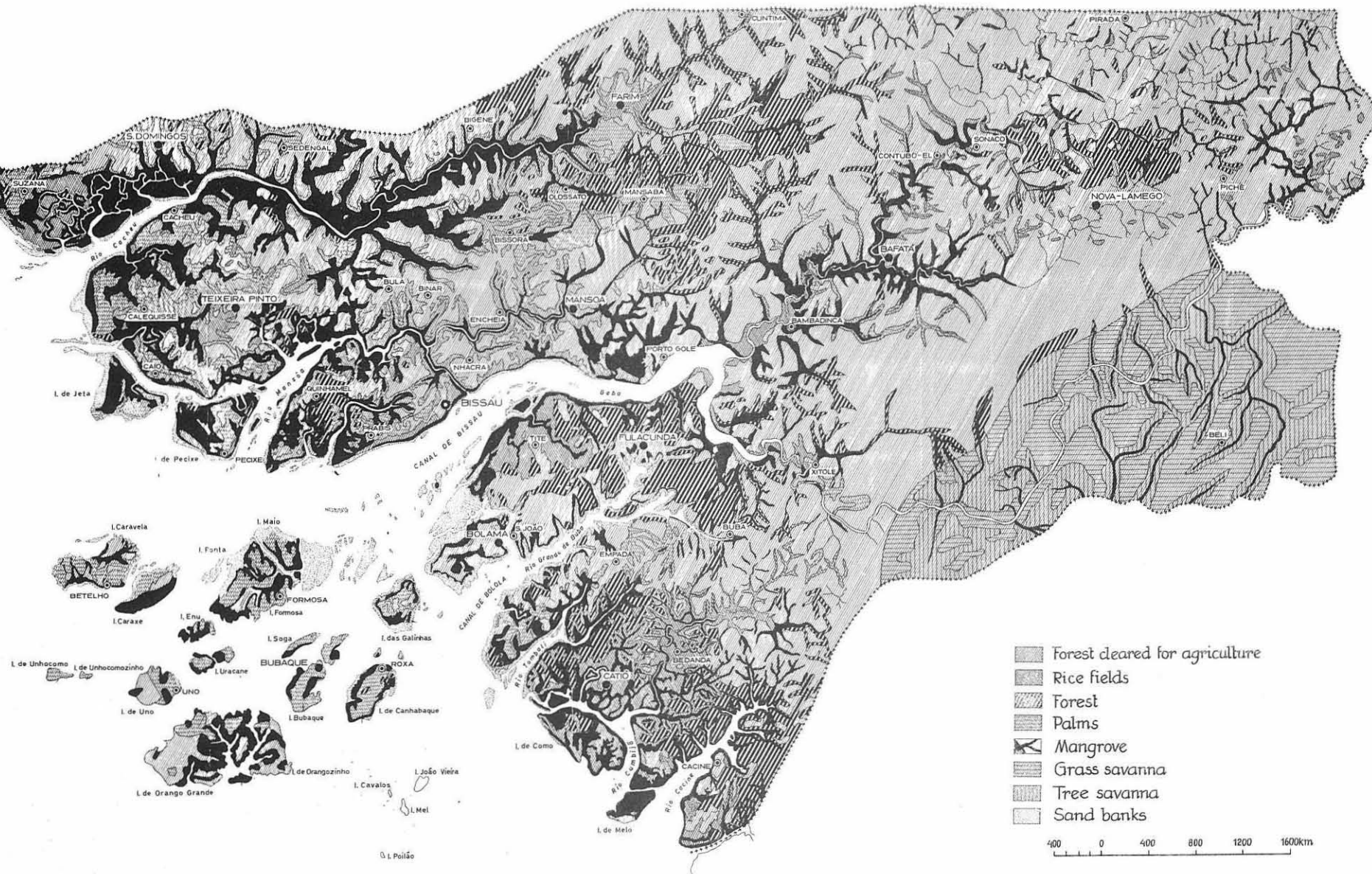
Guinea Bissau has an area of 3.6 million ha including some low-lying ground which is periodically flooded at high tide. Except for some higher terrain close to the Guinea border (about 300 m) the country consists of a coastal plain deeply indented by rivers. The main physical characteristics of Guinea are its meandering rivers and wide estuaries, where it is difficult to distinguish mud, mangrove and water from solid land.

The climate is tropical, hot and wet with two seasons. The average temperature is above 20° C. May and April are the hottest months (about 28° C), January and December the coldest (about 23° C). The rainfall is abundant (1,000 to 1,500 mm in the north, and over 2,000 mm in the south).

According to FAO Production Yearbook 1971 the land use is as follows (information from 1970):

Land use	Area, 1000 ha
Arable land and land under permanent crops	275
Permanent meadows and pastures	1,280
Forest land	1,000
Other land	1,057
Land area	2,800
Total area	3,612

FOREST MAP—GUINEA BISSAU



Forest land

The WFI 1970 gives an area of 2.28 million ha as Forest and other wooded areas. The area of man-made forests is given as 300 ha.

The great discrepancy between different estimates is probably dependant on different definitions. According to a detailed vegetation map roughly 10 years old the vegetation cover is as follows:

Vegetation cover	Area, 1000 ha
Forest cleared by agriculture	1,291
Rice fields	213
Forest	294
Palms	182
Mangrove	465
Grass savanna	162
Tree savanna	126
Sandbanks	67

The woody cover has been described by portuguese foresters as follows. (All the names given are not shown on the map):

Dry dense forest: At S. Domingos this is characterized by dense stands of *Daniellia oliveri* and at the forests of Umpacaca by stands of *Guibourtia copallifera*.

Dry open forests: These are found in the low-lying regions in the north-east and in the interior and constitute the normal type of forest. The forests of Guedage, Oio, Xime and Fulacunda are the most important. In these forests the most important species are: *Khaya senegalensis*, *Pterocarpus erinaceus*, *Daniellia oliveri*, *Erythrophleum suaveolens*. *Khaya senegalensis* is the species of greatest economic importance.

Gallery forest: This is developed along rivers.

Dry forest and savanna: This is mixed stands composed of dry forest and savanna.

Tree savanna and bush savanna: These occupy a very large area in Gabú, Bafatá and Farim and have a considerable extension in S. Domingos, Teixeira Pinto and Fulacunda. Along the coast savanna is found in Sucujaque, Sedengal, Pelundo, Cajegute and S. Joao. This savanna represents the different aspects between dry open forests and bushvegetation and is composed of secondary stands with dispersed trees and bushes.

Stands of *Oxytenanthera abyssinica*, *Borassus aethiopum* and *Daniellia oliveri* occur.

Strata from 8 to 18 m height especially of the species *Khaya senegalensis*, *Azelia africana*, *Erythrophleum africanum*, *Daniellia oliveri*, *Parkia biglobosa* and *Terminalia macroptera* is found.

Exploitation

During the years 1964 to 1970 the removals were as follows:

Group I	46,539 m ³ without bark
Group II	2,732 " " "
Group III	29,925 trees cut

- Group I: *Khaya senegalensis*, *Azizelia africana*, *Pterocarpus erinaceus*,
Detarium senegalense, *Chlorophora excelsa*, *Albizia gummifera*.
Group II: *Erythrophloeum africanum*, *Daniellia oliveri*, *Ceiba pentandra*,
Antiaris toxicaria, *Dialium guineense*, *Malacantha heudelotiana*
Group III: *Borassus aethiopum*

Other

- 1/ An area of 200,000 ha is reported to be affected by shifting cultivation.
2/ The area of protection reserves has been given as 40,000 ha.

I V O R Y C O A S T

General

Ivory Coast covers an area of 32.2 million ha. The topography of the country shows no drastic features but the land rises slowly from the coast to the north with some mountains of 800 m altitude in the north. Mount Nimba in the west reaches above 1,300 m. In the south there is a closed (high) forest zone followed by a transition zone which in the north turns into open country with vast savannas.

In the coastal region the climate is tropical with two dry and two rainy seasons. Temperatures range between 22° C and 33° C and the humidity is permanently very high. The rainfall is above 1,800 mm. Moving up north, humidity and rainfall gradually diminish and seasonal variations shade off into one rainy and one dry season in the upper north.

According to FAO Production Yearbook 1971 the land use is as follows (information from 1968):

Land use	Area, 1000 ha
Arable land and land under permanent crops ^{1/}	8,859
Permanent meadows and pastures ^{1/}	8,000
Forest land	12,000
Other land	3,387
Land area	31,800
Total area	32,246

- 1/ Another source (WFI 1970) gives the area of agricultural land as 1,832,000 ha and the area under bush fallow as 5,456,000 ha.

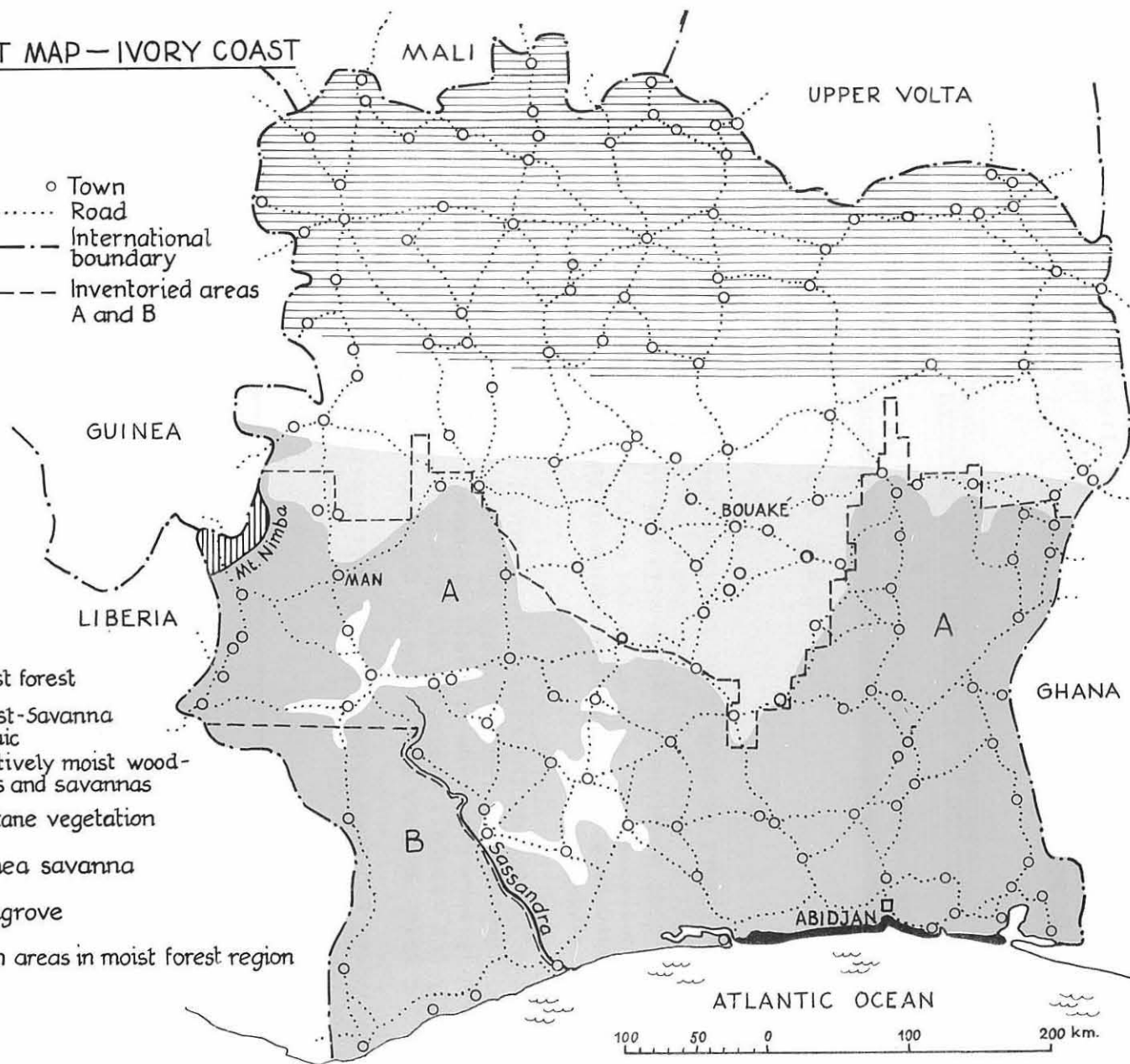
Natural forest land

The different vegetation types can briefly be described as follows:

FOREST MAP — IVORY COAST

- Town
- Road
- - - - International boundary
- - - - Inventoried areas A and B

-  Moist forest
-  Forest-Savanna Mosaic
-  Relatively moist woodlands and savannas
-  Montane vegetation
-  Guinea savanna
-  Mangrove
-  Open areas in moist forest region



A. Moist evergreen forest: This type demands an annual rainfall of about 1,600 mm. The most important timber species exclusive to this zone are *Mansonia altissima* (bété), *Tieghemella heckelii* (makoré) and *Tarrietia utilis* (niangon).

B. Moist semi-deciduous forest: This type needs an annual rainfall of 1,350 to 1,600 mm. *Celtis* spp. are often an important part of the dominant layer. The most important timber species exclusive to this zone is *Triplochiton scleroxylon* (samba). In the dry season the trees of the upper layer shed their leaves.

C. Forest-savanna mosaic: This zone is found north of the moist semi-deciduous forest and is a transition between this type and the savanna woodlands in the north. The development of this intermediate zone is caused by frequent fires.

D. Open woodlands: The open woodlands are characterized by *Isoberlinia doka*, *Uapaca togoensis* and *Anogeissus leiocarpus*. The open woodlands are deciduous and need an annual rainfall of 1,000 mm. The dry season is four to five months. Due to fire and human utilization the open woodlands have mostly changed into savannas with a discontinuous crown-cover. Gallery forests are found along rivers.

E. Other vegetation types: Moist montane forest is found in the mountains in the west. Along the coast there are areas of mangrove. In the moist evergreen forest certain areas of littoral savannas exist.

Present Forest Areas

Roughly 13 million ha in the southern part of the country is covered by the high forest zone. At present an area of 8 million ha is still classified as forest i.e. blocks of forest with more than 500 ha each. This forest area is decreasing rapidly.

The WFI 1970 gives an area of 7,779,000 ha as covered by open woodlands.

In 1966 the forest inventories gave the following breakdown of the area in different classes:

Land class	Area, 1000 ha
Forest area (blocks > 500 ha)	8,357
Small forest blocks (10-500 ha)	626
Degraded forests (blocks 5-10 ha)	5,701
Unforested areas (in inventoried areas)	988
Total inventoried area	15,672
Other areas and savannas ^{1/}	16,574
Total land area	32,246

^{1/} Including small forest blocks outside inventoried areas.

Man-made forests

The present area of planting amounts to 42,000 ha. Of this area around 14,000 ha is probably enrichment plantings. An old breakdown of 24,000 ha estimated 8,000 to 9,000 ha to be teak. Most of these teak plantations were done in recent years. Around 2,000 ha are old teak plantations. Since 1966 (to 1972?) 15,000 ha has been planted. The plans now are to plant 4,000 ha/year; of this, 1,500 ha with teak and the rest with indigenous species. (This is the absolute maximum area to be planted.)

An area of 3,300 ha was planted in 1972 of which 1,200 ha was teak, 850 ha *Terminalia ivorensis* (framiré), and 850 ha *Entandophragma utile* (sipo). Around 26,500 ha of the plantations are found in the high forest region while 15,500 ha are in the savanna region.

The main planting regions are said to be Bouaké, Tissola, Mopu, and the area around Man. Certain grasslands in the closed forest region are said to be very suitable for plantation of pines.

Inventories

The whole high forest region was inventoried between 1965 and 1967.

- (a) CTFT has inventoried 13.1 million ha (Code A on the map)
- (b) Development and Resources Corporation (DRC) New York has inventoried 2.6 million ha in the south-western part of the country (Code B on the map).

A. Results from CTFT inventory

In 1966 CTFT undertook an inventory of 13.1 million ha in the high forest zone (this was the whole high forest zone except for the south-west region).

a) Area classification:

Land class	Area, 1000 ha
"Forest" (blocks of more than 500 ha)	5,970
" - swampy	478
Total	6,448
Small blocks of dense forest (10-500 ha)	571
Total dense forest	7,019
Degraded forest (blocks 5-10)	5,171
Non-forested areas	900
Total	13,090

b) Volumes (of 43 commercial or potentially commercial species):

- (i) Trees of middle size in "forest" (blocks above 500 ha) had a volume of 227 million m³ (d.b.h. 36-62 cm)
- (ii) Big and very big trees (trees above 62 cm d.b.h.) in "forest" (areas above 500 ha) had a total volume of 433 million m³. The breakdown in species groups is as follows:

Species group	Species	Volume, million m ³
I	acajou, makoré, aboudikron (sapelli), sipo, niangon	24
II	bossé, kosipo, tiama	9
III	avodire, bête, dibétou, amaza- koué	16.8
IV	samba (obeche)	106
V	iroko	12.8
VI	assamela	0.7
VII	framiré, ilomba, fromager ... ("white woods" other than samba)	112
VIII	linguê, azodau ("Dossiê")	3
IX	frakê ... (species with little value)	71
X	azobê ... (hard species)	77

(iii) M³ per ha of trees above d.b.h. 62 cm in different species groups is as follows:

Species group	m ³ /ha
I	3.8
II	1.4
III	2.6
IV	17.1
V	2.1
Frakê	4.8
Kotibê	2.3

c. Actually exploitable ("extractable") and commercial volumes^{1/}:

Species group	Species	Volume, million m ³
<u>In "forest"</u>		
I	Total (main "red-woods")	15
	Sipo	5.8
	Acajou	2.7
	Niangon	2.5
	Makoré	1.55
	Sapelli (aboudikron)	2.7
II	Total (secondary "red-woods")	4.85
	Tiama	2.7
	Bossé	1.8
	Kosipo	1.35

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cont.

Species group	Species	Volume, million m ³
III Total (species used for cutting)		9.35
	Bété	6.15
	Amazakoué	1.6
	Avodire	1.15
	Dibétou	0.45
IV	Samba	28.55
V	Iroko	6.35
VI	Assamela	0.35
VII Total ("white-woods" other than samba)		46
	Fromager	30
	Ilomba	7.4
	Ako	4.5
	Koto	1.8
	Framiré	0.95
Other species (most frequent)		
	Kotibé	6.4
	Fraké	30
	Dabema	28
<u>In degraded forest:</u>		
(most frequent)		
	Samba	19
	Fromager	10
	Iroko	5
	Framiré	3

1/ Volume above 62 cm d.b.h. The volume of defective trees etc. are excluded.

B. Results from inventory in south-west (DRC)

a) Classification of area:

Land class	Area, 1000 ha
Non degraded high forest	1,535
Degraded high forest	374
Sub-total (high forest)	1,909
- of which swamp forest	242
Unforested areas, degraded forests and forest areas of mediocre quality	673
- of which with forest blocks	213
Total area inventoried	2,582

b) Gross volumes per ha:

Species group	Gross volume, m ³ /ha
All species above 10	174.7
All species above 43 cm	136
30 species above 10 cm ^{1/}	73.8
30 species above 43 cm ^{1/}	68.8
11 species above 43 cm (category 1)	19.3
Export quality ^{2/}	38

1/ Three categories of commercial species

2/ Of categories 1-3

c. Net volume of all three categories (30 species) above 70 cm:

Forest type	Net volume, m ³ /ha
All high forest	38
Evergreen	19
Semi-deciduous	49
Transitional	49

d) Volume distribution:

Volume class, m ³ /ha	Percentage of area
300 +	18
200 - 300	26
150 - 199	18
100 - 149	17
50 - 99	14
0 - 49	8

C. Total volume in Ivory Coast

The result from the CTFT and DRC inventories have been updated to give information about the forest resources in mid 1968. This information is shown in the table on next page:

Shifting cultivation

The closed forest areas are decreasing rapidly due to shifting cultivation. The area of "forest" has decreased from 9.8 million ha in 1956 to 6.8 million ha in 1966, in the area inventoried by CTFT. This means an average decrease of 300,000 ha per year. These areas do normally not return to forest. The calculation was based on aerial photographs taken at a ten years interval.

Species group	Species	Gross volume o.b. (minimum d.b.h. 60 cm)	
		In forest	In degraded forest
		1000 m ³	
Group I	Acajou	10,704	260
	Makoré	5,344	-
	Sapelli	11,122	220
	Sipo	11,675	270
	Niangon	12,261	510
	Total Group I	51,106	1,260
Group II	Bossé	3,708	270
	Kosipo	4,732	270
	Tiama	8,709	280
	Total Group II	17,149	820
Group III	Avodire	2,664	230
	Bété	11,233	430
	Dibétou	3,731	320
	Amazakoué	3,247	-
	Total Group III	20,875	980
Group IV	Ako	15,714	1,070
	Ilomba	22,719	2,860
	Aiélé	4,558	90
	Fromager	65,862	18,900
	Kondroti	3,632	80
	Bahia	5,008	1,400
	Koto	13,549	1,350
	Total Group IVa	131,042	25,750
	Samba	123,745	21,080
	Framiré	5,290	3,320
	Iroko	14,826	5,760
	Assamela	714	60
	Total Group IVb	144,575	30,220
	Fraké	36,897	4,280
	Faro	6,967	80
Group V (9 spp.)			
Group VII(9 spp.)	Azobé	12,581	200
	Badi	9,437	80
	Movingui	3,533	60
	Kotibé	16,060	460
	Dabema	40,058	4,110

It is difficult to understand how the CTFT and DRC inventories together can give these figures.

All the figures given in previous chapters are therefore relatively out-dated and must be reduced considerably.

Shifting cultivation increases in an area when new roads are opened up e.g. for forest exploitation.

Concessions

The forests are state-owned. Loggers buy concessions that are usually in the size of about 2,500 ha. In 1969 a total number of 2,560 concessions had been sold (6,390,000 ha).

A concession can be held for 15 years if the logger has a sawmill and some other wood industry, 10 years if he has a sawmill and 5 years if he merely produces logs.

Accessibility

Logging conditions are very good in Ivory Coast. The soils are well drained and the topography is nearly level.

In 1972 there were about 25,000 km of all weather roads in Ivory Coast. The roads to the south-western region are not well developed.

Exploitation

About 25 of in all 400 species are utilized. Some of the main timber species - *Tieghemella heckelii*, *Entandophragma utile* and *Afrormosia elata* (assamela) - are disappearing from the forests. The potential exploitable volume of *Entandophragma cylindricum* (sapelli), *Khaya* spp. (acajou), and *Entandophragma angolense* (tiama) is considered to be small in relation to the present demand.

The production of logs was 4 million m³ in 1970 (export 2.5 million m³). In 1972 the total export was around 3 million m³.

K E N Y A

General

The total area of Kenya is 58.3 million ha. The main part of eastern Kenya consists of extensive plains. These are rising slowly from sea-level towards the highlands of the interior which have their base at about 1,200 m. The plains are broken up here and there by inselbergs and hills.

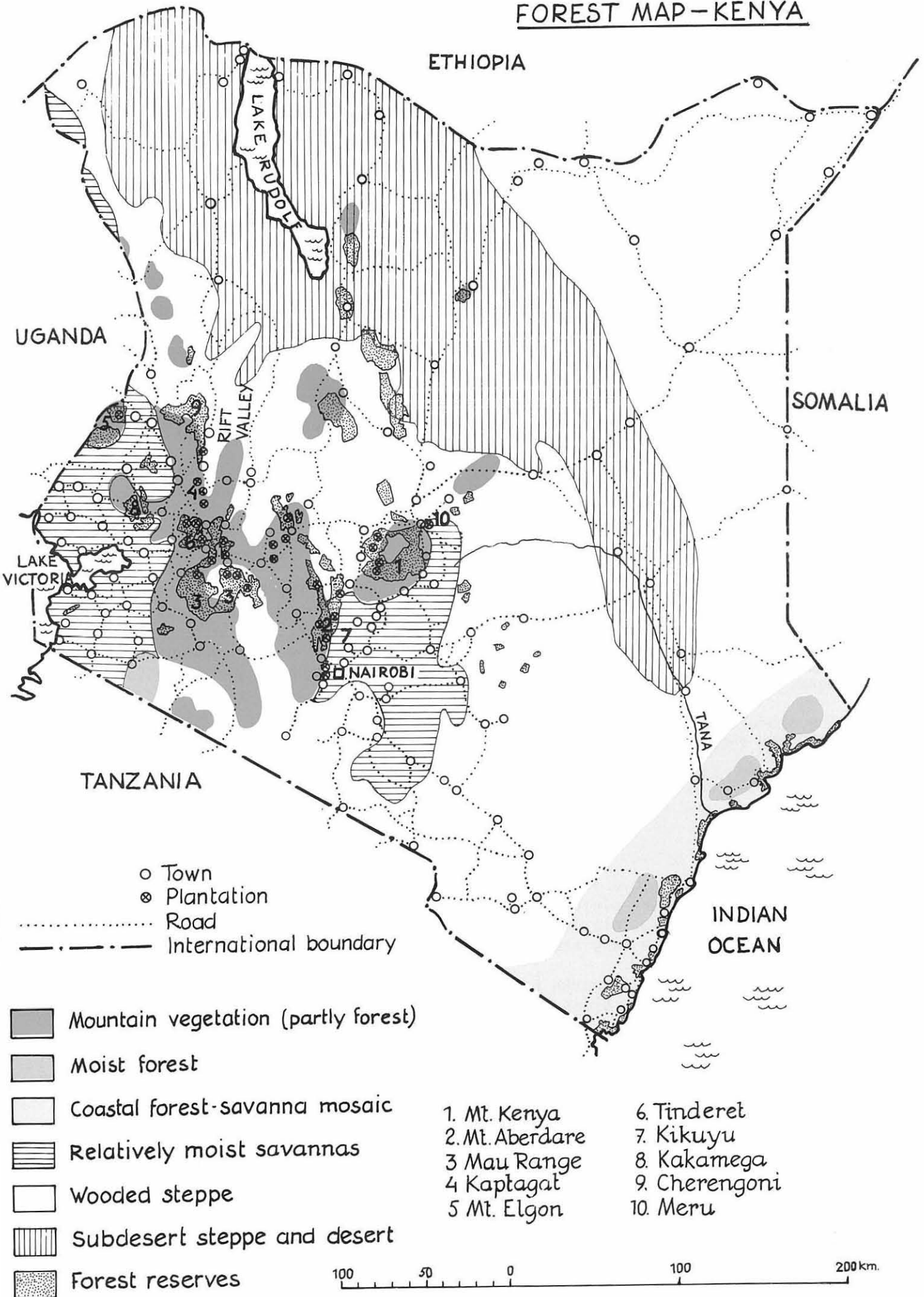
The country is divided north to south by the eastern Rift Valley (about 80 km across). On both sides of this lie long mountain chains.

The height of the Kenya highlands have been increased by vulcanic activities. The highlands are at 2,400 - 3,000 m with isolated extinct volcanoes still higher (Mt Kenya 5,199 m).

Westward the highlands descend to Lake Victoria.

The annual average temperature is 26° C at sea-level. The temperatures in the highlands can be roughly calculated by deducting from this sea-level value 1.7° C for each 300 m of altitude.

FOREST MAP - KENYA



Near Lake Victoria and in the highlands west of the Rift valley, rainfall is generally adequate for cultivation and falls in one long rainy season. East of the Rift valley there are two distinct seasons. Rainfall is greatest at the coast and in the highlands, while the extensive plains below 1,200 m are arid and semi-arid.

According to FAO Production Yearbook 1971 the land use is as follows (information from 1960):

Land use	Area, 1000 ha
Arable land and land under permanent crops	1,670
Permanent meadows and pastures	3,944 ^{1/}
Forest land	2,267
Other land	..
Land area	56,925
Total area	58,264

1/ In agricultural holdings

Natural forest land

The total "forest" area is given as 1,892,053 ha. Most part of this area have been covered by an inventory. The following breakdown has been given to the WFI 1970:

Vegetation type	Area, 1000 ha
Forest	735 ^{1/}
Bamboo thickets	289
Open woodland	75
Scrub and brushland	364
Not inventoried	430
Total	1,892

1/ Plantations included (given as 102,000 ha)

It is probable that the above breakdown is for the area classified as forest land.

An area of 1,675,885 ha is covered by Forest reserves. They can be subdivided in the following way (1972):

Type of forest land	Area, ha
Productive forest land ^{1/}	707,287
Stocked forest land ^{2/}	346,126
Sub-total	1,053,415
cont.	

Cont.

Type of forest land	Area, ha
Unstocked forest land	343,758
Mangrove forest	45,066
Moreland, giant heath, swamp, water and rock, alpine vegetation	43,744
Sub-total (sampled and classified forest land)	1,485,982
Unclassified forest land	189,903
Total forest land	1,675,885

1/ Land with merchantable wood. Including 60,000 ha with plantations

2/ Bamboos and trees; brush and trees etc. (any land with even one tree)

The principal forest areas are concentrated on the slopes of Mt Kenya and Aberdare mountains east of the Rift valley, and on the Mau Range, Mau Masai, Kaptagat, Elgeyo, Tinderet and Mt Elgon to the west. The forests used to be much more widely distributed than at present but cultivation and, in some areas, burning for grazing have taken their toll, so that few large blocks of forest remain below 1,800 m.

Mountain forests which are situated on Mt Kenya, Mt Elgon, Aberdare Range, Kikuyu escarpment and the Mau Elgeyo, Cherengoni mountain system, far exceed in area those of the rest of the country and they have an important, bearing, on the water supply.

They are essentially evergreen and extend from plateau forest to the bamboo zone at an altitude of 2,000 m up to 2,750 m and may be divided into two classes.

(a) The montane (camphor) rainforests:

This type is characterized by the absence of cedar and is confined mainly to the eastern and southern slopes of Mt Kenya and the eastern slopes of the Aberdare range and has an area considerably less than that of the cedar forests.

(b) Cedar forests:

These forests, which are commercially the most important in Kenya cover the slopes of all mountains with the exception of the southern slopes of Mt Kenya and the eastern slopes of the Aberdares, and contain a large proportion of the only coniferous timber species of the country i.e. *Juniperus procera* (East African pencil cedar) and *Podocarpus* spp. The altitudinal range is approximately 2,000 m - 2,750 m.

Below 1,800 m wherever favourable rainfall and aspect permit, semi-tropical and lowland forests may occur. Such forests still remain at Kakamega, in the basin of Lake Victoria and in Meru (Lower Imenti and Ngada forests) to the north-east of Mt Kenya.

The typical East African Miombo is not found in Kenya. There are however open woodland types, such as the *Brachystegia* woodland of the coastal stands and *Acacia* woodlands on the Rift valley floor in the altitude range from 900-1500 m. *Acacias* are also found in the highlands on dry sites up to 2,100 m.

Mangrove forests are situated in tidal creeks and deltas of scattered parts of the Kenya coast.

Schematically the forest types can be classified as follows: (from Logie & Dyson, 1962:)

Forest type	Location, altitude	Main species
<u>Montane forests</u>	Above 1,650 m	
<u>Montane rainforest</u>	Mt Kenya, Aberdares; 1,800-2,400 m	Camphor, podo (<i>P. milanjanus</i>)
Montane conifer	1,800-2,700 m: Not including above areas	Cedar, podo brown olive
Montane bamboo	2,400-3,000 m	1,600 - 2,800 stems/ha. Some podo and cedar emergents
Montane semi-evergreen	1,500-1,800 m	From shrubland to 24-30 m. Muhugu, brown olive
<u>Semi-tropical rainforests of the highlands</u> (1,200-1,800 m)		
Semi-tropical rainforest	N.E. Mt Kenya, L. Victoria	Few large blocks left. Elgon olive
<u>Lowland forests</u>	Below 1,200 m	
Lowland rainforest	Coastal strip	
Lowland dry forest	North of Tana river	
Lowland savanna		<i>Acacia</i> spp.
<u>Edaphic forests</u>		
Mangrove		<i>Rhizophora</i> , <i>Ceriops</i> tagal

There are 24 main commercial species, some of them now very rare. Perhaps another 20 species could be used. The recent forest inventory identified 325 different tree species, in all 42 of which were said to be commercial. The most important indigenous commercial timber species are the "softwoods", *Podocarpus gracilior*, *P. milanjanus* (podo) and *Juniperus procera* (East African pencil cedar). The forests are not rich in hardwoods suitable for veneer production or cabinet stock, except for relatively small volumes of *Ocotea usambarensis* (camphor), *Olea welwitschii* (Elgon olive, loliondo) *Vitex keniensis* (Meru oak).

Other species listed as commercial are the following:

<i>Afzelia guanzensis</i>	<i>Fagara macrophylla</i>
<i>Aningeria adolfi-friderici</i>	<i>Hagenia abyssinica</i>
<i>Antiaris toxicaria</i>	<i>Lecaniodiscus fraxinifolius</i>
<i>Brachylaena hutchinsii</i>	<i>Maesopsis eminii</i>
<i>Brachystegia spiciformis</i>	<i>Manilkara butugi</i>
<i>Canthium battiscombei</i>	<i>Manilkara sansibarensis</i>
<i>Cassine buchananii</i> (probably)	<i>Mimusops</i> spp.
<i>Celtis africana</i>	<i>Newtonia paucijuga</i>
<i>Celtis mildbraedii</i>	<i>Ocotea kenyensis</i>
<i>Chlorophora excelsa</i>	<i>Oldfieldia somalensis</i>
<i>Combretum schumannii</i>	<i>Olea hochstetteri</i>
<i>Cordia africana</i>	<i>Premna maxima</i>
<i>Craiba brownii</i>	<i>Pygeum africanum</i>
<i>Deinbollia kilimandscharica</i>	<i>Strychnos mitis</i>
<i>Dombeya goetzenii</i>	<i>Strychnos</i> spp.
<i>Ekebergia rueppeliana</i>	<i>Tamarindus indica</i>
<i>Erythrophleum suaveolens</i>	<i>Trachylobium verrucosum</i>
<i>Eclea nobilis</i>	

Very little is known about forest land outside the Forest reserves but they are thought to cover very small areas.

The indigenous high forests offer little promise. The recent inventory has, however, shown a growing stock much in excess of earlier estimates. The logging and transport difficulties are serious for a major part of the indigenous hardwoods, which grow mostly on mountain slopes.

Man-made forests

Planted area at 31/12 1970:

Species group	Area, ha
<u>Indigenous</u>	
Softwood	4,600
Hardwood	4,500
Sub-total	9,100
<u>Exotic softwoods</u>	
Cypress	54,300
Pines ^{1/}	54,600
Others	9,100
Sub-total	118,000
<u>Exotic hardwoods</u>	
Timber	2,900
Fuelwood	7,800
Sub-total	10,700
Grand total	137,800

^{1/} Mainly *P. patula* and *P. radiata*. Lately *P. radiata* has been attacked by needle blight.

The plantations were started as much as 70 years ago. The present age distribution is as follows:

Years of planting	Area, ha
1910-14	100
1915-19	300
1920-24	700
1925-29	1,400
1930-34	3,400
1935-39	3,300
1940-44	4,900
1945-49	10,100
1950-54	11,200
1955-59	15,300
1960-64	24,800
1965-67	12,200

The Government plantation programme has lately been running at a rate of 6,000 ha a year (of which 45 per cent pines and 45 per cent cypress).

The plantations are concentrated in the Kenyan highlands in the south-western quarter of the country.

The timber demand in 1980 will be met from 142,000 ha of softwood plantations. Another 20,000 ha is needed to meet the demand for pulpwood.

The annual planting programme is expected to be 6,500 ha. Annual clear-fellings will be 1,300 ha and the annual net increment will be 5,200 ha.

The target for 1980 is as follows:

Utilization category	Area, 1000 ha
Pulpwood	20
Saw-log	142
Total	162

The estimated annual cut from the plantations is as follows:

Year of exploitation	Volume, 1000 m ³
1977	510
1978	736
1980	991

There also exists 141,000 ha of private forests on large and small farms (excluding farms in coastal areas). A tenth of this is plantations with *Acacia mearnsii* (black wattle) grown for tanbark or so-called "wattle extract". These wattle plantations also support a fuelwood and charcoal trade in the Kenyan highlands. The balance of farm forests consists largely of windbreaks and small plantations for fuelwood and building materials.

Inventories

Inventories have been undertaken in both the indigenous forest and in the plantations. The reports cover in all 8.6 million ha. An area of 1,387,000 ha of forest and other wooded areas has actually been inventoried (of which 105,000 extensive). All species above 15.2 cm d.b.h. were measured. Summary of results for "natural forests" (area 1,264,000 ha) is given in the table below:

Species group	Volume, million m ³
Softwoods	30
Hardwoods (Commercial species)	23
Hardwoods (Non-commercial species)	56
Total	109

The volume of commercial species with a d.b.h. over 33 cm in cover types with an utilizable gross volume of over 140 m³ is 24 million m³.

The volume in the publicly owned coniferous plantations was estimated to 5.5 million m³ (area covered 101,000 ha).

An inventory in the coastal mangrove forests showed that only 35,000 ha were covered with stocked mangrove forests (of which 15,000 ha merchantable).

Exploitation

All "forests" (1,812,000 ha) are publicly owned.

Most of the logging is done by private firms (sawmills) which hold timber concessions. The number of concessions is about 70.

LESOTHO

General

Lesotho is a small country of 3 million ha situated at the highest part of the Drakensberg escarpment on the eastern edge of the South African plateau. About two-thirds of Lesotho is very mountainous. Elevations in the eastern half of the country are mostly above 2,400 m and in the north-east and along the eastern border exceed 3,300 m. This is a region of very rugged relief and an annual rainfall of 1,900 mm. Westwards the land descends through a foothill zone of rolling country between 1,800 - 2,100 m to Lesotho's main lowland area. This strip of land along the western border averages 40 km in width and lies at around 1,500 m. Yearly rainfall here averages between 600 and 750 mm.

According to FAO Production Yearbook 1971 the land use is as follows (information from 1962):

Land use	Area, 1000 ha
Arable land	353
Permanent meadows and pastures	2,495
Forest land	-
Other land	188
Total area	3,036

Natural vegetation

The natural vegetation is described as temperate and subtropical grasslands. There is complete absence of naturally occurring tree-growth. At present only uneatable shrubs can survive due to the high grazing pressure.

The country has a large population and also a large stock of cattle. Erosion problems are said to be very serious.

There is a need for plantations of fuelwood, poles etc. At present there are some plantations on a trial basis. The area covered may be 1,000 ha.

L I B E R I A

General

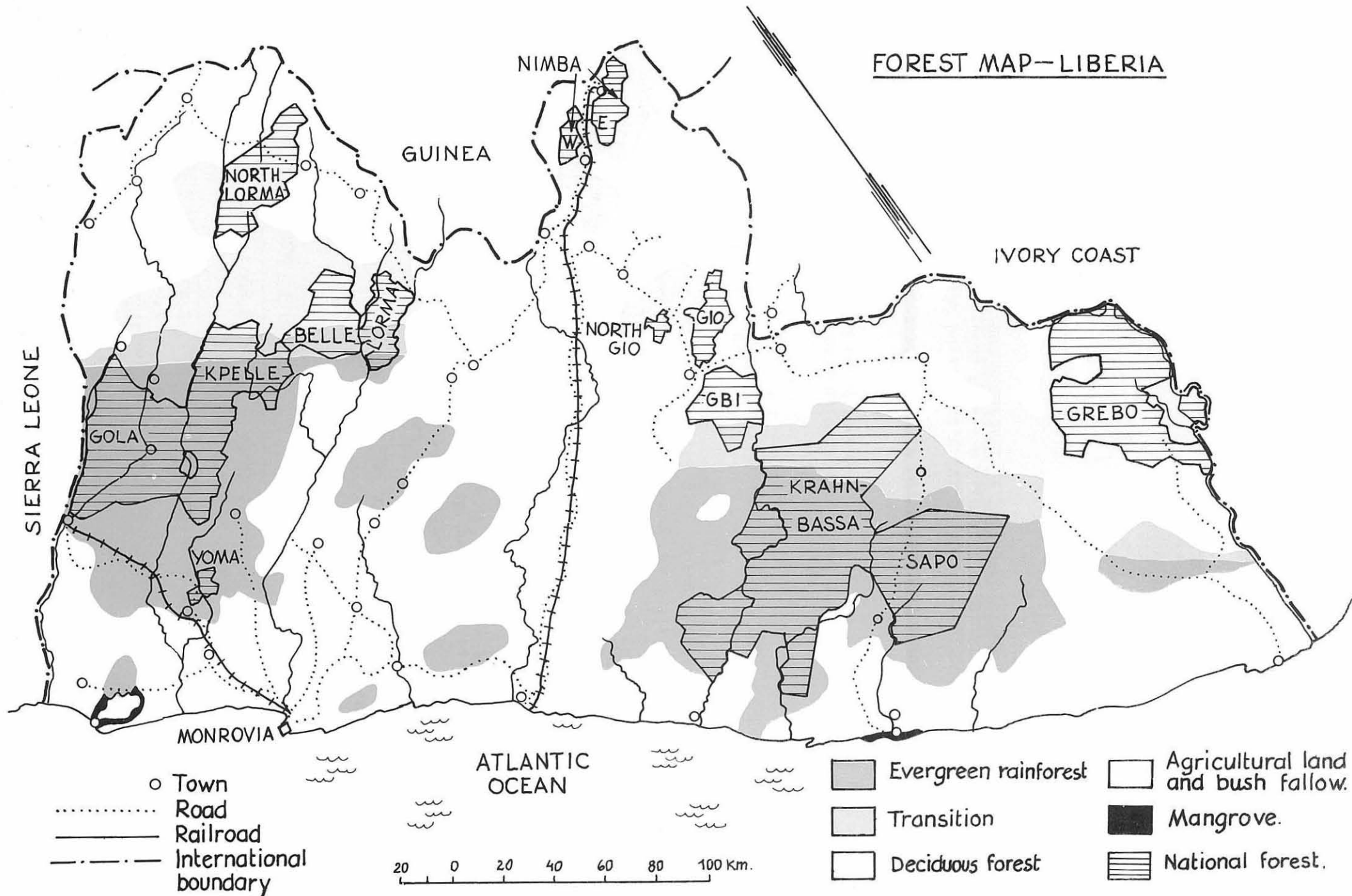
Liberia occupies a total area of 11.1 million ha (land area 9.6 million ha). A flat coastal plain, 15 to 55 km wide, carries a man-made forest-savanna mosaic. The interior hills and mountain ranges, with altitudes from 200 to 370 m are part of a dissected table-land covered by evergreen rainforest in the south and semi-deciduous rainforest in the north. Liberia's greatest elevations are located in the northern highlands, e.g. the Nimba mountains (1,380 m above sea-level). Here Guinea savanna with its typical elephant grass is found.

Liberia has two rainy seasons in the absolute south of the country and one rainy season from May to October in the rest of the country. From Monrovia with an average rainfall of 4,600 mm a year, rainfall decreases towards the south-east, and the interior, reaching 2,000 mm. Average temperatures are more extreme in the interior than at the coast.

According to FAO Production Yearbook 1971 the land use is as follows (information from 1964):

Land use	Area, 1000 ha
Arable land and land under permanent crops	3,850
Permanent meadows and pastures	240
Forest land	3,622
Other land	3,425
Land area	9,631
Total area	11,137

FOREST MAP—LIBERIA



Natural forest land

Forest is the natural vegetation in Liberia but a large part of this has disappeared. At present 2.5 million ha are considered to be closed forests. Of the forest area 1.6 million ha is classified as Forest reserves (National forests).

It is very difficult to determine the area of forests in Liberia as shifting cultivation is the normal agricultural practice. In less populated regions the rotation period is mostly 15-25 years while it is only 2-4 years near the major cities. Large areas are therefore covered by bush fallow. The area of forests given will therefore depend on the chosen definition of forest.

If "forest" includes the National forests and other forest areas where most of the trees have a d.b.h. above 50 cm, the total area amounts to 2.5 million ha.

In certain agricultural areas the stocking of valuable species is so dense that exploitation is possible. These areas are included in the figure of 2.5 million ha mentioned above.

In the whole of Liberia around 290 different tree species have been identified.

Vegetation zones

Note. The breakdown is given for the total land area (9,780,000 ha).

a) Coastal forest and mangrove swamps: These types are found along the coast. The area is 200,000 ha.

b) Evergreen rainforest: This type reaches 80 km inland up to an altitude of about 300 m above sea-level. The area is 4.5 million ha; 180 species reach commercial size. The most frequent species are *Gilbertiodendron preussii* and *Monopetalanthus compactus*. They are sometimes dominant.

c) Transition type: The transition between evergreen and semi-deciduous forest covers about 1 million ha.

d) Moist semi-deciduous forest: This type occurs from 80 km inland to the northern boundary. It covers about 4 million ha. The altitudes covered by this type fall between 250 and 1,200 m.

e) Savanna and park-like forest in the extreme north of the country covers 80,000 ha.

Man-made forests

Gmelina arborea and *Tectona grandis* have been planted as a pilot scheme (started 1970-1971). In 1971 500 ha with *Gmelina arborea* were planted. The years 1972-1976 it is planned to plant 6,500 ha.

Inventories

A large part of National forests have been inventoried in recent years. The main results are summarized below:

Summary of results from the inventory:
 (Source: Sachtler, 1965)

a) The closed forest areas in Liberia are shown in the table below:

Region and legal class of forest	Area, 1000 ha
<u>North-west Liberia</u>	
National forests	540
National Park	28
Unprotected forests	270
Sub-total	838
<u>North Liberia</u>	
National forests	41
Unprotected forests	20
Sub-total	61
<u>South-east Liberia</u>	
National forests	960
National Park	13
Unprotected forests	600
Sub-total	1,573
Grand total	2,472

b) The species groups in percentage of total volume above 40 cm d.b.h. is given as follows for different timber areas:

Timber area	Species group ^{1/}						
	1	2	3/4	5	6	7	
	percentage of total volume						
South-east	1	10	5	50	15	8	12
	2	12	5	35	15	13	20
	3	18	12	15	20	20	15
North-west	1	8	12	35	10	10	25
	2	12	3	35	20	18	12
	3	20	5	15	20	25	15
North	3	25	5	15	20	25	10

1/ Definition of species groups:

Species group 1 = Export timber of quite high value (16 spp.)

" " 2 = " " , low prices (6 spp.)

" " 3/4 = Sawtimber. At least suitable for home market (over 30 spp.)

Cont.

Cont.

Species group 5 = Heavy construction timber, sleepers (8 spp.)
 " " 6 = Species of low or unknown commercial value (11 spp.)
 " " 7 = Species without commercial value. Rare species.

c) Volume of the main forest types as percentage of high forest volume has been found to be as follows (volume of trees above 40 cm d.b.h.):

Forest type	Percentage of high forest volume
High forest	100
Elephant forest ^{1/}	60
Recently farmed land	24
Formerly farmed land	51
Intermediate	60
Swamp with merchantable timber	60

1/ The elephants destroy much forest

d) The approximate proportion of the main forest types in National forest is as follows:

National forest	Forest type				
	Area	Undisturbed high forest	Forest disturbed by elephants	Forest disturbed by farming	Swamps and rivers
	1000 ha	%			
Grebo	251	30	45	15	10
Gio	33	70	-	20	10
Gbi	61	80	-	15	5
Krahn-Bassa	514	40	20	20	20
Sapo	153	35	20	25	20
South Kpelle	174.8	90	-	+	10
Lorma	43.5	50	5	30	15
North Lorma	100	25	+	60	15

e) The table below shows the volume above 40 cm d.b.h. per ha in m³ o.b. by species groups:

Timber area	Forest	Species group						
		1a	1b	2	3/4	5	6/7	Total
		m ³ /ha						
EI	Sapo	8	1	7	48	14	24	101
EI	Krahn-Bassa	11	-	2	73	9	17	112
W1	School Forest	7	0.5	11	35	9	31	93
E2	Krahn-Bassa	9	1	4	33	11	32	87
E2	Gbi	9	13	7	30	12	31	91
W2	South Kpelle	13	0	2	33	20	30	98

Cont.

Cont.

Timber area	Forest	Species group						Total
		1a	1b	2	3/4	5	6/7	
		m3/ha						
E3	Grebo	11	2	11	15	23	29	90
E3	Gio	14	3	10	13	15	32	86
W3	North Lorma	12	4	4	11	16	33	80
N3	Nimba	22	4	7	18	22	37	109

f) The timber areas in Liberia have been sub-divided as follows:

Region	Timber area	Exploitable forest			Unexploitable forest	Total closed forests
		National forest	Unprotected	Total		
		1000 ha				
South-east	E1	300	80	380	230	610
	E2	180	-	180	140	320
	E3	170	350	520	120	640
Sub-total	E1-E3	650	430	1,080	490	1,570
North-west	W1	15	35	50	-	50
	W2	-	50	50	290	340
	W3	-	-	-	450	450
Sub-total	W1-3	15	85	100	740	840
North	N3	15	10	25	35	60
Grand total		680	525	1,205	1,265	2,470

To this table the following comments can be given:

The timber area W1 is exploitable. The timber area W2 have difficult logging conditions. The most important species of export timbers are very rare in all of north-western Liberia.

The Nimba region in northern Liberia is the richest forest area.

The "potential reserve" of timber in Liberia should total some 60 million m³.

Accessibility

The forests are away from modern transport routes. Some years ago only 10 per cent of the forests were classified as accessible. During the rainy season trails in the forest are flooded and transport impossible over large areas. In the National forests, 3-30 per cent of the area is covered by swamps.

Exploitation

In 1970-1971 370,400 m³ were exploited. Most of the exploitation was exported as roundwood.

Present export species: *Entandophragma* spp., *Khaya* spp., *Triplochiton*, *Lovoa*, *Tarrietia*, *Afzelia* spp., *Guarea*, *Tieghemella*, *Tetraberlinia*, *Terminalia*, *Pycnanthus*, *Mitragyna* and *Mansonia*. *Lophira*, *Erythrophleum* and *Sacoglottis* are exported on trial basis.

At the local market is also sold: *Antiaris*, *Turraeanthus*, *Gilbertiodendron*, *Pterygota*, *Chlorophora*, *Nauclea Canarium*, *Erythrophleum*, *Brachystegia*, *Gossweilerodendron* and *Piptadeniastrum*. At present there are 17 timber companies operating concessions over an area of 1,655,000 ha. Nine of these concessions are located in areas outside reserves, This is to prevent that these forests are being destroyed by shifting cultivation.

Other

All the forests are state-owned.

LIBYAN ARAB REPUBLIC

General

Libya covers an area of 176 million ha. It is nearly completely situated within the Sahara region from the Tibesti mountains in the south to the Mediterranean Sea in the north. The coastal region is covered by steppe vegetation interrupted by a number of oases.

The country has a desert-climate with hot summers, cool winters and very little rain.

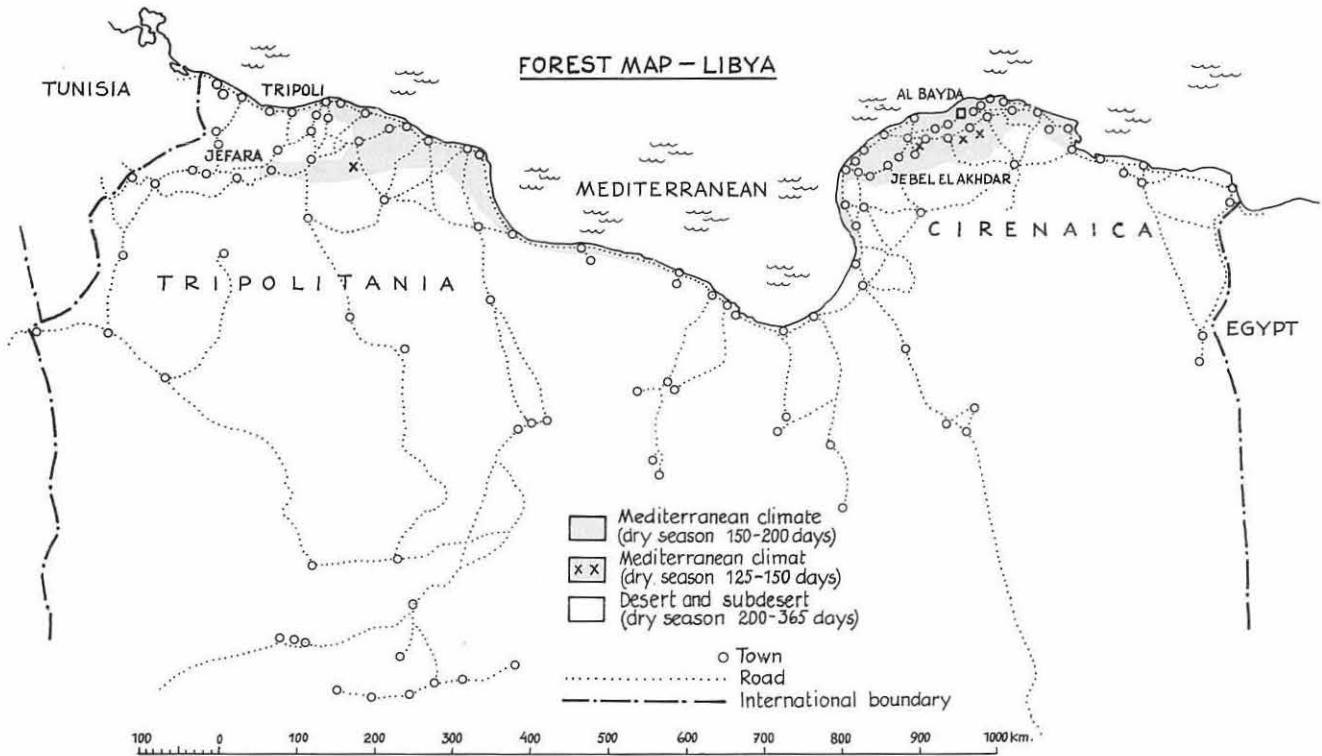
According to FAO Production yearbook 1971 the land use is as follows (information from 1969):

Land use	Area, 1000 ha
Arable land and land under permanent crops	2,515
Permanent meadows and pastures	1,130
Forest land	532
Other land	171,777
Total area	175,954

It is estimated that 460,000 ha of mixed coniferous-hardwood scrub-forest exists. The vegetation is degraded to a large extent. The woodlands remaining are described as follows:

The indigenous wooded lands are almost exclusively located on the two plateaus of the Jebel el Akhdar. One of them is the high plateau with a mean elevation of 600 m (up to 900 m), the other an arcshaped shelf beginning in the desert north of 31st parallel and extending to the sea with a mean elevation of 300 m. In the higher, sub-humid zones (rainfall 450-600 mm per year) of Jebel el Akhdar, as well as of the shelf, there are some fair stands

FOREST MAP - LIBYA



of *Cupressus sempervirens* var. *horizontalis*, *Quercus coccifera*, *Juniperus phoenicea* and some other species. This type of woodland covers about 60,000 ha on the Jebel el Akhdar and 10,000 ha on the shelf and in fact these are the only forest areas between Lebanon and Tunisia. They form the remnants of what were at one time more extensive forests which have been destroyed over the centuries. Remnants of former forests, some petrified, can still be traced in the adjoining steppes and deserts.

In the semi-arid parts of the two plateaus (rainfall 300-450 mm per year) an open type of woodland, or maquis, occurs. It is composed of *Juniperus phoenicea*, *Olea oleaster*, *Pistacia lentiscus*, *Arbutus pavarii* and *Ceratonia siliqua* on about 100,000 ha of the Jebel el Akhdar and on some 130,000 ha of the shelf. *Pinus halepensis* grows in isolated clumps in among this type of woodland. Towards the south of the plateaus the climate turns arid (150-300 mm rainfall per year) and the woodlands grade into very open scrub with *Juniperus phoenicea*, *Zizyphus lotus* and *Thymelaea hirsuta*, on perhaps 160,000 ha.

Outside the plateaus, the natural tree vegetation is very sparse and consists of occasional *Tamarix articulata*, *Pistacia atlantica*, *Rhus tripartitus*, *Acacia tortilis* (in the Jefara), *Zizyphus lotus*, etc. In the western provinces, the survival of widely spaced *Pistacia atlantica*, *Acacia tortilis*, and *Zizyphus lotus* clumps, are living memorials of the ancient natural forests which covered this part of the country as well.

The Forest Service makes all possible efforts for the conservation and preservation of what is left of the natural "forests" and controls any further degradation.

Man-made forests

Since 1952 the Forestry Department has undertaken an ever-expanding afforestation and tree planting campaign in a promising and successful endeavour to restore to the country its ancient greenery.

Sand dune fixation and afforestation is given top priority in the planning of the Forestry Department, the objectives of this programme are both protective and productive. The main species in sand dune fixation are *Eucalyptus camaldulensis*, *E. gomphocephala* and *Acacia cyanophylla*.

The Forestry Department is also engaged in an extensive programme of afforestation of steppe and marginal areas, village fuel reserves, mountain escarpments, roadside plantings; and shelterbelts and windbreaks. Afforestation under this programme is largely carried out by mechanical means.

Since 1952 and up to 1972 the total area afforested on state land is approximately 75,000 ha (about 40 million tree seedlings have been produced). Plantations established at the start of the afforestation programme are coming to maturity and some of these are already being harvested.

In 1971/1972 the total area planted by the state was 3,600 ha. The three years development plan (1972/73-1974/75) provides for the afforestation of about 15,000 ha on state land.

The most common species planted are *Eucalyptus camaldulensis*, *E. gomphocephala*, *E. rudis*, *Acacia cyanophylla*, *Pinus halepensis* and *P. brutia*.

In the private sector, the Forestry Department encourages farmers in tree planting by providing them with tree seedlings and putting technical assistance at their disposal. These incentives have mainly produced shelterbelts and windbreaks. In 1971/72 the number of trees planted exceeded 3.5 million trees. The total number of trees planted by the private sector since 1952 exceeds 40 million trees. In 1968 an area of 21,800 ha were reported to be covered by private plantations. Since then the area may have increased considerably. The forest-tree nurseries presently produce 14 million seedlings per year.

Exploitation

Total commercial forest volume is estimated at 8 million m³ of a "commercial forest area" estimated at 332,500 ha. Harvest for 1971 is estimated at 53,685 m³ including 29,607 m³ sawtimber and 24,078 m³ fuelwood (in whole Libya 410,000 m³ of fuelwood).

M A D A G A S C A R

General

Madagascar covers an area of 58.7 million ha and is the fifth largest island in the world. The central highlands rise abruptly from the narrow eastern coastal strip but descend gradually to the wide plains of the west coast. Four mountain massives reach above 2,000 m; the highest mountain reach 2,876 m.

Madagascar has a tropical climate. The rainfall is most plentiful along the east coast (2,500 mm per year) decreasing gradually towards the west coast. The driest part of the island is in the south-west. The east coast has rain all the year round while the inland and western parts have a dry period from April to October.

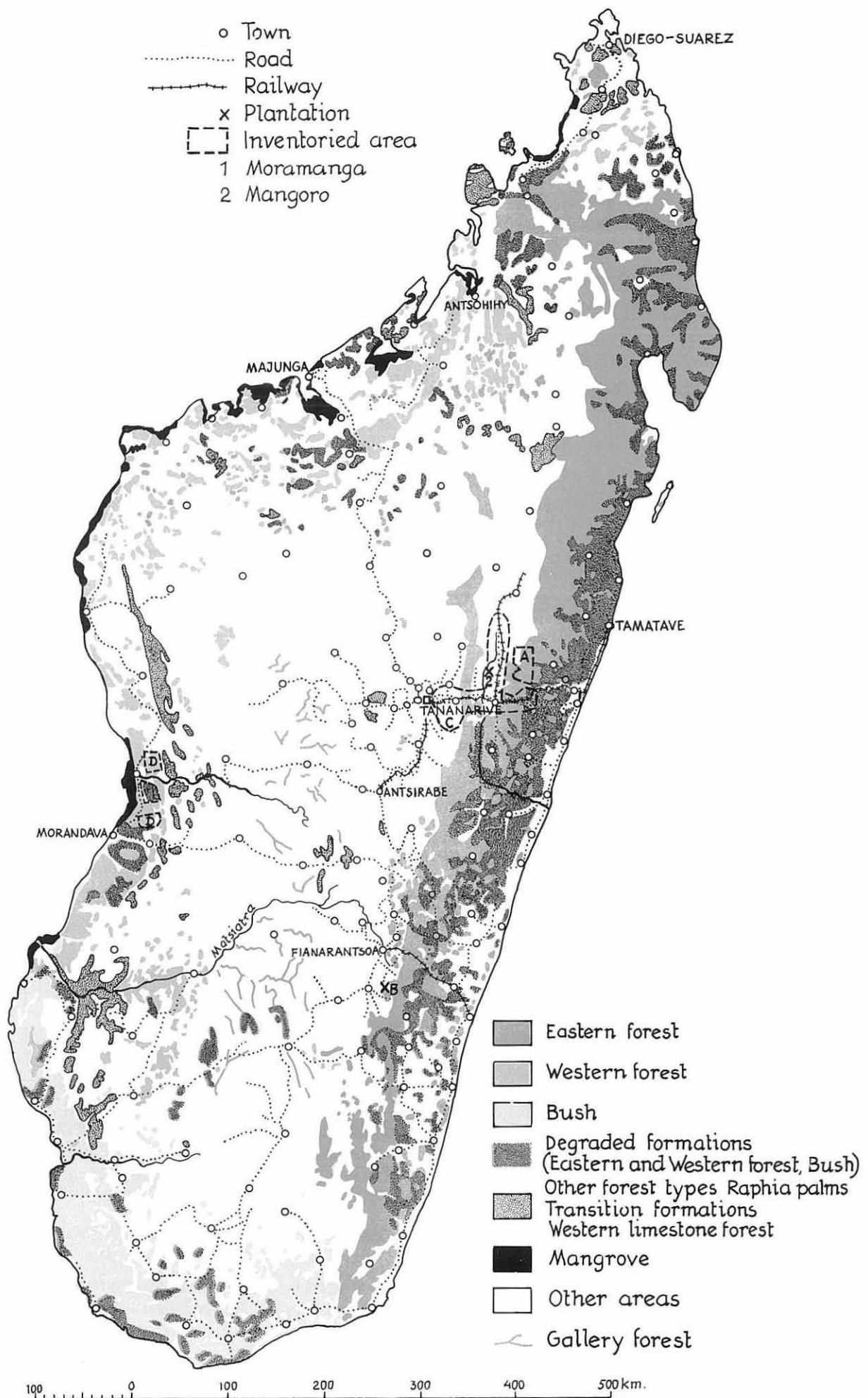
The land use (according to two different sources) is as follows:

Land use	Area, 1000 ha	
	WFI 1970	FAO Production Yearbook 1971 ^{1/}
Forest and other wooded areas	16,790	12,470
Forest	16,170 ^{2/}	..
Open woodland	540	..
Scrub and brushland	80	..
Arable land and land under permanent crops	..	2,856
Permanent meadows and pastures	..	34,000
Other land	..	9,378
Total land area	58,099	58,154
Total area	59,099	58,744

1/ Information from 1969.

2/ Of this area 3,580,000 ha is said to be under shifting cultivation.

FOREST MAP - MADAGASCAR



Natural forest land

In the case of Madagascar quite a lot of information is available but it is difficult to achieve a clear picture of the forest resources of the whole island.

Different sources give different breakdowns and areas. The most important study has been done by CTFT. This study is based on Carte de Madagascar from 1964. The aerial photographs used for the preparation of this map were from 1957-1959 in the east, and from 1949-1950 for the rest of the country. This means, naturally, that the map is largely out of date.

Some different breakdowns and descriptions of the forest area are given below:

A. Undegraded forest

The distribution of these forests in different regions is reported to be as follows:

Regional type	Area, 1000 ha
Eastern forest	6,700
Western forest	3,700
Bush (south)	2,100
Total	12,500

A more detailed breakdown of the forests according to vegetation types looks as follows:

Vegetation type	Area, 1000 ha
Moist tropical forest or rainforest	6,132
Raphia palms	97
Mangrove	218
Riverine forest	264
Transition between moist and dry forest	195
Dry tropical forest	2,052
Limestone forest	591
Bush	2,924
Total	12,473

Another estimate gives the area of untouched forest as 3.8 million ha. If scrub forest is included the total should be 7-8 million ha. Forest destruction occurs in both east and west but how much is not known. One estimate gives the area to be cleared every year as 100,000 to 200,000 ha (145,000 ha according to another).

B. Degraded forest

In addition to the so-called undegraded forest there are degraded forests. The following areas of different vegetation types have been classified as degraded:

Vegetation type	Area, 1000 ha
Moist tropical forest	3,585
Transition between moist and dry forest	114
Dry tropical forest	539
Bush	81
Total	4,319

C. Forest types

A more detailed description of the conditions in the most important forest types is given below:

a) Eastern rainforest:

This forest is very heterogeneous without dominating species. There is reported to be little variation in the forest from north to south. Practically all the species found in this forest, which is rich in species, are exploited. The same species are found at low and high altitudes but in different proportions.

The trees reach a height of around 25-30 m. The large trees are often poorly formed. The diameter of the trees is normally below one meter and there are said to be many defects.

Useful timber species (essences) are:

Local name (essence) ^{1/}	Scientific name
Nato	
Hintsy	Intsia bijuga & spp.
Kiji	Symphonia clusoides & spp.
Ramy	Canarium madagascariensis
Vintahina	Calophyllum parviflorum
Longotra	Cryptocarya louvelii
Abora	Tambourissa thonvenotii
Rotra	Syzygium spp.
Sambalatra	Albizia spp.
Palisander	Dalbergia spp.
Varongy	Ocotea platidisca & spp.
Tavolo	Ravensara spp.
Merana	Vernonia merana
Hetatra	Podocarpus madagascariensis
Famelona	Gambeya madagascariensis

^{1/} One "essence" may mean several species.

- (i) An inventory in this region gave a mean value of 26 m³ per ha (minimum d.b.h. 38.2 cm p.b., the trees must be usable for sawnwood). The variation of values range from 17 to 35 m³ per ha.

Values for certain species:

Species	m ³ /ha
Tavolo	3.7
Varongy	3.1
Ramy	2.1
Famelona	2.0

- (ii) An inventory in the Moramanga area gave a mean gross volume of 64 m³ per ha and a mean value of 44 enumerated trees per ha (d.b.h. above 30 cm).

Tavolo trees	counted	mostly	20.7-27.1	cm	d.b.h.	Medium	22.3	cm	d.b.h.
Varongy	"	"	"	20.7-27.1	"	"	"	23.9	"
Ramy	"	"	"	20.7-25.5	"	"	"	25.5	"
Vamboana	"	"	"	23.9-33.4	"	"	"	25.5	"

In the Moramanga area there are 100 species which reach exploitable limit. Nearly all species are exploited and together produce 20-50 m³/ha, half of which is lost in conversion. In general the number of exploitable trees per ha is fairly large, which tends to make up for a relatively modest average volume per tree.

The quality of the forest in the east decreases from north to south and especially from east to west. Different sub-types can be distinguished depending on altitude, topography and soils.

b) Dry western forest

The western region has a long dry season (5-7 months) and rainfall ranging from 1,500 mm in the north to 600 mm in the south.

There are not as many commercial species as in the eastern rainforest and the forest is not as dense. The flora is quite different in the northern and southern parts. The better stands attain a maximum height of 20 to 25 m in the north and 15 to 25 m in the south.

Useful timber species within this forest type include:

Local name	Scientific name
Hazomalanga	Hernandia voyroni & spp.
Palisander	Dalbergia spp.
Vory	Myristica voury
Ramy	Canarium madagascariensis

A small inventory in this region gave 14.5 m³/ha (minimum d.b.h. 31.8 cm o.b.) and 19 trees/ha.

In Antsohihy area was found 8 m³/ha (mainly ramy) in one area and 25 m³/ha (80 per cent ramy) in another area.

Much of this type of forest has disappeared completely as a result of fire and only a few major blocks are left. The survival of this forest is due to sparse population.

In this forest type the savanna is expanding. It has been estimated that 50 per cent of the wooded areas has disappeared during the last 30-40 years.

c) Bush

This vegetation type is found along the south-western and southern shores. The stands are composed of xerophytic trees and shrubs and attain a height of 3 to 10 m.

The climate in this vegetation type is semi-arid and the vegetation is degraded. Only one species - fantsilotra (*Alluaudia procera*) - is of commercial interest in this vegetation type. The area of commercial interest may be 1 million ha.

Man-made forest

Existing plantations:

Eucalyptus: A great number of Eucalyptus plantations (mainly *E. robusta*) are found in the central part of the country, mainly around Tananarive. Eucalyptus was in the beginning planted mainly along railways.

The plantations are scattered here and there and have only been partly inventoried. The estimates vary from 160,000 to 240,000 ha. An area of 8,000 ha of Eucalyptus is found in the Moramanga region.

Pines: Pine plantations cover around 40,000-45,000 ha. The species mainly planted are *Pinus patula* and some *Pinus kesiya*. At lower altitudes *Pinus caribaea* is planted.

Main plantation areas:

a) Haute Matsiatra:

In this area 20,000 ha with *Pinus patula* has been planted (30,000 ha if some more distant areas are included). The plantations are between 7 and 16 years old (1973).

The plans are to plant another 15,000 ha in this area. Each year 3,000 ha should be planted.

It has been discussed to establish a pulp mill in this area.

b) Haute Mangoro:

In this area 100,000 ha are available for planting. The plans are to plant 60,000 ha with *Pinus kesiya*. A pulp mill is planned in this area.

In 1969/70	it was planned that	3,000 - 3,500	ha would be planted
" 1970/71	" " "	" 3,500	" " " "
" 1971/72	" " "	" 4,000	" " " "

The growth rates expected to be 9-16 m³ per ha and year.

c) Antsirabe:

In this area 7,000 ha is planted with *Pinus patula*. In addition it is said to be 3,000 ha with private plantations.

Plans for plantations:

The figures quoted in different reports vary much. How much and where to plant also changes very often. The present planting rate seems anyhow to be very high.

In 1969-1971 (two planting seasons?) the following areas are reported to have been planted:

Region or project	Area, ha	Species
Haute-Matsiatra	6,490	<i>Pinus patula</i>
Haute-Mangoro	8,000	<i>Pinus kesiya</i>
Moramanga	150	<i>Populus deltoides</i> var. <i>carolina</i>
Ambatoma, Majunga	7,000	<i>Anacardium occidentale</i>
Ambilobe, Diego-Suarez	6,000	<i>Anacardium occidentale</i>
National afforestation	3,000	Pines
Communal plantations	6,000	Eucalyptus, <i>Anacardium</i>
Private plantations	6,000	Eucalyptus, <i>Anacardium</i>

InventoriesA. Fierenana (code A on the map)

In this UNDP/FAO inventory 100,000 ha were covered by photo-interpretation and of this area 61,000 ha were covered by a field inventory (inventory intensity 0.73 per cent). All trees from 30 cm d.b.h. were measured. In all 104 essences were found. The maps prepared showed 15 different types of forest.

The basic results are as follows:

a) In the table below is given a breakdown of the land area according to crown-density:

Crown-density	Percentage of area
Good density	55
Medium density	25
Low density	12
Denuded areas	8

b) The terrain has been classified as follows:

Terrain				Percentage of area
Slope above 50	per	cent		37
Slope 33-50	"	"		35
Slope 0-33	"	"		28

c) Considering all trees above 40 cm d.b.h. the following information can be given:

No. of trees per ha	33
Volume per ha	56 m ³
Percentage of volume usable for sleepers	61
Percentage of volume usable for sawnwood	37

d) The number of trees per 100 ha in different diameter classes are shown below. Only species with more than one tree per ha have been included:

Diameter class, cm	No. of trees per 100 ha
30-40	4,183
40-50	1,855
50-60	813
60-70	370
70+	274

e) Number of trees and volume of different species groups are given in the table below:

Species group ^{1/}	Trees per ha		Volume per ha	
	Diameters included			
	>30	>40	>30 cm	>40 cm
	no./ha		m ³ /ha	
I	2.7	1.9	4.8	4.4
II	30.8	15.0	36.2	26.5
III	31.8	13.2	32.7	21.8
IV	8.6	2.8	6.7	3.7
V	1.1	0.3	0.8	0.4

- ^{1/} Species group I - Highly appreciated woods
 " " II - Woods for cabinet-making, high quality parket, high-class joinery
 " " III - Woods for joinery, parket, sleeper, high-class timber scaffold
 " " IV - Wood for ordinary rotary cutting and slicing, ordinary timber scaffold, box wood, mining timber
 " " V - Other and unknown species

f) All trees above 30 cm d.b.h. gave a ground-area of 11.4 m² (81 m³/ha). If all diameter classes are included the ground-area is roughly double. This relation is reported to be more or less the same in all vegetation types.

B. Haute (Upper) Matsiatra (code B on the map)

This UNDP/FAO inventory covered the plantations of *Pinus patula* in the Haute Matsiatra area. The total area covered was 18,000 ha but of this area only 12,000 ha was forest.

The increment was calculated to be 5-16 m³/ha/year. As a meanvalue 10 m³/ha/year can be accepted.

Result:

Age classes (years)	Area, ha	Volume, m ³ /ha		
		Total o.b.	Industrial u.b. (above 7 cm d.b.h.)	Sawnwood u.b. (above 15 cm d.b.h.)
18	44	122.2	78.0	37.2
17	50	129.2	75.0	31.2
16	0	0	0	0
15	50	97.3	62.6	29.0
14	475	98.3	60.5	32.4
13	856	94.2	57.1	25.5
12	1,325	79.7	45.3	22.0
11	853	98.8	58.2	34.6
10	1,763	121.3	80.1	42.8
9	1,438	113.7	71.6	38.1
8	1,075	103.1	61.9	29.8
7	681	105.6	57.2	18.8
6	1,063	107.0	50.8	7.5
5	1,306	65.2	24.2	2.0
4	781	38.0	10.2	0.5
3	356	28.8	3.7	0
<3 (after 66-67)	19	35.3	12.8	0
Total	12,145	..	..	..

C. Eucalyptus inventory (code C on the map)

This inventory of 180,000 ha was undertaken by UNDP/FAO to decide what volume of Eucalyptus can be transported on the railroad to Tamatave. Only areas near existing railways in the Tananarive area were covered by this inventory. No results available.

D. Morandava inventory (code D on the map)

This UNDP/FAO inventory covered 100,000 ha of dry forest on the west coast. This is a very poor forest with a meanvalue of only 4-5 m³/ha (all trees above 30 cm d.b.h. with bark).

Number of trees/ha (all trees above 30 cm d.b.h. with bark) are shown in the table below:

Species	Trees/ha
Commiphora spp.	5.8
Adansonia digitata	17.2
Other spp.	4.1
Total	27.1

Over 80 per cent of the trees are in the size class d.b.h. 30-40 cm. The final results are not available.

E. Biological inventories

A FAO project has inventoried 25 blocks of 40 ha each. These blocks were situated in all forest types. The blocks were covered by a 10 per cent random sample. In these inventories they enumerated all trees above 20 cm girth.

F. Overall estimates

Utilizing all different sources the recent FAO project estimated the total gross volume of all trees above 30 cm d.b.h. to be 575 million m³.

This total was based on the following estimated figures:

Region	<u>Estimated area, 1000 ha</u>		<u>Estimated gross volume</u>	
	Total	Nonexploited and rather dense	m ³ /ha	Total 1000 m ³
East-north-east < 800 m	2,000	1,500	140	210
East-north-east > 800 m	2,500	2,000	80	160
East-south-east	2,000	1,500	80	120
North-west	1,500	1,000	50	50
West	2,000	1,000	25	25
South	2,000	1,000	10	10
Total	12,000	8,000		575

According to another crude estimate the merchantable log volume may be 36 million m³ of roundwood (only 700,000 ha estimated to be economically exploitable in this estimate).

Accessibility

In the eastern rainforest the terrain has been classified as follows:

Terrain	Steepness %	Percentage of land area
Plateaus	-	10
Plains	0 - 5	5
Undulating	5 - 30	15
Zone with difficult terrain	30 - 70	38
Zone with very difficult terrain	70 - 100	32

The slopes are very steep and extraction is impossible in the rainy season (November - March). It is difficult to improve the accessibility. A distance of 5 km is exploited on each side of the roads.

In the UNDP/SF MAG 8 (FAO) an accessibility classification of the whole eastern rainforest has been completed. This classification was based on aerial photographs.

In connection with Fierenana forest inventory, also in the eastern region, a detailed accessibility classification of 60,000 ha of forests has been made.

In the western forest the topography is not as difficult as in the eastern region.

Ownership

The natural forests are all state-owned. Most of Eucalyptus plantations are privately owned or owned by communities while most of the pine plantations are state-owned.

Exploitation

An estimate gives an area of 2 million ha as having been exploited for logs. The forests remaining unexploited and undegraded have survived because they are inaccessible.

A number of 65 essences are said to be commercial.

In 1971 there was said to be one exploitation of considerable size in the north of the country. All other exploitations are small. Very often pit-sawing is used as the method.

Twenty-five per cent of the exploitation occur in the Moramanga area.

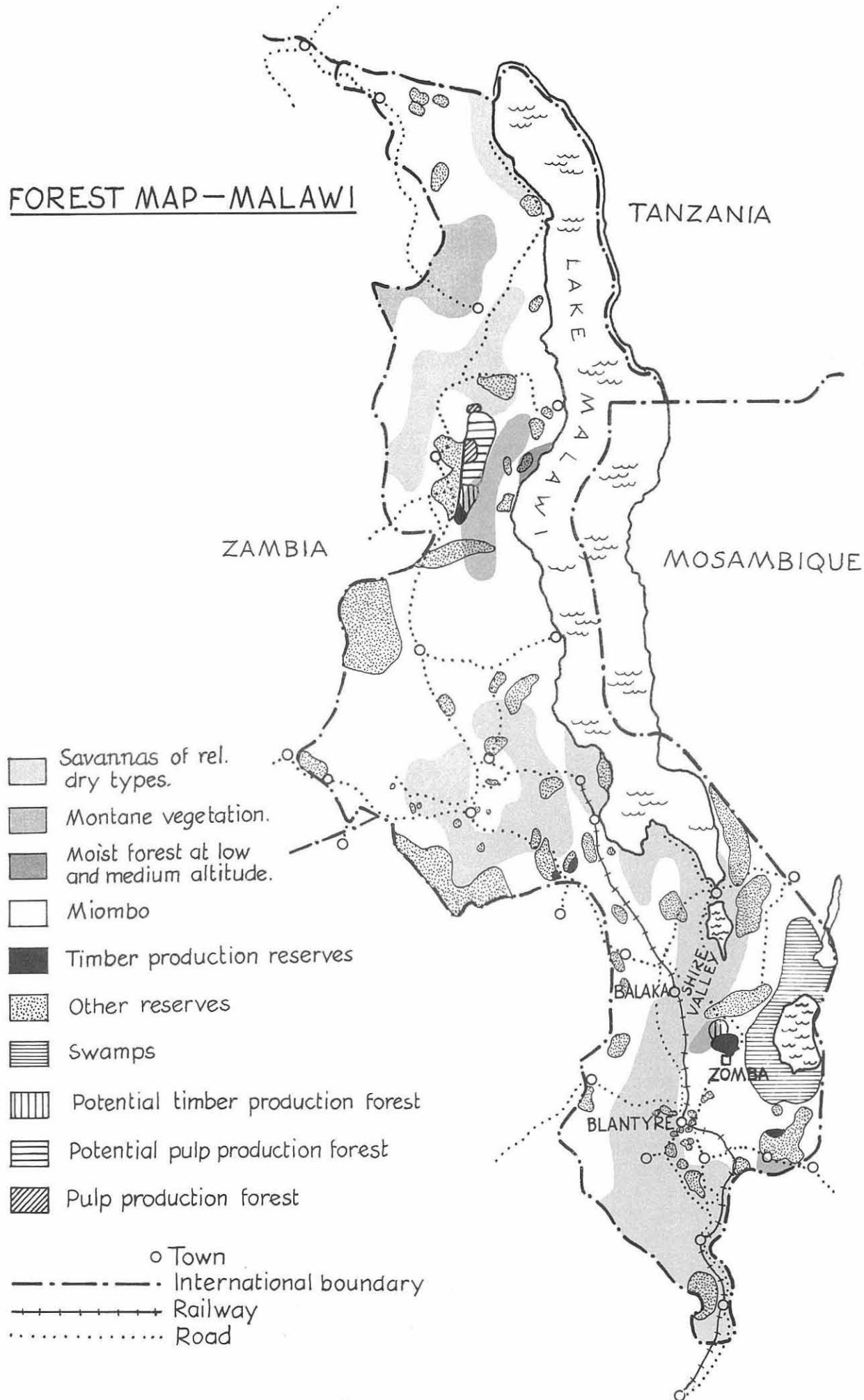
The fellings in man-made forests were in 1969 given as 50,000 m³ (with bark).

M A L A W I

General

Malawi occupies an area of 11.8 million ha. Essentially Malawi is a plateau country of varying height bordering the deep Rift valley which here averages 80 km in width. The northern two-thirds of the Rift valley floor are almost entirely occupied by Lake Malawi with a mean altitude of 470 m above sea-level.

FOREST MAP—MALAWI



The plateau surfaces of the Rift valley lie mainly between 750 and 1,350 m but very much higher elevations are attained, particularly in the north (between 1,500 and 2,400 m) and in the south (between 1,800 m and 3,000 m).

The climate is continental with a large seasonal variation in temperature. There are three climatic seasons. During the cool season, from May to August, there is very little cloud and mean temperatures on the plateau areas are 16 to 18° C. Frost are frequent on the high plateau. In September and October, prior to the rains, a short hot season occurs when humidity is increasing and mean temperatures of 27 to 30° C occur in the Rift valley. Over 90 per cent of the rain falls between November and April, the rainy season. Most of Malawi receives between 500 and 1,200 mm annual rainfall but some areas in the higher plateaus receive over 2,000 mm.

The land use is, according to two different sources, as follows:

Land use	Area, 1000 ha	
	FAO Production Yearbook 1971 ^{1/}	WFI 1970 ^{2/}
Forest and other wooded areas	2,314	7,266
Forest	..	2,192
Open woodlands	..	4,693
Scrub and brushland	..	341
Arable land and land under permanent crops	2,977	
Permanent meadows and pastures	596	1,843
Other area	5,961	359
Total land area	9,408	9,429
Water area	2,440	2,400
Total area	11,848	11,829

1/ Information from 1959

2/ Information from 1966

Natural vegetation

A. Miombo woodlands

This is the dominant wooded cover and occupies in the main the medium altitude plateaus at 1,000 to 1,600 meters above sea-level. It is open woodland savanna with poor saw-log content, the trees being of poor form and height. Little natural regeneration occurs. Composition is very uneven. This type covers approximately 60 per cent of the area. It is characterized by *Brachystegia*, *Isobertinia* and *Julbernardia* species. Dispersal galleries occur in moister areas with species like *Khaya nyasica*, *Adina microcephala* and *Chlorophora excelsa*. Most of these gallery forests have been cut over. Shifting cultivation is common in the Miombo.

B. Pterocarpus-Oxytenanthera woodlands:

This type is of little or no commercial significance. It occurs on the steep escarpments by the Rift valley and covers 15 - 20 per cent of the area. *Oxytenanthera abyssinica* (bambo) said to cover around 10,000 ha.

C. Combretum-Afrormosia-Acacia woodlands:

This type is found on better soils along Lake Malawi and the Shire valley and covers 15 - 20 per cent of the area. On the poorer soils *Colophospermum mopane* occurs in almost pure stands. This latter type is relatively undisturbed by agriculture.

D. Evergreen forests:

They are found in the high mountain zones from 1,500-2,400 m in altitude and include the valuable indigenous conifers *Widringtonia whytei* (Mlanje cedar) and *Juniperus procera* (pencil cedar). There are also mountain forests of hardwoods such as *Entandophragma*, *Chrysophyllum* and *Parinari*. One of the seven existing sawmills is said to utilize indigenous hardwoods such as *Pterocarpus angolensis*, *Entandophragma cordatum*, *Afzelia quanzensis* and an *Albizia* sp. Total input is around 5,000 m³ per year.

One inventory of 10,400 ha in the Balaka-Blyntyre West area in the southern region (excluding the lower river area) gave *Brachystegia* spp. and *Sterculia* spp. as the dominant commercial species (75 per cent of volume).

An area of approximately 2 million ha has been reserved. This is mainly for protection. Methods are being investigated to obtain yields of firewood and poles from the open woodlands.

Man-made forests

On 31 March 1971 the following information was given:

Species	Area, ha	
	Planted 1969-71	Total as at 31.3.1971
<u>Timber plantations</u> ^{1/}		
<i>P. patula</i> , <i>P. taeda</i> , <i>P. elliotii</i> , <i>P. kesiya</i>	2,526	12,950
<i>E. saligna</i> , <i>E. cloeziana</i> , <i>Gmelina</i> <i>arborea</i> , <i>Chlorophora excelsa</i>	257	1,247
Total timber plantations	2,783	14,197
<u>Pulpwood plantations</u> ^{2/}		
<i>P. patula</i> , <i>P. taeda</i>	1,894	21,020
<i>E. saligna</i>	1,673	1,855
Total pulpwood plantations	3,972	22,875
Total planted	6,755	37,072

1/ Locations: Chongoni/Dedza, Zomba Mtn, Blantyre/Lime, Amalika, Bunda, Luwawa

2/ " : Vipya plateau and Chisasira

It is planned to establish 18,500 ha of softwood plantations by the year 2000.

The pulpwood project aims at planting 27,900 by 1980 (21,850 ha pines and 6,050 ha Eucalyptus) which should be sufficient for a pulp mill of 50,000 tons.

Some 4,000 ha of private plantations (Eucalyptus and Gmelina) also exist, mainly belonging to tea and tobacco plantations.

Logging in plantations gives 28,000 m³ of roundwood per year - mainly from thinnings of immature stands. The planned final rotation of pine is 30 years. At the moment there are only limited clear fellings. The maximum production of softwood plantations to be reached in late 1990 will be 140,000 m³.

Other

1) Of the so called "forest area (2.2 million ha) 1.5 million ha is publicly owned, 0.1 ha privately and 0.6 million ha without defined ownership.

2) The crown-density in the "forest" area has been estimated to be as follows:

Crown-density	Area, 1000 ha
Good (1.0 - 0.7)	28 ^{1/}
Medium (0.69 - 0.4)	1,425
Poor (less than 0.4)	145
Temporarily unstocked	-

1/ Including plantations

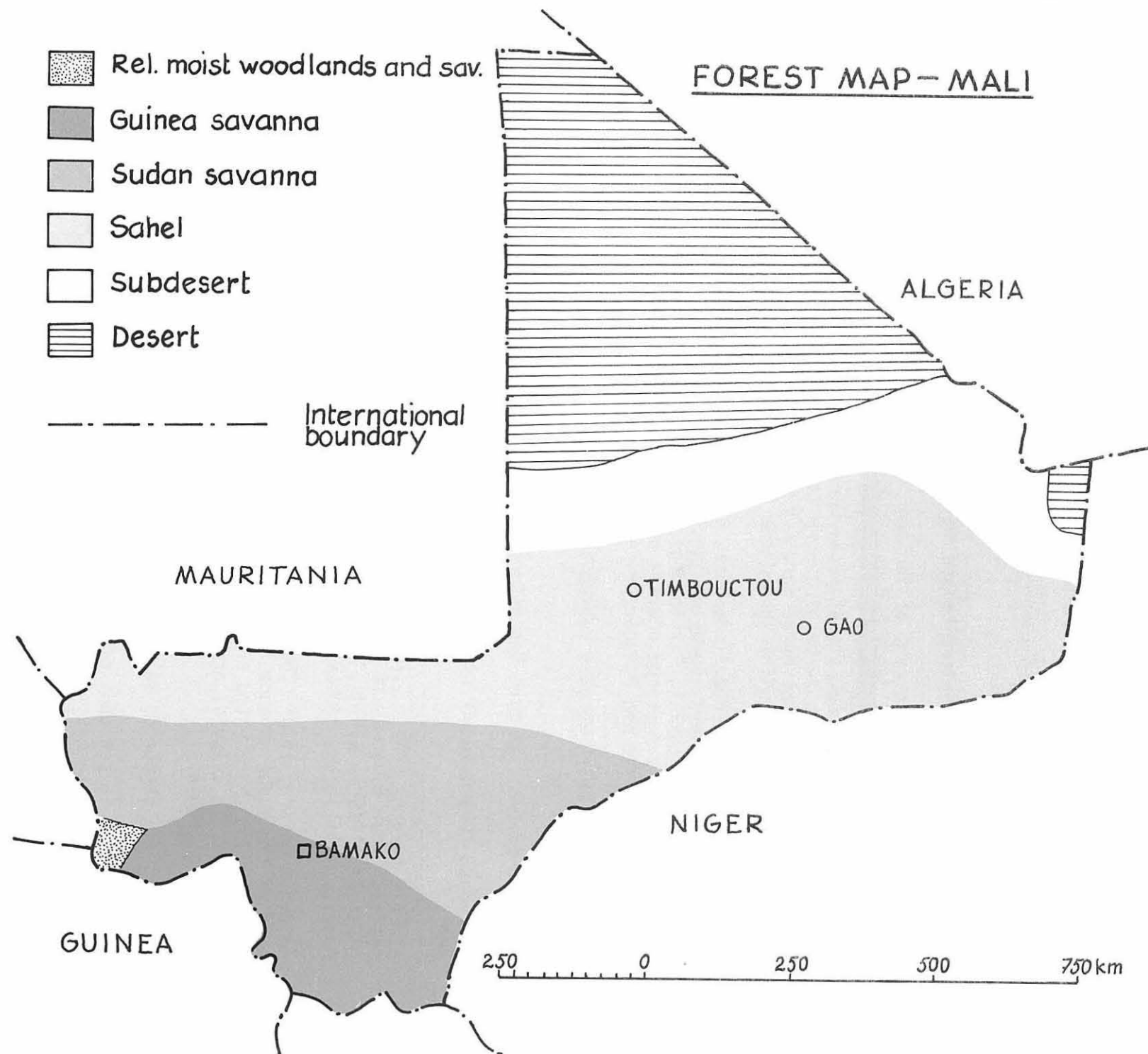
M A L I

General

Mali covers a total area of 124 million ha. There are some mountainous regions in the north-east of the country (640 m above sea-level). The rest of the country is rather flat but there are some erosion escarpments here and there.

- * Mali is everywhere a dry country with a rainy season of seven to eight months and a total rainfall of 1,100 mm at Bamako. At Gao the rainy season is only about two months and the average annual rainfall 230 mm. North of Gao there is only semi-desert or desert, which occupies nearly one half of Mali.

FAO Production Yearbook 1971 gives the following information about land use (information from 1970):



Land use	Area, 1000 ha
Arable land and land under permanent crops	11,600
Permanent meadows and pastures	30,000
Forest land	4,457
Other land	77,543
Total area	124,000

Natural vegetation

A. Guinea savanna (la savane boisée du type aire septentrionale):

This type covers six per cent of the land area in the southern part of the country. It is normally described as a bush vegetation with *Isoberlinia doka*, *Erythrophleum suaveolens* and *Lophira alata*. However, there are areas with dry but dense forest (forêt sèche dense) which could be exploited; These areas are thought to be of a very limited extent. CTFT is going to make a reconnaissance survey of around 6 million ha in this part of the country. Preliminary studies showed the following species:

Khaya senegalensis, *Isoberlinia doka*, *Azizelia africana*, *Pterocarpus erinaceus*, *Daniellia oliveri*, *Cordyla pinnata*, *Burkea africana*, *Prosopis africana*, *Butyrospermum parkii*, *Parkia biglobosa*, *Anogeissus leiocarpus*, *Lophira lanceolata*, *Bombax costatum*, *Carapa procera*, *Erythrophleum suaveolens*, *Ekebergia senegalensis* and *Pseudocedrela kotschy*.

The rainfall, which in this region is above 1,200 mm, comes during 7 - 8 months of the year.

B. Sudan savanna (la zone des savanes parc et herbeuse):

This type covers 27 per cent of the land area (rainfall 500 - 1,200 mm per year).

a) Parc savanna (750 - 1,200 mm rainfall per year). This is said to be the typical Sudan savanna. It is characterized by *Butyrospermum parkii*, *Parkia biglobosa*, *Acacia albida*, *Tamarindus indica*, *Khaya senegalensis*, *Terminalia*, *Adansonia digitata*, *Bombax buonopozense*.

b) Grass savanna (500 - 750 mm rainfall per year) is found in the northern part of the Sudan savanna zone and in the southern zone of "sub-sahel" zone. Bush species represented are *Combretum* spp., *Guiera senegalensis*, *Zizyphus* and *Acacia*. In alluvial areas are found *Acacia sieberiana* and *Borassus aethiopum* (rônier).

C. Sahel (la steppe boisée)

Sahel covers 16 per cent of the area. The yearly rainfall is 200-500 mm. Characteristic bushes: *Acacia tortilis*, *A. hockii*, *A. senegal*, *A. nilotica*, *Zizyphus abyssinica*, *Calotropis procera* and *Hyphaene thebaica*.

D. Tropical subdesert steppe

This type covers 21 per cent of the land area. The yearly rainfall is 50 - 200 mm.

E. Desert

Desert covers 30 per cent of the area.

Man-made forests

Except in the southern part, the present woodlands in Mali allow the use of wood for fuel and building poles only.

The population pressure causes a degradation of the natural vegetation. There is therefore a need for plantations to meet the needs of the local people. There are some plantations of teak around Bamako which sometimes give good results. Other species that have been planted are *Gmelina arborea* and *Anacardium occidentale*. In drier areas it is difficult to find species which grow well. A rainfall of 250 mm may be acceptable for tree growth north of the Sahara but south of the Sahara where the rain falls during the hot season, 600 - 700 mm may be inadequate. At present the area planted may amount to 1,200 ha.

MAURITANIA

General

Mauritania occupies an area of 103 million ha. The relief has a north-east to south-west direction and a series of westward-facing escarpments separate monotonous plateaus. Locally these plateaus have been eroded, so that only isolated peaks remain. The highest peak reach 915 m.

Two-thirds of the country may be classed as "Saharan", with rainfall absent or negligible in most years and always less than 100 mm. Southwards rainfall increases to about 600 mm a year.

According to FAO Production Yearbook 1971 the land use is as follows (information from 1964):

Land use	Area, 1000 ha
Arable land and land under permanent crops	263
Permanent meadows and pastures	39,250
Forest land	15,134
Other land	48,423
Total area	103,070

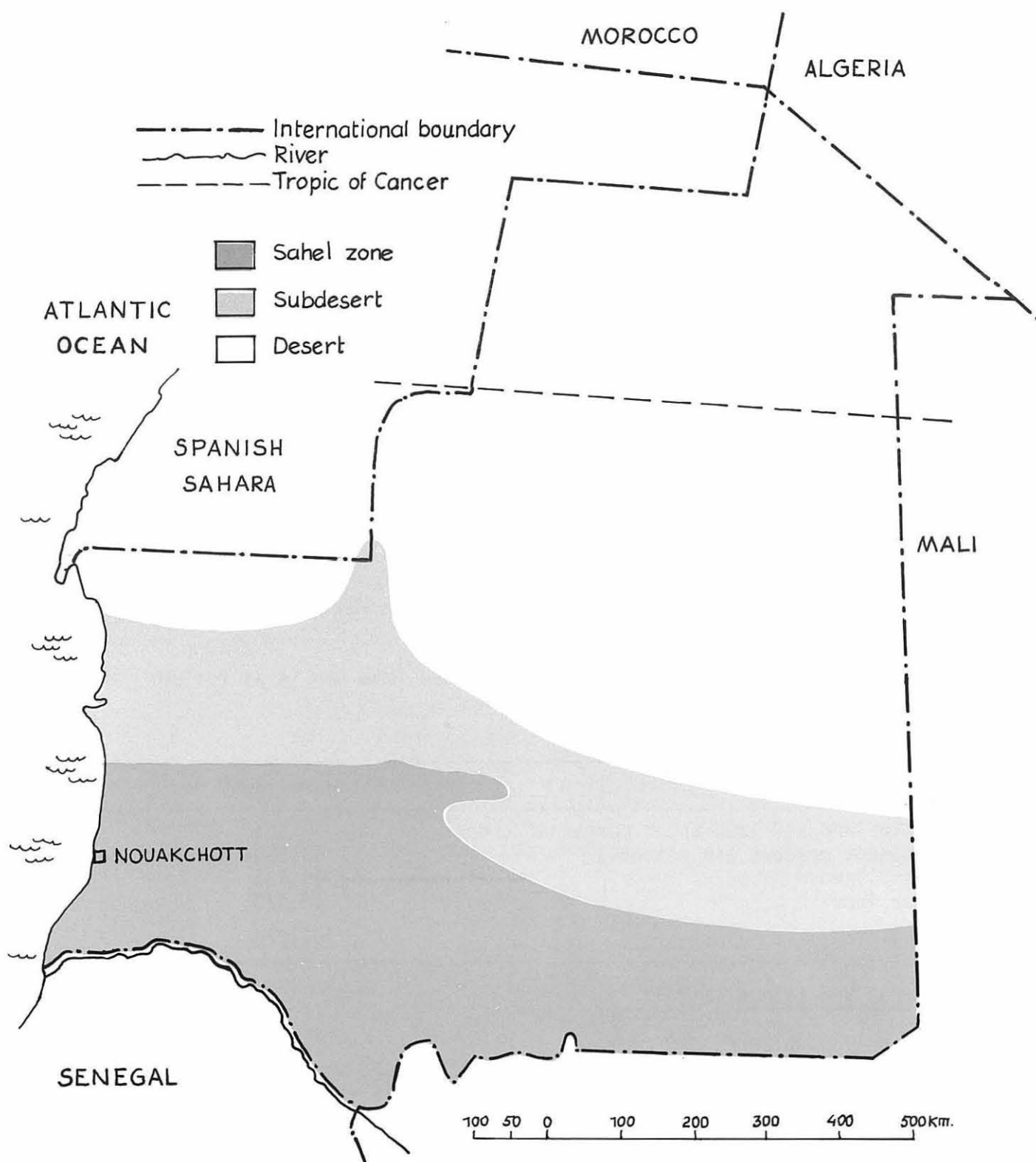
Natural vegetation

A. Sahel-Sudan zone

Rainfall is above 400 mm. This vegetation type is very open but there may be some denser areas along the Senegal river.

The main tree species are *Combretum glutinosum*, *C. elliottii*, *C. aculeatum*, *C. micranthum*, *Terminalia* spp., *Anogeissus leiocarpus*, *Acacia senegal*, *Cordia pinnata*, *Sclerocarya birrea*, *Sterculia setigera* and *Bombax costatum*.

FOREST MAP—MAURITANIA



Acacia senegal is the principal "forest resource" in the country. From this tree 6,500 tons per year of gum are produced. Acacia scorpoides is used for the production of charcoal (2,000 tons/year).

Legally protected species: Khaya senegalensis (cailcédrat), Borassus aethiopum (rônier), Pterocarpus erinaceus, Bombax costatum (kapokier), Acacia al-bida (faidherbia).

B. Sahel zone

Rainfall is 200 - 400 mm per year. Around 50 species of bushes are found. They are grouped in certain associations, sparse, but continuous.

Species: Acacia scorpoides var. pubescens, Tamarix, Salvadora persica, Euphorbia balsamifera, Acacia raddiana, Euphorbia commiphora, Acacia senegal, Balanites aegyptiaca, Acacia hockii, Boscia senegalensis.

C. Sahara zone

Rainfall is 0 - 200 mm per year. No characteristic formations exist and bush and grass species are restricted. They are found where the conditions are more favourable.

Bush species: Acacia raddiana, Acacia hockii, Capparis decidua, Maerua crassifolia, Boscia senegalensis, Euphorbia balsamifera, Tamarix senegalensis, Adenia hongkel, Salvadora persica.

M A U R I T I U S

General

The island of Mauritius lies in the Indian Ocean 800 km east of Madagascar and occupies an area of 186,000 ha. It is volcanic and consists of a plain rising from the north-east to 826 m in the south-west. The plain is broken by abrupt volcanic peaks and gorges. The island is almost completely surrounded by a coral reef.

The climate is subtropical maritime, but with a dry and a moist season.

The warm dry coastal areas contrast with the cool rainy centre.

According to FAO Production Yearbook 1971 the land use is as follows (information from 1970):

Land use	Area, 1000 ha
Arable land and land under permanent crops	105
Permanent meadows and pastures	7
Forest land	59
Other land	15
Total area	186

Natural forests

Very little natural forest remains. Originally the island was covered with forest. At present 30 per cent of the area is under some form of wooded cover. Most of these wooded areas are situated in the south-west of the island.

In 1967 the following breakdown was given (probably of classified forest):

Type of vegetation	Area, 1000 ha
Closed natural tropical evergreen forest	2
Mixed natural forest and secondary exotic scrub	} 25
Predominantly secondary exotic forest scrub	
Used for non-forestry purposes	4

In 1970 an area of 2,000 ha was given as natural closed forest, 7,080 ha as open woodland and an area of 47,760 ha as scrub and brushland (WFI 1970).

The principal aim of the forests in Mauritius is the protection of catchment areas. Productive forestry is a second objective.

Cyclons are very destructive and create great difficulties for forestry. They occur once every 12-15 years.

Man-made forests

There is an area of around 7,000 ha with exotic plantations. The main part of these are state-owned.

About one half of the total plantation area consists of conifers (*Pinus elliotii*, *P. taeda*, *Cryptomeria japonica* etc.), the remainder largely of *Eucalyptus* (*E. robusta*, *E. kirtoniana* etc.).

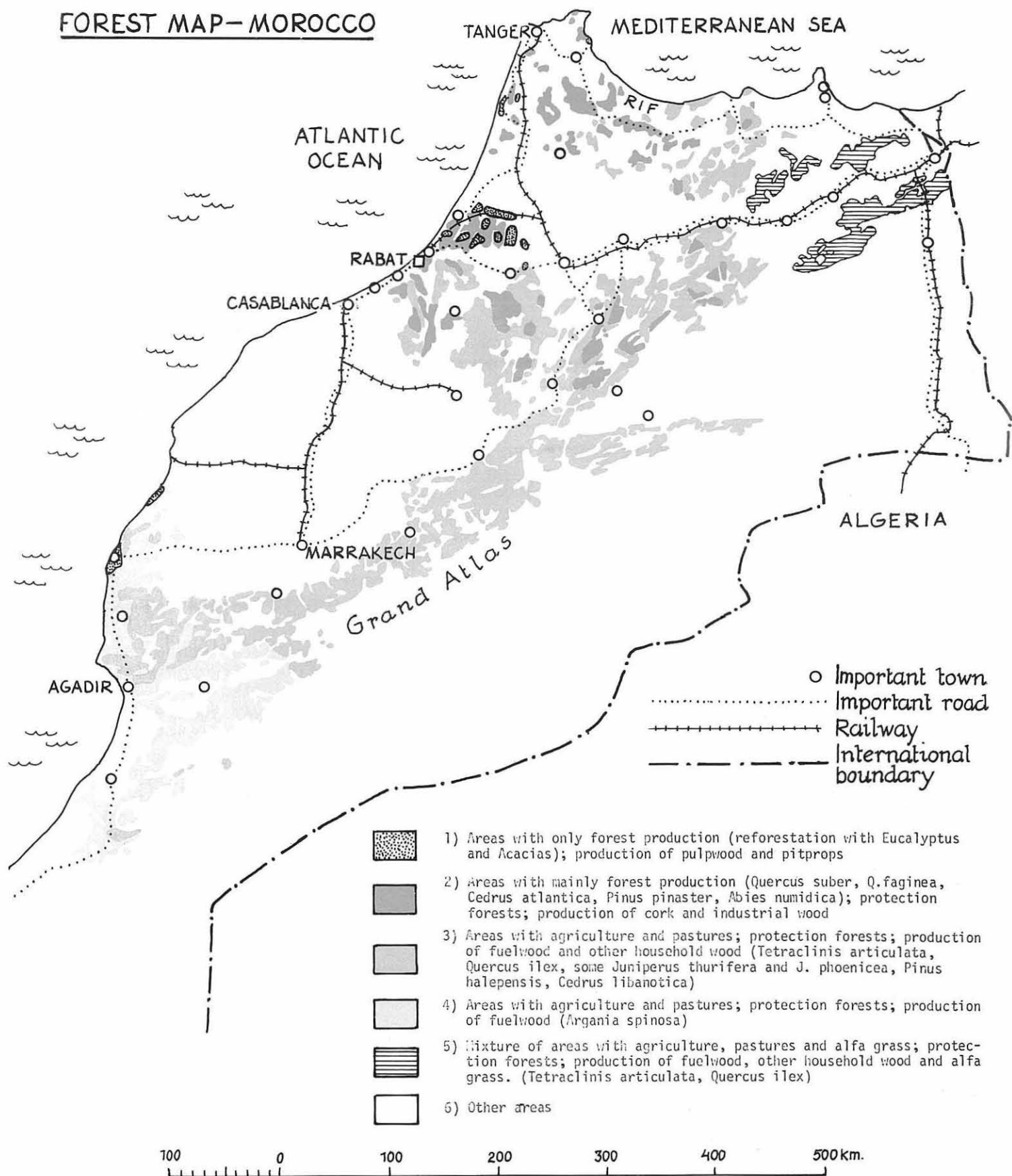
M O R O C C O

General

Morocco covering an area of 44.5 million ha is situated on the extreme west of North Africa bounded by both the Mediterranean and the Atlantic Ocean. The high mountain chain Grand Atlas crosses the country south-west to north-east with altitudes up to above 4,000 m and meets the Rif mountains which follow the coastline of the Mediterranean. Between this big mountain barrier and the Atlantic coast a vast plain, with some valleys constitutes the richest agricultural region of the country.

The Atlas mountains divide the country into two different climatic zones: Western Morocco with temperate and high humidity at the coast but drier inland; the east with severe, very arid climate which creates almost desert-like conditions. The rate of rainfall varies from one year to the next and between regions but generally the summer months are very dry and there are considerable rainfalls in the winter.

FOREST MAP—MOROCCO



FAO Production Yearbook 1971 gives the following information about land use (information from 1966):

Land use	Area, 1000 ha
Arable land and land under permanent crops	7,900
Permanent meadows and pastures	7,650
Forest land	5,359
Other land	23,596
Total area	44,505

The natural forests

The so-called forest area is said to cover around 5 million ha. The World Forest Inventory, 1970, gives for instance 5.16 million ha as Forest and other wooded areas of which 4.41 million ha is given as forest with a crown-cover of more than 20 per cent.

With the exception of certain areas on the plains between Tanger and Casa-blanca the forests are found in the mountains. Even the lowest figure given above includes considerable areas of very poor forest. Boudy (1958) estimated exploitable forest as covering 2.53 million ha, the rest being protection forest, inaccessible and so on. Much of the exploitable forest consists of species with very slow growth and wood usable only for fuel.

In another report, productive forests are given as 1.6 million ha protective forests as 3.4 million ha.

Detailed breakdowns of the forest area by species are given in a number of documents. These breakdowns, however, vary widely, the area said to be occupied by a species differing in some cases by as much as 100 per cent from one publication to another. This is probably partly because species mixtures are variously treated, partly because the distinction between maquis and forest is differently defined.

Below are given the latest breakdown that have been found. This can be taken as an example of the importance of different species.

Species	Area, 1000 ha
Quercus ilex	1,430
Quercus suber	425
Q. tozae, Q. afares, Q. faginea, Q. lusitanica	25
Argania spinosa	740
Acacia spp.	75
Cedrus atlantica	140
Tetraclinis articulata	950
Juniperus spp.	240
Cupressus	6
Pinus spp.	80
Abies numidica	6
Other species	25
Maquis	58
Total	5,000

The forest area (or area of forest and other wooded areas) has recently been classified into interest groups. The results are given in the table below:

Interest group	Species	Area, 1000 ha
Class 1 - low interest	<u>Broadleaved</u>	
	Argania spinosa	740
	Quercus ilex	715
	Acacia spp.	75
	Other spp.	25
	Maquis	740
	<u>Coniferous</u>	
	Juniperus	240
	Cupressus	6
	Sub-total	2,541
Class 2 - mean interest	<u>Broadleaved</u>	
	Quercus ilex	715
	" suber	210
	" faginea	25
	<u>Coniferous</u>	
	Tetraclinis articulata	950
	Other spp.	6
	Sub-total	1,906
Class 3 - strong interest	<u>Broadleaved</u>	
	Quercus ilex	215
	<u>Coniferous</u>	
	Cedrus atlantica	140
	Pinus spp.	80
	Sub-total	435
Class 4.5 and 6 -	<u>Man-made forests</u>	
	Eucalyptus	178
	Pinus spp.	83
	Sub-total	261
	Grand total	5,143

Important species:

In 1965 the following descriptions of the most important species were given (second hand information, source unknown). This description has been modified somewhat as a result of correspondence with the Moroccan Forest Service in 1972.

Cedar (*C. atlantica*) is the most valuable species present producing excellent sawtimber. It covers over 100,000 ha in northern Morocco, mainly on the higher slopes of the Middle Atlas. The forests are seriously over-mature. Natural regeneration is very difficult, and artificial regeneration or replacement by other species still meets some difficulties. Consequently, exploitation is considerably lower than increment. Boudy (1958) gave 100,000 - 120,000 m³ for annual increment from 1950 to 1955. Boudy estimated at 13 million m³ the volume of mature and over-mature cedar in Morocco. A recent estimate (1972) gives the gross volume as below 11 million m³ of which as a maximum 8 million m³ is mature. Most of the forest is regarded as exploitable.

Tetraclinis articulata, (called thuya in French), is the other main indigenous conifer. It is a highly tenacious species, surviving in very difficult country. It covers about 900,000 ha in Morocco, but most of this is rather maquis than forest, and the species may be regarded as chiefly valuable for protection. The same may be said of the other Cupressaceae in Morocco, several species of Juniper, which cover between 200,000 and 300,000 ha.

Pine species (*P. pinaster* and *P. halepensis*) cover about 70,000 ha chiefly in the north of the country. *P. halepensis* occurs also in the High Atlas. The forests are at lower altitudes and in flatter terrain than those of cedar. *P. pinaster* produces some sawtimber but forms a relatively small part of the pine forests. *P. halepensis* is utilized for sleepers, pitprops, transmission poles and boxwood. Regeneration is very easy, but increment is low, and it may be that some of these forests would best be replaced by faster-growing species.

Holm oak, (*Quercus ilex*) is by far the most widespread hardwood and with about 1.4 million ha makes up between one third and one quarter of Morocco's forests. Like *Tetraclinis* it is a very resistant species with a capacity to regenerate by coppicing even when it is over-exploited and badly managed. Unfortunately it has few uses and serves mainly for fuelwood and charcoal. It is said to be usable also for sleepers and pitprops, but does not appear to be so used at present.

Cork oak (*Quercus suber*) covers between 350,000 and 450,000 ha partly in mixture with other oaks. Only 200,000 ha carry more than 100 stems/ha, said to be the lower limit of exploitability. Cork is still the main source of forest revenue, in spite of declining prices and contracting markets. The Moroccan cork forests have been steadily improving both their quality and their quantity of production under the good management of recent decades. Most of the cork oak forests are situated in low-lying country around Rabat so that they are of easy access and close to centres of industry and commerce. There has been considerable replacement of poor cork oak forest by *Eucalyptus* spp. and by pines (*P. halepensis*, *P. pinaster*) and as transition by *Acacia mearnsii*.

Other oaks (*Q. tozae*, *Q. afares*, *Q. faginea*, *Q. lusitanica*) cover about 25,000 ha, and the two last named species produce some sawtimber.

Argania spinosa covers more than 700,000 ha in south-west. It is mainly of local interest, providing goat fodder, edible oil and fuelwood for the inhabitants of the area. This is a protection forest. Its destruction would lead to desertification.

Other hardwoods make up the remainder of Morocco's forest, mainly maquis and steppe. They are of no great significance for production but certain

species might be useful for erosion control schemes.

The natural forests of Morocco are thus, for the most part, poor yielders of industrial forest products with the important exception of cedar and cork oak. Cedar constitutes large reserves of sawtimber, utilization of which would need a change of policy. Present policy is to accept the indigenous species and seek to regenerate them naturally. No rapid departure from this tradition is possible in so erosion-prone a country.

The description given above indicates that there exists around 400,000 ha of valuable forests in Morocco. The remaining part of the forest mainly has its value as a producer of fuelwood, poles and for protection.

Man-made forests

Species distribution in plantations (31 March 1971)

Species	Area, ha
Eucalyptus camaldulensis	82,835
Eucalyptus gomphocephala	61,997
Other Eucalyptus	23,938
Total Eucalyptus	168,770
Other broadleaved	21,659
Total broadleaved	190,429
Pinus halepensis	70,995
Other coniferous	32,841
Total coniferous	103,836
Total plantations	294,265

The ownership of the plantations is as follows:

Ownership	Area, ha
State plantations	194,689
Private plantations	45,757
Plantations in collectively owned areas	53,819

The plans for plantations during the last years are as follows (it is not known if these goals have been reached):

Year	Area, ha
1968	24,020
1969	25,130
1970	26,290
1971	27,450
1972	29,610

In coming years (1968-2000) it is planned to plant the following areas:

Species	Area to be planted 1968-2000, 1000 ha
Conifers	540
Broadleaved	115
Others	7
Total	662

Inventories

An area of 15,000 ha has been reported to be covered by an intensive inventory and 60,000 ha to be covered by an extensive inventory (WFI 1970, Africa). Morocco plans to undertake, with Danish assistance, an inventory of all forests (this project may have been delayed).

In 1972 the Forest Service gave the following preliminary estimate about standing timber:

Species	Standing timber ^{1/} , million m ³
Cedar	11
Pines	4
Eucalyptus	8
Others	130
Total	153

1/ All species, all diameters, bark included.

Grazing

Grazing is a major ecological feature restricting the number of species that can be established in North Africa. The main species in Morocco, *Quercus ilex*, *Tetraclinis articulata*, *Argania spinosa* are those which can most easily regenerate under heavy browsing. More intensive forestry can only be developed in areas where grazing is excluded.

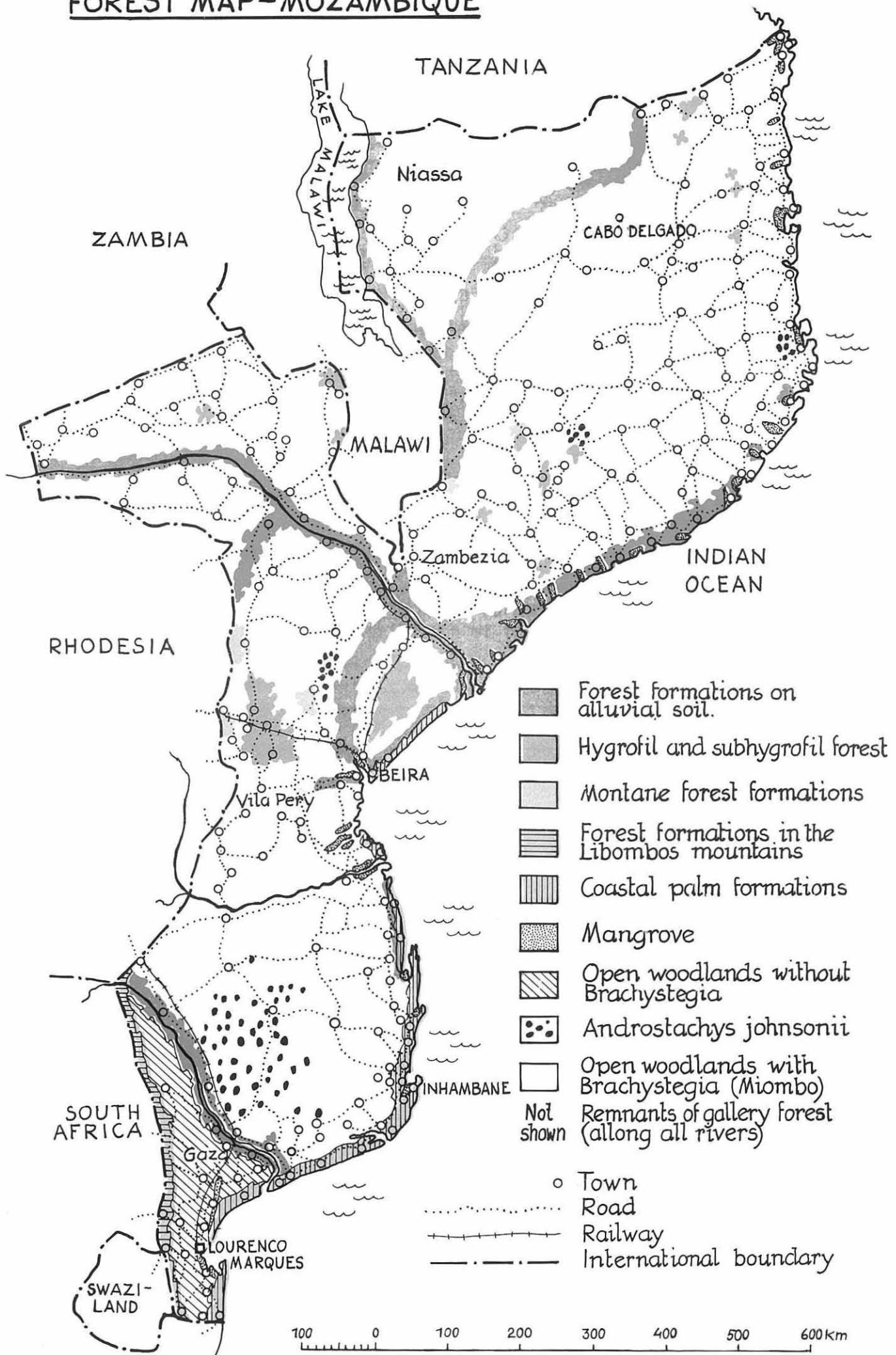
M O Z A M B I Q U E

General

Mozambique has an area of 78.3 million ha. With the exception of the zone towards the western border, it is generally a low-lying plateau of moderate height descending through a sub-plateau zone to the Indian Ocean. The coastal lowland is narrow in the north but widens considerably as it goes south, so that terrain less than 200 m makes up about 40 per cent of the total Mozambican area. The main peak in the western highland areas reach 2,436 m. Mozambique is crossed by at least 25 main rivers which all flow to the Indian Ocean.

Mozambique has a wet and a dry season. The wet season has monthly averages between 26 and 29° C with cooler temperatures in the interior uplands. The

FOREST MAP-MOZAMBIQUE



dry cooler season has June and July temperatures of 18 to 20° C in the southern coast region.

The annual rainfall varies between 300 mm in parts of the southern region, and 2,000 mm at high altitudes in the central region.

FAO Production Yearbook 1971 gives the following estimates about land use (information from 1966):

Land use	Area, 1000 ha
Arable land and land under permanent crops	2,700
Permanent meadows and pastures	44,000
Forest land	19,400
Other land	12,203
Total area	78,303

Natural forest land

Of the total area about four-fifths is covered by tree cover. The vegetation is distributed among the following types (information from 1963):

Land use	Area, 1000 ha
Closed rainforest	-
Moist semi-deciduous forest	trace
Miombo woodland	60,000
Mopane and Adansonia woodlands	5,000
Riparian and Mangrove forest	1,500
Total	66,500

As can be seen above, closed rainforest does not occur. Moist evergreen submontane forest is said to occur in very restricted localities (perhaps 50,000 ha). More than 76 per cent of the province is covered by semi-deciduous Miombo woodland of the *Brachystegia-Julbernardia* type. Within it, especially in the Beira and Vila Pery district, the main commercial tree species are: *Pterocarpus angolensis*, *Khaya nyasica*, *Chlorophora excelsa*, *Azelia quanzensis*, *Albizia versicolor*, *Millettia stuhlmannii*, *Erythrophleum suaveolens*, *Burkea africana*, *Amblygonocarpus andongensis*.

The most important forest formations are the hygrophil and subhygrophil forests in the Beira, Vila Pery, Cabo Delgado and Zambézia districts.

Inventories

Some inventories have been undertaken in Mozambique and some are being undertaken at present. No information is available.

Man-made forests

In December 1971 the following plantations were reported:

Type of plantation	Area, ha
Productive forests	17,079
Arboreta	813
Sand dune fixation	3,424
Total	21,316

Some private plantations are also found mainly in the Vila Pery and Zambézia districts. There, about 1,000 ha are reported to exist.

Major planting areas:

a) Lourenço Marques Districts

Namaacha	857 ha
Marracuene	690 "
Salamanga	661 "

b) Vila Pery District

Penhalonga	2,851 ha
Messambuzi	7,020 "

c) Niassa District

5,000 ha in four different areas

d) Sand dune fixation

Zambézia district	311 ha
Inhambane district	410 "
Gaza district	2,672 "

The main species planted are *Pinus patula* (80 to 90 per cent), *P. caribaea*, *P. elliottii* and *Eucalyptus saligna*. For sand dune fixation *Casuarina equisetifolia* is mainly used but some *Azalia guanzensis* is also used.

Exploitation

The total area covered by concessions is 800,839 ha. The concessions vary in size from 100 (one hundred ha) to 55,950 ha.

It should be mentioned here that all forests are state-owned.

The species mainly exploited are the following:

<i>Azalia guanzensis</i>	<i>Cassipourea gummiflua</i>
<i>Chlorophora excelsa</i>	<i>Cordia africana</i>
<i>Dalbergia melanoxylon</i>	<i>Erythrophleum suaveolens</i>
<i>Milettia stuhlmannii</i>	<i>Funtimia latifolia</i>
<i>Pterocarpus angolensis</i>	<i>Heritiera littoralis</i>
<i>Albizia versicolor</i>	<i>Julbernardia globiflora</i>
<i>Khaya nyasica</i>	<i>Newtonia buchananii</i>
<i>Morus lactea</i>	<i>Pericopsis angolensis</i>
<i>Acacia nigrescens</i>	<i>Pteleopsis myrtifolia</i>
<i>Adina microcephala</i>	<i>Sclerocarya caffra</i>
<i>Albizia adianthifolia</i>	<i>Swartzia madagascariensis</i>

Amblygonocarpus andongensis
Androstachys johnsonii
Balanites wilsoniana
Bombax rhodognaphalon
Brachystegia spp.
Burkea africana

Syzygium guineense
Guibourtia coleosperma
G. conjugata
Sterculia africana
S. quinqueloba
Uapaca kirkiana

N A M I B I A

General

Namibia (South West Africa) covers an area of 82.4 million ha. A plain varying in width from 60 to 160 km extends 1,600 km along the Atlantic coast. This is the Namib desert where mean annual rainfall is less than 100 mm. Behind the coastal plain an escarpment rises to the plateau which forms the rest of the country. It has an average elevation of 1,100 m above sea level but towards the centre of the country there is a rise to altitudes between 1,500 and 2,400 m. A number of mountains rise above the general surface throughout the plateau.

Temperatures of the coastal areas are modified by the cool Benguela current whilst altitude modifies plateau temperatures. Mean annual rainfall over the plateau increases northwards from less than 100 mm on the southern border to over 500 mm in the north-east.

FAO Production Yearbook 1971 gives the following information about land use (information from 1960):

Land use	Area, 1000 ha
Arable land and land under permanent crops	642
Permanent meadows and pastures	52,906
Forest land	10,427
Other land	18,454
Total land	82,429

Natural vegetation

The whole coastal area is covered by desert or sub-desert types. The southern part of the inland plateau is covered with wooded steppe with *Acacia* and *Commiphora* species.

The absolute northern part of the country (Owamboland) is covered with relatively dense woodlands. The characteristic species is *Colophospermum mopane*.

There are practically no plantations.

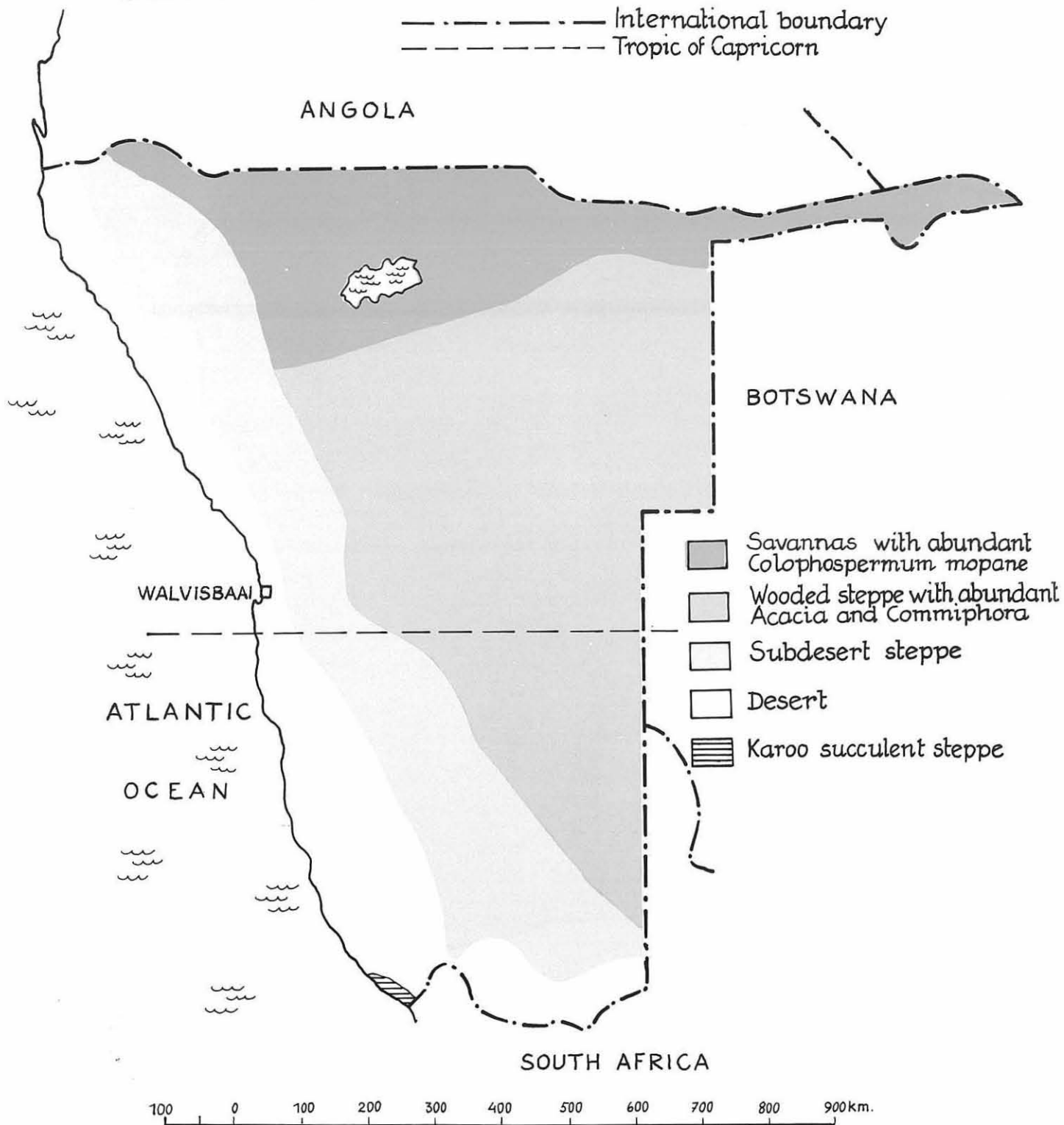
N I G E R

General

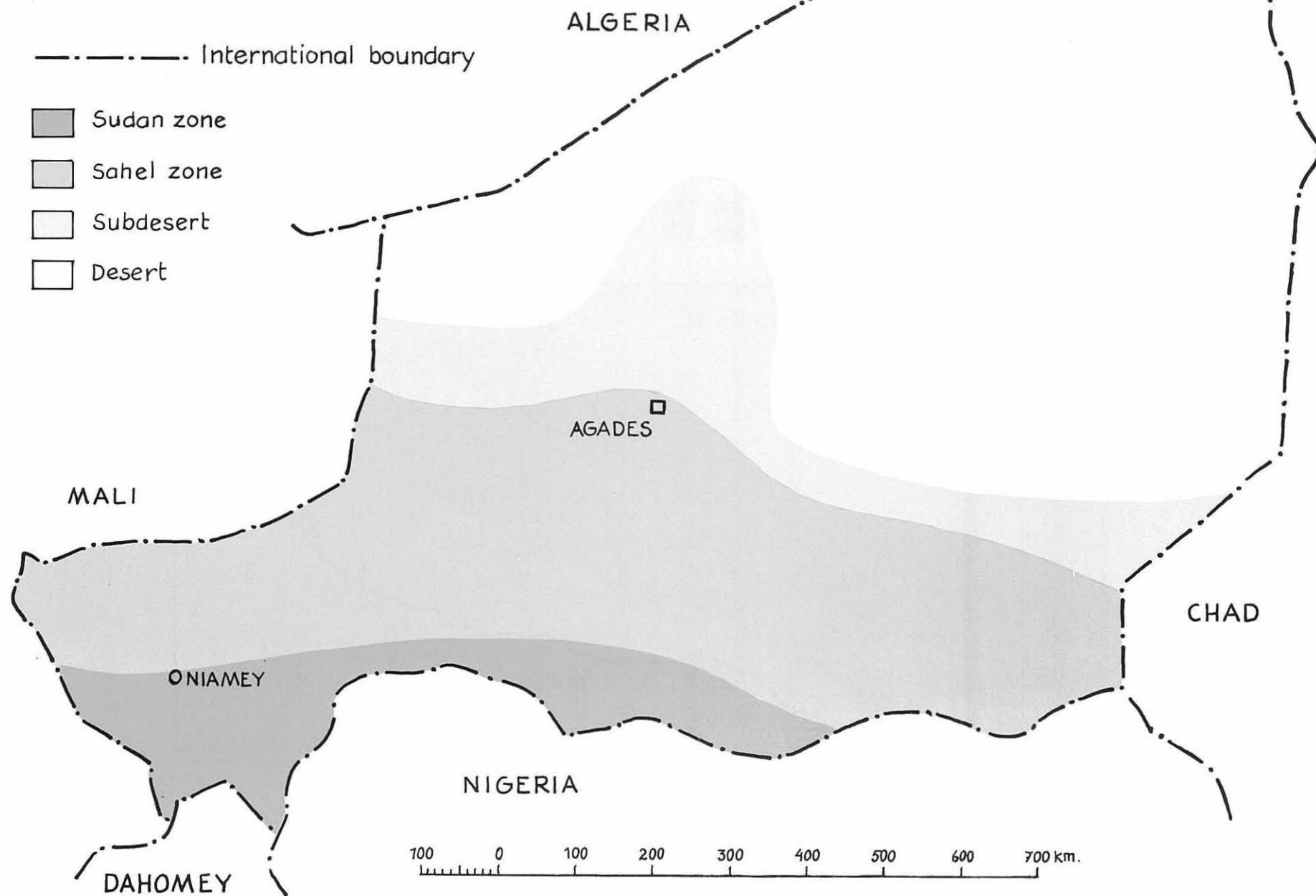
Niger has a total area of 126.7 million ha. The country consists of a plain for the most parts. Two-thirds of the country is desert, most of the north-

FOREST MAP - NAMIBIA

— · — · — · — · — International boundary
 - - - - - Tropic of Capricorn



FOREST MAP-NIGER



east being uninhabitable. In the north-centre is the partly volcanic Air Massif. This area receives, on average, no more than 180 mm of annual rainfall, and that in only two months. South, along the Nigerian border, are sandy areas where there is a rainfall of some 560 mm. In the south-west is the seasonally flooded Niger valley.

According to FAO Production Yearbook 1971 the land use is as follows (information from 1969):

Land use	Area, 1000 ha
Arable land and land under permanent crops	12,177
Permanent meadows and pastures	2,900
Forest land ^{1/}	51,600
Other land	96,023
Total area	126,700

1/ Of which 15 million ha are used also for grazing.

Natural vegetation

The northern half of Niger is covered by desert and tropical sub-desert steppe. The remaining part of the country is mainly covered with wooded steppe (Sahel). On the southern frontier with Nigeria some woodlands of Sudan type are found.

With the present population there is not enough fuelwood in most areas. The natural vegetation becomes degraded. Trials are therefore going on to find suitable species for planting. The dry climate makes this very difficult; for instance, Eucalyptus does not grow well. Dalbergia sissoo has, on the other hand, given interesting results.

CTFT has done an inventory to study the resource of rônier (Borassus aethiopum).

N I G E R I A










General

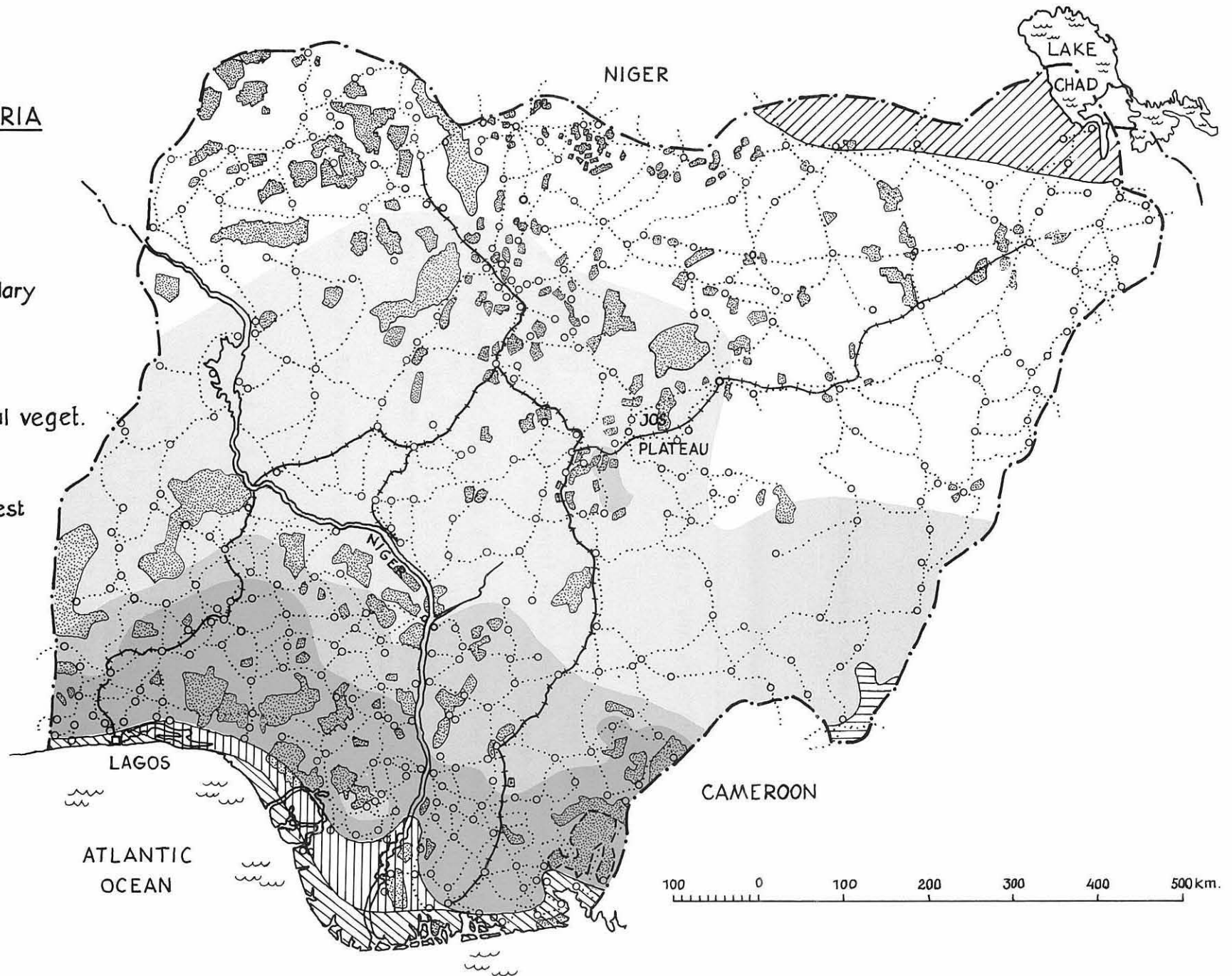
Nigeria has a total area of 92.4 million ha. In the south a coastal belt of sandy beach ridges, coastal creeks and lagoons up to 90 km wide, flanks an area of mangrove and swamp comprising the Niger delta (1 million ha). The highest lands are along the eastern border and rise to 2,040 m at Vogel Peak. Much of the highland is greatly dissected. The Jos Plateau is situated close to the centre of the country and with an average level of some 1,200 m. Away from the plateau the land drops steadily northwards but never below 300 m except in river valleys. To the south-west across the Niger river similar relief is represented in the Yoruba highlands. Elsewhere in the country, lowlands of less than 300 m predominate. The lowlands are gently undulating being dissected by innumerable streams and rivers flowing in broad sandy valleys.

Nigeria has a climate which is characterized by relatively high temperature throughout the year. The average annual temperatures varies from 22-35° C

FOREST MAP—NIGERIA

- Town
- International boundary
- +++++ Railroad
- Inventoried areas
- Road

-  Mangrove and coastal veget.
-  Freshwater swamp
-  Dry lowland rainforest
-  Derived savanna
-  Guinea savanna
-  Sudan savanna
-  Sahel savanna
-  Mountain forest and grassland
-  Forest reserves



in the north and from 18-31° C in the south. The annual rainfall decreases from 3,750 mm along the south-eastern coast to 400 mm in the north-east of the country. The length of the rainy season also shows a similar decrease from nearly twelve months in the south to under five months in the north.

According to two different sources the land use pattern is as follows:

Land use	Area, 1000 ha	
	FAO Production ^{1/} Yearbook 1971	WFI 1970 ^{2/}
Forest and other wooded areas:	31,592	67,125
Forest ^{3/}	..	31,339
Open woodland	..	35,780
Scrub and brushland	..	..
Arable land and land under permanent crops	21,795	24,605
Permanent meadows and pastures	25,800	
Other land	13,190	647
Total land area	..	92,377
Water area	..	..
Total area	92,377	92,377

1/ Information from 1961

2/ Information from 1957-1959

3/ Includes any land suitable for the practice of forestry but excludes farm land or land on which agriculture is practised and other non-forested land.

Vegetation types

A. Mangrove

Mangrove is found along the coast. Considerable areas are said to remain. About 48,000 ha of mangrove is included in Forest reserves. According to one source two per cent of the land area should be (or has been) covered by mangrove.

B. Closed forest zone

The volume of commercial species is considered to be low. For the closed forest zone as a whole there is estimated to be 10-25 m³/ha of commercial species. Around 600 species attain a height of at least 12 m or a d.b.h. of 10 cm. Only around 40 of these are utilized at present but 100 of them could be utilized.

The forests are evergreen in the south while their northern limit merge imperceptibly into a semi-deciduous type. In Nigeria the rainforest seems to be the most luxuriant of the two types.

C. The savanna zone

In this zone fuelwood represents the major wood product. Savanna areas also

contain timber tree species that are short-boled. In the savanna zone, 7,710,000 ha have been gazetted as Forest reserves.

Forest areas

Due to the strong influence of man in the closed forest region in Nigeria it is very difficult to estimate how much forest really remains. In the future probably only the reserved forests will remain. In the closed forest region these reserves cover around 1.9 (or 3.9) million ha.

For the whole of Nigeria the area of Forest reserves is as follows according to the most authoritative and recent source.

State	Area of Forest reserves, ha (in 1970)			
	High forest	Savanna	Plantation	Total
North-east	54,850	1,709,109	2,560	1,766,600
Kwara	488,450	1,004,430	1,160	1,494,040
B/Plateau	163,380	610,280	5,130	778,790
North-west	18,460	2,405,660	1,450	2,425,570
Mid-west	562,120	72,020	31,310	665,450
West	592,060	705,870	14,370	1,317,300
Rivers	1,366,070	-	30	1,366,100
East-Central	23,310	14,250	5,440	43,000
North-Central	12,250	949,940	2,150	964,610
Lagos	2,070	-	30	2,100
South-east	648,590	2,770	3,750	655,110
Kano	-	235,390	2,250	237,640
Total	3,936,880	7,709,800	69,630	11,716,310

Another estimate gave the following information as to the areas of closed forest:

Region	Closed forest area, 1000 ha		
	Forest reserves	Non-reserved (estimated)	Total
Western	597	1,200	1,797
Mid-western	500	520	1,020
Eastern	645	260	905
Northern	136	520	656
Total	1,878	2,500	4,378

The difference in the area of Forest reserves between these two tables may be caused by a difference in the meaning of "Forest reserve" or the creation of a considerable amount of new reserves during the last years (1.9 million ha of closed forest is normally said to be reserved).

Inventories

A number of enumerations for management plans have been undertaken in Nigeria

(area covered 1.48 million ha) but only a few selected species have then been enumerated. The results are said to be unsuitable for any statistical analysis.

In the South-east State an area of 400,000 ha near the Cameroon border has been inventoried.

Summary of this inventory:

Over 150 hardwood species were enumerated. Total volume above 15 cm d.b.h. is 74 million m³. Of this volume 30 per cent is considered to be commercial at present. Seventy per cent of the species are of unknown potential. The eight most important species occupy nine per cent of the volume of trees above 33 cm d.b.h.

The same inventory gave 27 m³/ha of commercial species below 70 cm d.b.h. and 42 m³/ha above 70 cm d.b.h.

A forest inventory of the high forest areas of the south has been planned for the period 1971-1985; and preliminary work on the project has already begun.

Total volume of at present commercial species in the whole country has been estimated at 71 million m³.

Man-made forests

The species distribution at the end of 1967 were as follows:

Species	Area, ha
Pines	12
Other coniferous	10
Eucalyptus	3,480
Teak	7,490
Other broadleaved	24,600
Total	35,600

In 1970 the area planted was given as 69,630 ha.

In the high forest zone: 54,930 ha

In the high savanna zone: 14,700 "

In 1970 an area of 6,400 ha was planted. In 1971 the plans were for 16,600 ha and during the period 1970-1974 (five-year plan) 56,500 ha was the goal.

Whether the plans can be (or have been) effected or not depends completely on the budgetary situation.

Some private fuelwood plantations also exist.

The following species have been successfully used in plantations: *Lovoa trichilioides*, *Nauclea diderrichii*, *Terminalia ivorensis*, *T. superba*, *Triplachiton scleroxylon*, *Tectona grandis*, *Pinus* spp., *Eucalyptus* spp., *Acacia nilotica*, *Melia indica*, *Dalbergia sissoo*, *Gmelina arborea* and *Cedrela mexicana*.

Shifting cultivation

Shifting cultivation is practiced widely all over the country. Due to the heavy population pressure the rotation period is shortening. In the western part of the eastern States (mostly East-Central) it is estimated to be as short as 4 years.

Exploitation

Most of the Forest reserves in the closed forest zone are under concessions. At present a large amount of the exploitation comes from non-reserved forests. It is sometimes estimated to be 50 per cent. Exploitation has been going on for 100 years and most parts of the accessible forests have been creamed. One estimate is that only 30 per cent of the forests are unexploited. The stock of known valuable species has decreased. Firms are usually located in the high forest areas of the south. As the more accessible forests become exploited the firms move gradually towards the north.

The main species for export are *Triplochiton scleroxylon* (obeche) 46 per cent, *Gossweilerodendron balsamiferum* 13 per cent, *Mitragyna* 9 per cent, *Entandophragma cylindricum* (Sapelli) 5 per cent, *Azelia africana* 5 per cent and *Mansonia altissima* 5 per cent. Other commercial species are:

<i>Chlorophora excelsa</i>	<i>Berlinia</i> spp.
<i>Afrormosia elata</i>	<i>Diospyros</i> spp.
<i>Khaya</i> spp.	<i>Erythrophleum</i> spp.
<i>Entandophragma</i> spp.	<i>Pterocarpus</i> spp.
<i>Nauclea diderrichii</i>	<i>Pycnanthus angolensis</i>
<i>Guarea</i> spp.	<i>Ricinodendron africanum</i>
<i>Nesogordonia papaverifera</i>	<i>Scotellia coriacea</i>
<i>Terminalia ivorensis</i>	<i>Sterculia</i> spp.
<i>Distemonanthus benthamianus</i>	<i>Ceiba pentandra</i>
<i>Brachystegia</i> spp.	<i>Celtis</i> spp.
<i>Canarium schweinfurthii</i>	<i>Cordia platythyrsa</i>
<i>Cylicodiscus gabonensis</i>	<i>Lourea trichilioides</i>
<i>Daniellia ogea</i>	<i>Mimusops</i> spp.
<i>Lophira alata</i>	<i>Oxystigma oxyphyllum</i>
<i>Terminalia superba</i>	<i>Piptadeniastrum africanum</i>
<i>Alstonia</i> spp.	<i>Pterygota macrocarpa</i>
<i>Antiaris toxicaria</i>	

The natural forests will probably be exhausted of valuable timber in the not too distant future.

The export was 0.5 million m³ in 1966 while it was only 0.2 million m³ in 1970.

REUNION

General

Reunion is a volcanic island lying 640 km west of Madagascar. The total area is 251,000 ha. Volcanoes have developed along a fault running north-west to south-east. All but one are now extinct. The cones still rise to 2,500 - 3,000 m and dominate the island.

The uplands and the frequent summer cyclones create abundant rainfall,

especially on the north-eastern (windward) side. Temperatures vary greatly according to altitude. Winter frosts occur frequently in the uplands.

According to FAO Production Yearbook 1971 the land use is as follows (information from 1970):

Land use	Area, 1000 ha
Arable land and land under permanent crops	62
Permanent meadows and pastures	20
Forest land	83
Other land	86
Land area	250
Total area	251

Natural forest land

Indigenous forest cover about 100,000 ha. Perhaps 65 per cent of the forest area is state-owned. The indigenous forests cover the mountainous and less accessible areas of the central part of the island. A large part of the forests consists of degraded formations. The most important forest types are represented by the tropical humid forest (50,000 ha) and by tamarisk forest (9,000 ha). Several useful timber species are found within the former type but the form of the stems is usually poor.

Man-made forests

The total area of plantations is reported to be around 9,000 ha. Of this 3,000 ha is *Casuarina* (in the lowlands) and 3,000 ha is of *Acacia* plantations (in the higher elevations). Approximately one half of the total area of the plantations is state-owned.

R H O D E S I A

General

Rhodesia has an area of 38.9 million ha. It consists of four relief regions. Three of those consist predominantly of gently undulating plateaus. The high-veld is comprised of land above 1,200 m and extends across the country from south-west to north-east. The middle-veld, land between 900 and 1,200 m, flanks the high-veld. It is most extensive in the north-west. Two-thirds of the country is above 900 m. The low-veld, land below 900 m, occupies the Zambezi basin in the north and the Limpopo and Sabi-Lundi basins in the south and south-east. The fourth physical region, the eastern highlands, has a mountainous character. The highest peaks reach above 2,390 m. Temperatures are moderated by altitude. Mean monthly temperatures range from 22° C in October and 13° C in July on the high-veld to 30° C and 20° C in the low-lying Zambezi valley. Rainfall is largely restricted to the period November to March and, except on the eastern highlands, is very variable. Mean annual rainfall ranges from 1,400 mm on the eastern highlands, to 800 mm on the north-eastern high-veld and to less than 400 mm in the Limpopo valley.

FOREST MAP—RHODESIA

- Town
- Road
- ~~~~~ River
- + + + + + Railway
- - - - - International boundary

Forest reserves

Forest

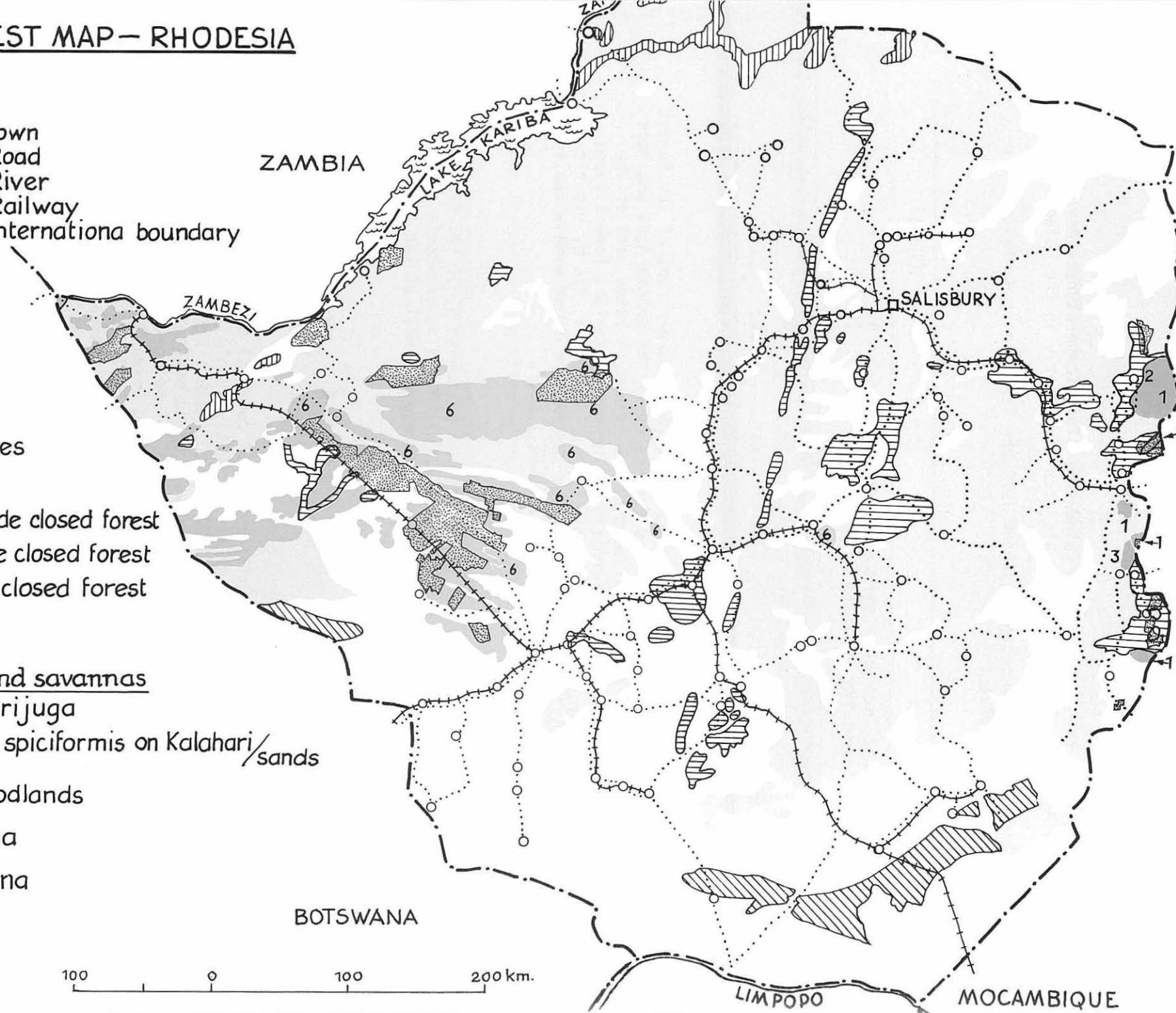
- 1 Medium altitude closed forest
- 2 Moist montane closed forest
- 3 Dry montane closed forest

Thicket

Woodlands and savannas

- Baikiaea plurijuga
- 6 Brachystegia spiciformis on Kalahari/sands
- Savanna woodlands
- Tree savanna
- Shrub savanna
- Grasslands

100 0 100 200 km.



According to FAO Production Yearbook 1971 (information from 1956) the land use is (or was) as follows:

Land use	Area, 1000 ha
Arable land and land under permanent crops	1,837
Permanent meadows and pastures	4,856
Forest land	23,570
Other land	8,673
Total area	38,936

Natural vegetation

In Rhodesia there exists a narrow strip of mountain grassland which contains a few relics of montane forest in the high rainfall area of the eastern border. The dominant species are *Khaya nyasica*, *Lovoa swynnertonii* and *Trichilia chirindensis*.

The characteristic woody vegetation comprises several types of open deciduous woodland with occasional fringes of riverine forest along the major water courses. Two-thirds of the land area is covered with such open woodland types.

The most important of these woodlands is the Rhodesian teak (*Baikiaea plurijuga*) forest which occurs in over 800,000 ha in the western corner of the country. The annual yield is now 57,000 m³ which cannot be sustained as this includes a lot of over-mature trees. The regeneration is inadequate.

The remaining woodland contains numerous species of hardwoods which are generally short-boled and unsound because of fire damage. In many cases, their timbers are not naturally resistant to insect and fungus attack. In addition, the trees are scattered, slow-growing and of very low volume per hectare. Annual increment is less than 0.8 m³/ha.

These woodlands are mainly of the Miombo type. In the Zambezi valley and in the southern part of the country woodlands of the Mopane type are found.

The main species in the open woodlands are *Guibourtia coleosperma*, *Pterocarpus angolensis*, *Parinari curatellifolia*, *Terminalia sericea*, *Acacia* spp., *Uapaca kirkiana*, *Brachystegia spiciformis*, *Brachystegia boehmii* and *Colophospermum mopane*.

In the riverine forests one finds species like *Syzygium* spp., *Acacia* spp., *Trichilia roka* and *Adina microcephala*.

There are only two indigenous softwood species (*Widringtonia whytei* and *Podocarpus* sp.).

Man-made forests

The plantations, especially of pines and wattle, are concentrated in the eastern districts while the *Eucalyptus* plantations are scattered over most of the settled areas.

The most common planted species are *Pinus patula*, *P. elliottii*, *P. taeda*, *Eucalyptus* and *Acacia mearnsii*.

In April 1967 the following areas were planted:

Species	Ownership	
	State	Private
	1000 ha	
Coniferous	12	24
Wattle	1.2	30
Other broadleaved	-	27
Total	13	81

In 1965 the area of plantations was given as 101,000 ha.

Coniferous plantations

In 1964 the growing stock was estimated at 2.7 million m³. It was expected to reach 5.7 million m³ by 1968-1969.

In 1965 the yield was 180,000 m³/year. The main genera are pines and Cupressus. Sufficient land is available to double the present area.

Broadleaved plantations

The growing stock in 1965 was estimated at 4 million m³.

R W A N D A

General

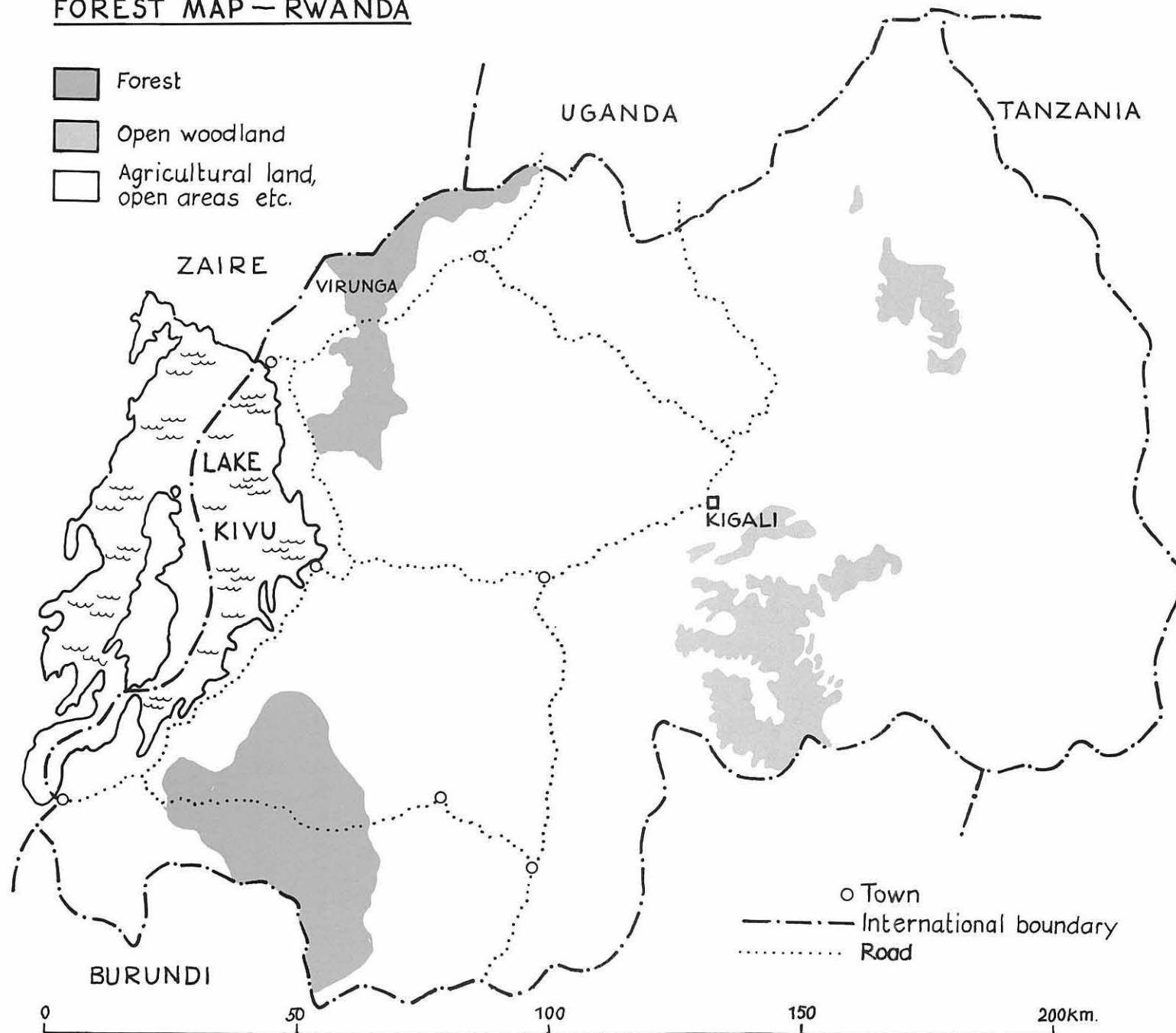
Rwanda has an area of 2.6 million ha and a population of about 3.5 million. The land area is very rugged and broken consisting of a series of sharply defined hills, with steep slopes and flat ridges intersected by deep valleys. The bottoms of the valleys are often formed by marshy plains. The north is dominated by a powerful chain of volcanoes, the Virunga. The Congo-Nile divide stretches from the Virunga towards the south.

The central part of the country has an average temperature of 19° C and an annual rainfall of 1,000 mm. Altitude is a factor which modifies the temperature.

FAO Production Yearbook 1971 gives the following information about land use (information from 1970):

Land use	Area, 1000 ha
Arable land and land under permanent crops	704
Permanent meadows and pastures	817
Forest land	328
Other land	785
Land area	2,524
Total area	2,634

FOREST MAP - RWANDA



Natural forest land

The remaining natural forests are found in the more remote areas in the northern part of the Congo-Nile divide. They are estimated to cover about 300,000 ha of which 180,000 ha are in the south and 120,000 ha in the north. They are diminishing quite rapidly. At the edge of the forests agriculture advances about 2 km each year.

Due to the lack of forest cover the country has big erosion problems.

The main native species are *Entandophragma* spp., *Carapa grandiflora*, *Laurea glabra*, *Symphonia globulifera*, *Podocarpus usambarensis*, *P. milanjanus*, *Ocotea usambarensis*, *Olea hochstetteri*, *Syzygium parvifolium*, *Strombosia scheffleri*, *Erythroxylum manii*, *Pygeum africanum* etc. The volume of these species is estimated to be below 100 m³/ha.

The natural forests are officially protected but they may disappear in the near future. Their future as a potential source of wood is very doubtful.

The open woodland areas that occur in the eastern part of the country are dominated by the acacias. The area of open woodland (tree savanna, bush savanna, gallery forests) is estimated as roughly 1 million ha but it is disappearing due to agriculture and cutting for fuelwood.

Man-made forests

In all there are 29,000 ha of plantations. These plantations are scattered in small blocks here and there.

In 1970 the following information was given:

Ownership	Area, ha
State plantations	2,060 ^{1/}
Communal	23,524 ^{2/}
Roadside plantations	800 ^{3/}
Private	1,350 ^{3/}
Plantations and tea plantations	1,000 ^{3/}
Total	28,700

1/ Of which *Eucalyptus* 1,500 ha; *Cupressus*, *Grevillea* and *Cedrela* 560 ha.

2/ Of which *Eucalyptus* 17,700 ha

3/ Mainly *Eucalyptus*

Plantations of 250 ha a year have taken place during the last years. A lot of different species have been tried. The plans are to plant 10,000 ha in 25 years.

The communal plantations were inventoried in 1968. This inventory gave the following species distribution:

Species	Area, ha
Eucalyptus ^{1/}	19,099
Acacia mearnsii	2,889
Grevillea robusta	561
Cupressus	723
Pinus	643
Others	1,657
Total	25,572

1/ Mainly *E. maidenii*, *E. saligna*, *E. grandis*

S T H E L E N A

The natural forests have been destroyed and this has caused serious erosion. Two-thirds of the island has been converted to barren waste.

The island has a large population of goats which makes natural regeneration difficult.

In a report from 1956 the land use was given as follows:

Land use	Area, ha
Forest	772
Flax	1,356
Pasture	1,813
Arable land	259
Barren land	801
Total	4,994

S E N E G A L

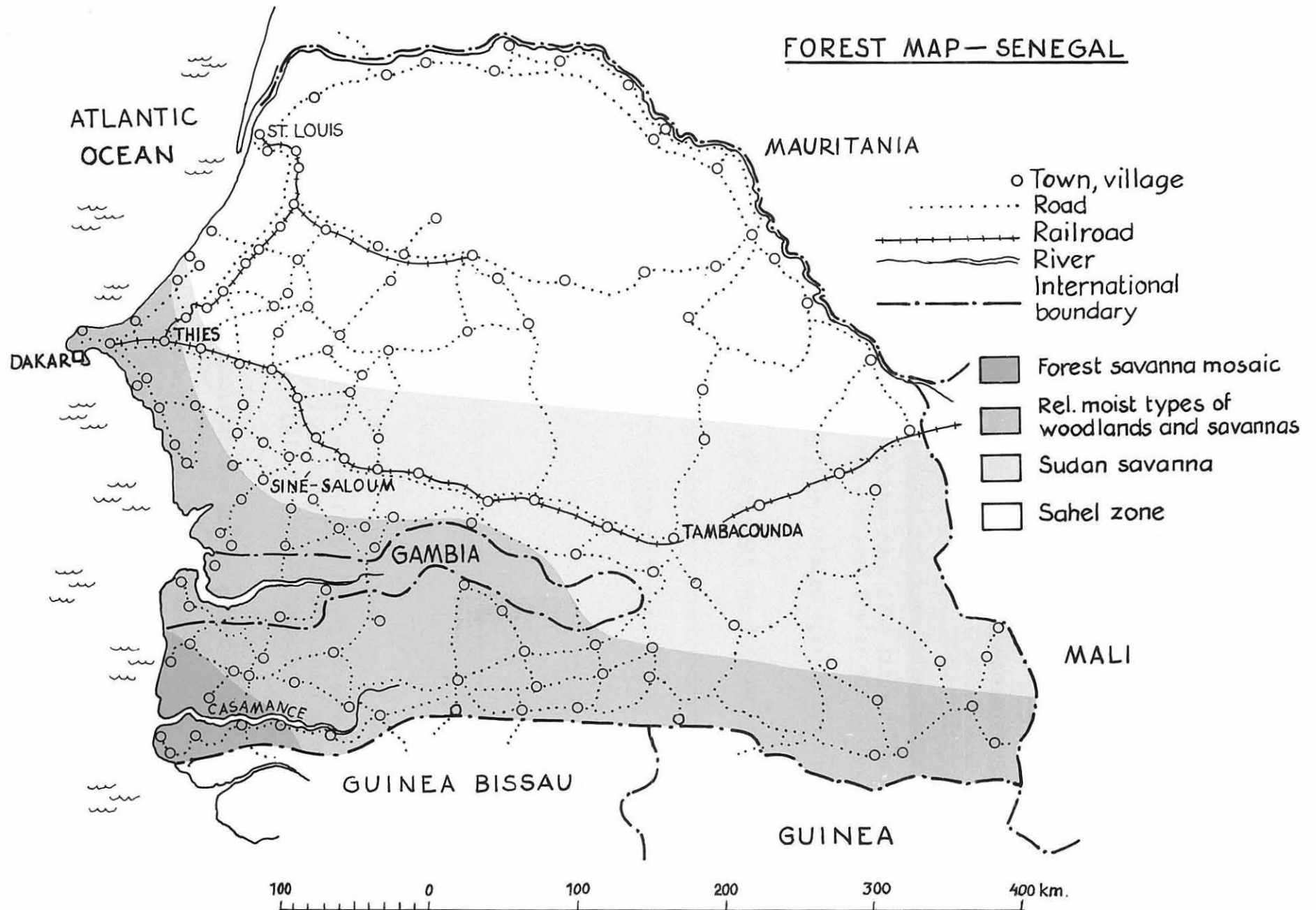
General

Senegal has an area of 19.6 million ha. Apart from the eastern and south-eastern borderlands (400 m altitude) most of the country consists of monotonous plains. The coast between St Louis and Dakar has a broad belt of unstable dunes.

Senegal's climate is very varied and the coast is remarkably cool for the latitude, the average temperature between 18° and 31° C. The rainy season is two months in the north and five to seven months in the south. The rainfall averages 300 mm and 1,500 mm respectively.

Two different sources give the land use as follows:

FOREST MAP — SENEGAL



Land use	Area, 1000 ha	
	FAO Production Yearbook 1971 ^{1/}	WFI 1970 ^{2/}
Arable land and land under permanent crops	5,564	} 2,431
Permanent meadows and pastures	5,700	
Forest land	5,318	5,327
Forest	..	3,743
Open woodland	..	1,584
Scrub and brushland	..	-
Other land	3,037	11,714
Land area	19,200	..
Total area	19,619	19,672

1/ Information from 1970

2/ Information from 1971

Natural vegetation

The natural vegetation in Senegal is savannas and steppes. As can be seen on the map the main part of the country is in the Sahel and Sudan zones. These areas mainly supply fuelwood. In the southern part of the country there are areas with Guinea savanna. Especially in the Casamance region it is a well-developed woodland, a dry forest, relatively dense but quite low.

In the Casamance region there are 185,000 ha of "classified forest" and 870,000 ha of "other forest" (libres ou protégés). Of the latter area 20,000 - 40,000 ha is estimated to be valuable. The total area of valuable forest in Casamance should therefore be around 210,000 ha. Species typical for the area are:

<i>Afzelia africana</i>	<i>Ekebergia senegalensis</i>
<i>Antiaris toxicaria</i>	<i>Elaeis guineensis</i>
<i>Burkea africana</i>	<i>Erythrophleum suaveolens</i>
<i>Chlorophora regia</i>	<i>Morus mesozygia</i>
<i>Cola cordifolia</i>	<i>Parinari excelsa</i>
<i>Daniellia thurifera</i>	<i>Schrebera arborea</i>
<i>Detarium senegalense</i>	<i>Syzygium guineense</i>

Species typical for the savanna area like *Afrormosia laxiflora*, *Bankinia thoningii*, *Borassus aethiopum*, *Daniellia oliveri*, *Erythrophleum africanum* are also found.

In Senegal there is about 200,000 ha of mangrove; 80,000 ha of which is estimated to be exploitable.

Senegal also has large areas of bamboo. The total area is estimated to be 20,000 ha mainly situated in the Tambaconda area. The species is *Oxytenanthera abyssinica*.

Inventories

An inventory has recently been undertaken in the Casamance region. No

results were available for the preparation of this report.

To the WFI 1970 the following estimate was given for the volume of different species:

Species	Volume, 1000 m ³
<i>Tectona grandis</i> ^{1/}	348
<i>Gmelina arborea</i> ^{1/}	121
<i>Acacia scorpioides</i> var. <i>pubescens</i>	6,000
<i>Borassus aethiopum</i>	2,800
<i>Daniellia oliveri</i>	14,400
<i>Combretum</i> spp.	12,000
<i>Rhizophora racemosa</i> & <i>Avicennia nitida</i>	8,000
Total	43,000

1/ Plantations

Man-made forests

The total area of plantations is given as 13,700 ha (WFI 1970).

Casuarina equisetifolia (filhao) has been planted for dunefixation in the Cap Vert region around Dakar.

In the central part of the country *Anacardium* is planted as wind-breaks. Teak and *Gmelina* plantations are established in the lower Casamance area. Something like 2,300 ha have been planted. The different plantation schemes are summarized below:

1. Casamance region:

Planted: Teak	1,714 ha
Gmelina	574 "
Planned: Teak	500 ha
Gmelina	500 "

2. Operation darcassou (*Anacardium occidentale*)^{2/}

Realized	9,233 ha ^{1/}
Planned	4,500 "

3. Operation cadde (*Acacia albida*)^{2/}:

Realized	1,600 ha
Planned	1,200 "

4. Reforestation and protection of Niayes:

Realized	482 ha
Planned	500 "

Cont.

Cont.

5. Dune-fixation in Cap Vert (*Casuarina* spp):

Realized	311 ha
Planned	360 "

-
- 1/ The regions of Cimbo, Thiés and Sine-Saloum
2/ Wind-breaks

The plantations are normally done as enrichment planting in classified forest.

It is reported that fire damage occurs in the plantations.

Shifting cultivation

Of the 5,327,000 ha given as forest land (to WFI 1970) an area of 2,431,000 ha is estimated to be affected by shifting cultivation. The area cleared every year is estimated to be 9,000 ha. It has also been estimated that the total amount of wood burnt every year because of shifting cultivation amounts to 4 million ha.

Other

1) Exploited wood in the Casamance region is processed by two small sawmills. More valuable logs suited for production of veneer are processed in Dakar.

2) The crown-density in the classified forests has been estimated to be as follows (WFI 1970):

Crown-density	Area, 1000 ha
Good (1.0 - 0.7)	121
Medium (0.69 - 0.4)	1,122
Poor (less than 0.4)	2,500
Temporarily unstocked	-

S E Y C H E L L E S

General

The Seychelles archipelago consists of a scattered group of 40 granitic and 45 coralline islands in the western Indian Ocean. Its land area is approximately 38,000 ha. Most of the granitic islands are mountainous (up to nearly 1,000 m).

According to FAO Production Yearbook 1971 land use is as follows (information from 1967):

Land use	Area, 1000 ha
Agricultural land	17
Forest land	5
Other land	16
Total area	38

Forest land

In the 17th century the island was covered with forest. Since then exploitation has been extensive. The forest vegetation occupies altitudinal zones characterized by fairly well marked assemblies of species. An area of 1,100 ha have been afforested since 1950. A further 1,000 ha are said to be required to meet the need for wood.

Introduced species are *Albizia falcata* and *Adenanthera pavonina*.

The vegetation in the Seychelles is very rich. Eighty species of plants are said to be endemic. Some of these endemic species are now practically extinct.

S I E R R A L E O N E

General

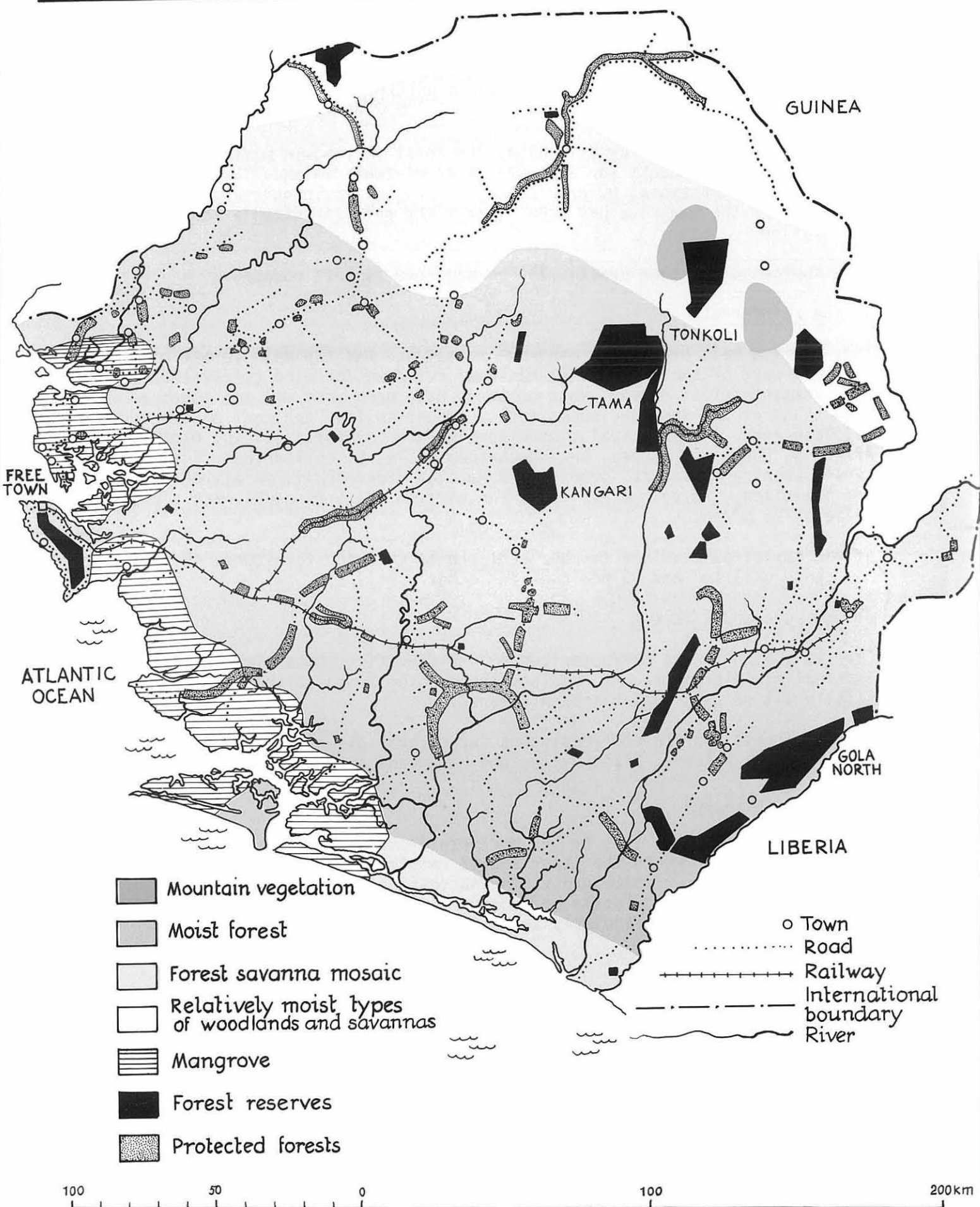
Sierra Leone covers an area of 7.2 million ha. From the low-lying land near the coast the land rises gradually to the broad plateaus of the Atlantic/Niger watershed at the north-eastern frontier (600 m). Rising out of this lower-lying land are several important hill and mountain masses whose main peaks exceed 2,000 m.

The main rains fall from June to September. Total rainfall - over 5,000 mm locally - is greatest along the coast. The savanna areas of the north-east have 1,800 to 2,500 mm.

According to two different sources the present land use is as follows:

Land use	Area, 1000 ha	
	FAO Production Yearbook 1971 ^{1/}	WFI 1970 ^{2/}
Arable land and land under permanent crops	3,664	} 5,868
Permanent meadows and pastures	2,204	
Forest and other wooded areas (Forest land)	301	345
Forest	..	289
Open woodland	..	44
Scrub and brushland	..	12
Other land	1,005	961
Land area	..	..
Total area	7,174	..

FOREST MAP—SIERRA LEONE



- 1/ Information from 1964
- 2/ Information from 1970

Natural vegetation

A. Mangrove swamps

Mangrove occupies a narrow belt along the coast varying in width from 8-24 km along the river banks for a considerable distance inland. The main genera are *Rhizophora racemosa*, *R. harrissoni*, *R. mangle*, *Avicennia* and *Laguncularia*. Where the mangrove has been cleared the soil is suitable for rice cultivation.

Some sources claim that practically no mangrove is left nowadays.

B. The rainforest

This forms a belt behind the mangrove forest and was the main forest of the southern part of the country. It has been cut down for rice cultivation and only remnants of it remain. Most of these have been reserved and together with those of the semi-deciduous forest amount to four per cent of the total land area. The principal timber species are *Tarrietia utilis*, *Oldfieldia africana*, *Khaya anthotheca*, *Entandophragma utile*, *E. cylindricum*, *E. angolense*, *Lophira alata* var. *procera* and *Nauclea diderrichii*. In all 45 species are exploited. The volume exploited ranges from 17 to 49 m³/ha with a mean-value of 23 m³/ha.

Of the exploitable volume two per cent can be used for furniture, 45 for per cent "utility" and 53 per cent for other uses.

C. Semi-deciduous forest

This is a high forest characterized by its specific composition in which *Terminalia*, *Chlorophora* and *Triplochiton* are the common timber genera. Practically all of this type has been cleared.

The rainforest and the semi-deciduous forest have given place to a fallow bush in which *Xylopia*, *Anisophyllea* and *Harungana* are the principal genera.

D. Savanna woodland

This is the vegetation type of the Northern Province. It is in fact a derived savanna in an area where the least annual rainfall is 2,000 mm. There are few species of timber value except in inaccessible areas where remnants of the original forests may still be encountered. The savanna is maintained by the annual fires which regularly sweep through the area.

E. Grasslands

These are found in different parts of the country in forest and savanna areas and may be of biotic or edaphic origin.

Forest reserves

The total area of the forest estate and unreserved forest is 345,000 ha. Of this area 289,000 ha is situated in the high forest region. The total forest estate i.e. Forest reserves and protected forests amount to 307,780 ha. Of this area 185,884 ha is protection forest (productive but inaccessible

forest is included in this figure). Protected forest here means areas that are owned by local chiefdoms but administered by the central Government. It consists of strips along roads, village forests etc. The Forest reserves belong to the Government. The area of unreserved forests treated as salvage areas amounts to 37,115 ha. The area of real productive forests should then amount to around 110,000 ha of which 92,465 ha are under working plans. There are plans to increase the forest estate but increasing competition for land makes progress slow.

The Forest reserves are, to a large extent, situated in remote areas which are often inaccessible and in terrain where economic exploitation is difficult.

The major forest reserves are the following:

a) Gola north, east and west Forest reserves cover 90,000 ha. It is a mosaic of high forest, secondary forest, bush, swamps and rocky areas.

b) Tama and Tonkoli Forest reserves cover 60,000 ha. This is a mosaic of high forest, secondary forest, bush, swamps and rocky areas. These reserves contain less mahogany species than the Gola forests.

c) There are a number of smaller Forest reserves throughout Sierra Leone, but they are of little consequence as far as exploitable merchantable timber is concerned.

Man-made forests

In 1970 the area of man-made forests was reported to be 6,500 ha (WFI). The main plantations are in the southern and eastern Provinces with a few in the northern Provinces. Main species planted are *Cordia alliodora*, *Terminalia ivorensis*, *T. superba*, *Entandophragma* spp., *Tectona grandis*, *Gmelina arborea*, *Triplochiton*, *scleroxylon*, *Nauclea diderrichii*, *Tarrietia utilis*.

Inventories

An inventory of 107,000 ha have been undertaken in Tonkoli, Tama, Kangari and Gola Forest reserves. Reconnaissance surveys have been carried out in other areas.

It is very difficult to extract any data from these inventories.

For Tama and Tonkoli the following summarized information has been found:

Reserve	Area, 1000 ha				Volume ^{1/} in accessible stocked areas	
	Stocked	Under-stocked	Inaccess-ible	Total	m ³ /ha	1000 m ³
Tama	10.5	3.4	2.2	16.2	42	440
Tonkoli	15.4	23.3	5.5	44.1	40	620

1/ Include all merchantable species above d.b.h. 58 cm.

In Goma Forest reserve, a total area of 77,000 ha, an inventory covered 52,080 ha. The "productive forest" area occupy 25,500 ha.

The net volumes under bark of trees with a d.b.h. of more than 39 cm were as follows:

Species group ^{1/}	Volume, 1000 m ³
A	1,103
B	745
C ₁	505
C ₂	598
Total	2,950

1/ A group: Dark coloured wood used for furniture.

B group: Used for construction and general purposes with mainly light coloured wood.

C₁ group: Species not used but which might be used especially in plywood manufacture.

C₂ group: Species which probably never will be used.

In all forests (300,000 ha) the volume of "merchantable timber" has been estimated to 10 million m³.

In bush fallow (3.66 million ha) the volume of fuelwood and building poles has been estimated to 75 million m³.

Shifting cultivation

Shifting cultivation is common in all areas outside the Forest reserves. Frequent encroachment in the Forest reserves is also reported to occur.

The forest areas located outside the Forest reserves and protected forests are owned by local chiefdoms (salvage timber areas). Where no forest industry exists a major part of the existing timber is being destroyed by clearing and burning for shifting cultivation.

Exploitation

The Forest Service has a 70 year plan for exploitation. The yearly coupe is in one source given as low as 400 ha(?). At present time there are three sawmills which makes the main part of the logging. There exist also a number of pit-sawyers.

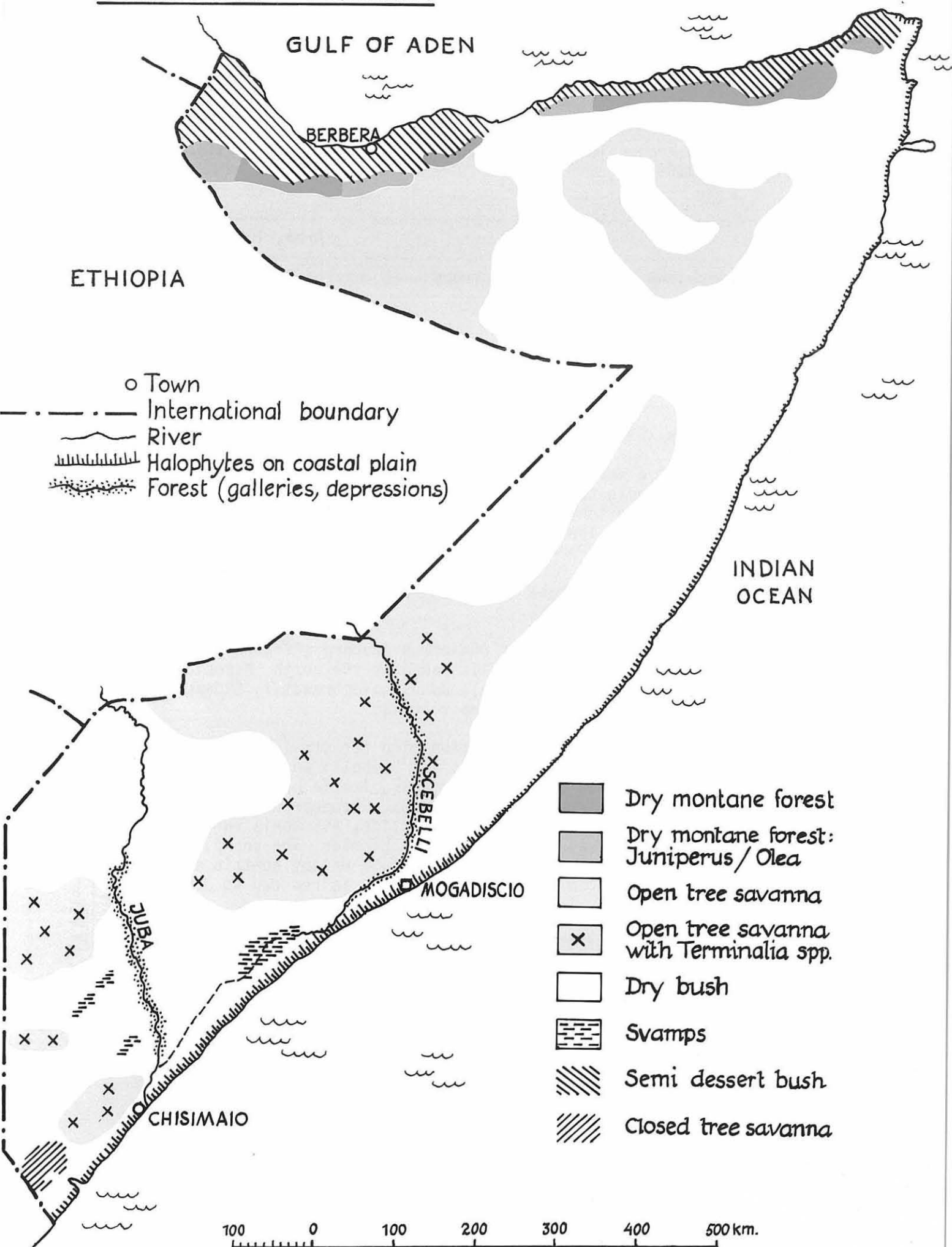
S O M A L I A

General

The total area of the country is 63.8 million ha. Most of the country consists of plains, with a high mountain escarpment in the north, facing the coast. The highest peak in this escarpment reach 2,400 m.

Only two permanent rivers - the Juba and Scebelli - water this dry land.

FOREST MAP - SOMALIA



Both rise in the Ethiopian highlands, but only the Juba regularly flows into the sea.

The climate is hot with poor rainfall rarely exceeding 500 mm in the most favourable regions.

According to FAO Production Yearbook 1971 the land use is as follows (information from 1960):

Land use	Area, 1000 ha
Arable land and land under permanent crops	957
Permanent meadows and pastures	20,568
Forest land	14,401
Other land	27,840
Land area	63,734
Total area	63,766

Natural vegetation

Somalia is known as a very dry country but vegetation types which deserve the name forest exist in some areas. Different sources give very different information as to the extent of these areas. Around 10 million ha may have some form of tree cover. The area of closed forest has been estimated at 150,000 - 200,000 ha.

The normal vegetation at present is of semi-desert type, low bushy country with Acacias as the main species.

There are said to be some stands of *Juniperus procera* (African pencil cedar) in the high altitude areas of the Golis range in the north. Associated with this species are *Olea africana* (olive), *Buxus hildebrandtii*, *Sideroxylon buxifolium*, *Cordia purpurea* and *Dodonaea viscosa*.

There are also some potentially productive high forests in the southern region of Somalia, along the rivers Juba and Scebelli and south-west of Chisimaio. The main species are *Mimusops degan*, *Acacia hockii*, *Gaccina ferrandii*, *Ficus sycomorus*, *Terminalia bispindosa*, *Excoecaria venenifera*, *Cordia ravae*, *Azzeria guanzensis*, *Thespesia somalica*, *Avicennia marina*, *Trichilia jubensis*, *Piptadenia erlangeri* and *Grewia bicolor*. The unexploited stands of the natural riverine forests in the lower Juba valley contain an estimated growing stock of 400 - 450 m³ per ha. This figure is reduced to 200 - 250 m³ in the degraded stands.

On the more sandy soils of the upper and lower Juba *Hyphaene thebaica* (Dum palm) is found. *Conocarpus lancifolius* ("Damas"), a local species, can be economically grown in the coastal regions of the north and the south.

The mangrove forest on the coast between the river Juba and the Kenya border has been heavily overcut.

The existing natural forests do not meet the requirements of the country.

The *Juniperus* forest has been estimated to be 120,000 ha while the forest along the Juba valley has been estimated as 40,000 ha. These figures are only old rough estimates, no inventories have been undertaken.

Man-made forest

There are some patches of plantation here and there. The total area is in one source reported to be as high as 15,000 ha. World Wood (1972) gave the area planted as only 25 ha. According to recent information, *Conocarpus lancifolius* is now being planted extensively over many areas of the country. The tree has become very popular for shade in the towns and villages. There is now a plantation exclusively of this species in the northern coast near the port of Berbera. In the south it has been used in combination with *Casuarina equisetifolia* to stabilize migratory sand dunes.

Other

Destruction occurs due to over-grazing and, in some localities, to uncontrolled charcoal burning.

A small sawmill will go into production very soon in the Dallo forest in the northern highlands using dead *Juniperus* wood. This will be the first sawmill in the country.

Forest reserves are reported to cover 0.4 million ha.

S O U T H A F R I C A

General

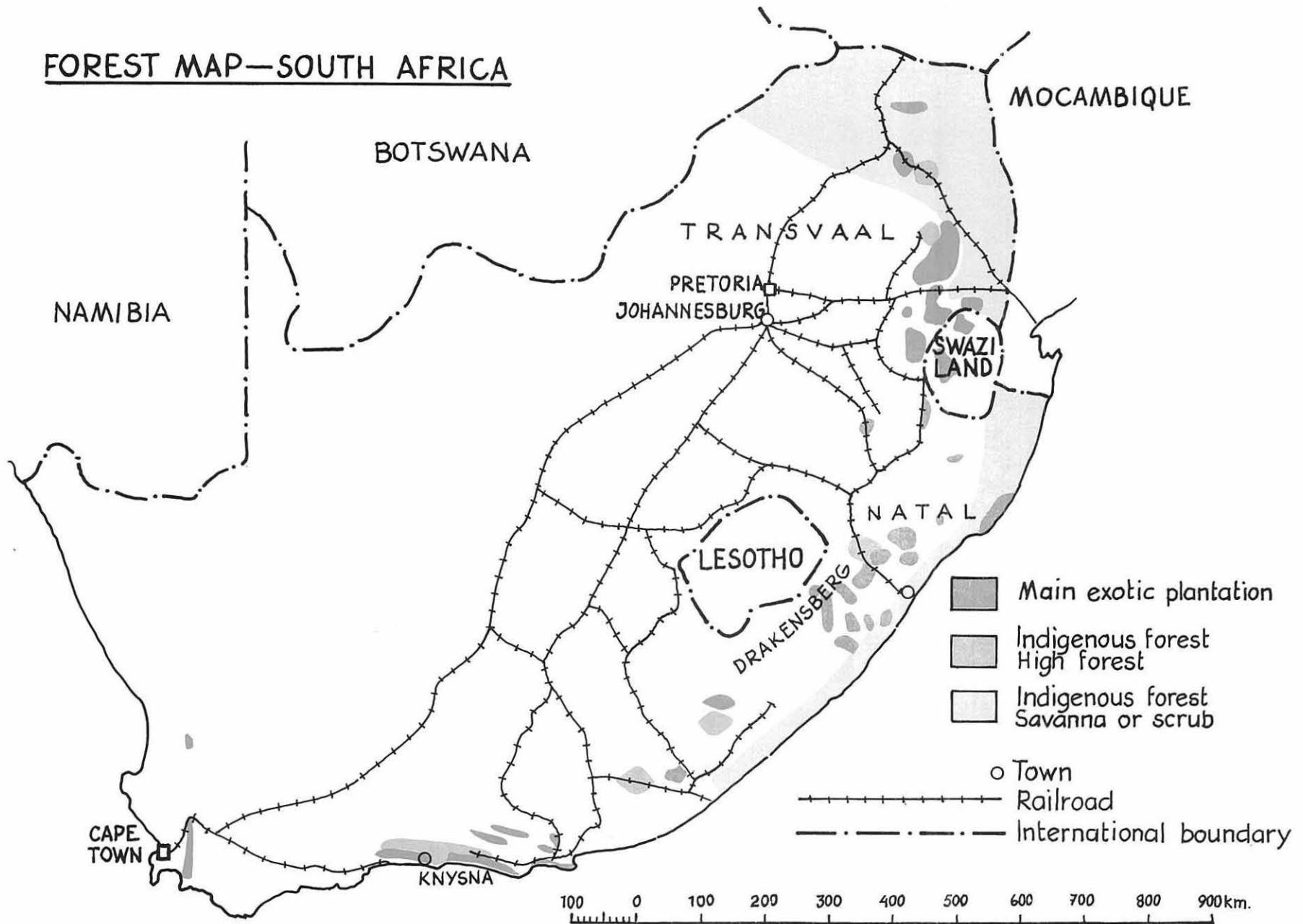
South Africa has an area of 122.1 million ha. Most of the country consists of a vast plateau bounded by an escarpment in the east. Along the coast there is a narrow coastal belt. The surface of the plateau varies in altitude from 600 to 2,000 m above sea-level. It is highest on the east and south-east and falls fairly gently towards the Kalahari basin on the north-west. The relief is generally monotonous consisting of undulating to flat landscapes over wide areas. Low ridges and inselbergs made up of rock more resistant to erosion occur occasionally. Maximum elevation of over 3,350 m occur in the escarpment in the south-east (Drakensberg).

The climate of South Africa is mainly subtropical. Altitude and relief influence temperature and the amount and distribution of rainfall. The temperature is remarkably uniform from north to south (mean annual temperature 17° C in Cape Town and Pretoria). The areas of highest annual rainfall largely coincide with the more mountainous regions. More than 625 mm are received only in the eastern third of South Africa and relatively small areas in southern Cape Province. Virtually all the western half of the country, apart from southern Cape Province receives less than 250 mm.

According to FAO Production Yearbook 1971 the land use is as follows (information from 1960):

Land use	Area, 1000 ha
Arable land and land under permanent crops	12,058
Permanent meadows and pastures	90,390
Forest land	4,105
Other land	15,551
Land area	..
Total area	122,104

FOREST MAP—SOUTH AFRICA



Natural vegetation

The natural vegetation in South Africa can be sub-divided into closed forest, sclerophyll forest, wooded savanna, grass savanna and desert.

The closed or high forest is estimated to cover around 255,000 ha while the open savanna forest and scrub covers around 2,686,000 ha.

These indigenous forests have no economic importance but some exploitation does occur (5,000 m³ in 1970).

The high forest can be sub-divided into the three following types:

a) Temperate

This forest consists of Podocarpus species, Ocotea bullata, Ptaeroxylon obliquum, Olea capensis subsp. macrocarpa and other evergreen species. This reaches its greatest extension around the town Knysna.

b) Subtropical forest

This type is found between the sea-level and 200 - 300 m above sea-level. The most common genera are Albizia, Protorhus, Sclerocarya, Trichilia and Ficus.

c) The mountain forest

This type covers some small areas in the higher areas of Natal and Transvaal.

Man-made forests

The planted area, according to information from 1969 is 959,000 ha. In 1971 the area planted was reported to be 1,025,000 ha. The following breakdowns are given for the 1969 area:

a) Species distribution:

Species	Area, 1000 ha
Pines and other coniferous	471
Eucalyptus	290
Wattle	191
Other broadleaved	7
Total	959

Of these plantations about half are publicly owned and half private.

b) Age distribution (also including Swaziland)

Age class, years	Species			
	Pines and other conifers	Eucalyptus	Wattle	Other broad- leaved
	Area, 1000 ha			
0 - 4	138	174	50	2
5 - 9	90	86	47	2
10 - 14	116	16	80	1
15 - 19	92	6	13	1
20 - 24	39	3	0.3	0.2
25 - 29	13	2	0.0	0.1
30	50	8	0.3	1
Total	538	295	187.6	7.3

c) Size class distribution

Size classes (in ha)	No. of plantations	Percentage of total area
1 - 10	256	0.1
10 - 40	555	1.3
40 - 80	411	2.3
80 - 200	564	7.2
200 - 400	305	8.2
400 - 2,000	387	34.7
2,000 - 4,000	74	20.4
4,000 +	28	25.8

At present the sustained annual yield from coniferous plantations is 7.1 million m³ and from broadleaved plantations 6.5 m³.

To meet the need for wood in the year 2,000 the area of coniferous plantations must increase 3.2 times and the area of broadleaved plantations by 1.6 times.

SPANISH SAHARA

The total area is approximately 26.6 million ha. The country consists mainly of an extensive, sterile rocky plain, rising slowly to the east.

According to FAO Production Yearbook 1971, arable land makes up 2,000 ha, permanent meadows and pastures 5 million ha and other land 21.598 million ha.

The "Vegetation Map of Africa" shows the whole country as covered by desert.

It is not known whether any forest plantations exist.

S U D A N

General

Sudan is the largest state in Africa and covers an area of 250.6 million ha. The country is crossed by the White Nile coming from Uganda and the Blue Nile, coming from Ethiopia. These two rivers join at Khartoum. Away from the Nile, Sudan is mainly a vast plain. There are however a number of mountain ranges such as the Imatong and the Nuba mountains (rising to over 1,500 m) in the south - Jebel Marra in the west (3,087 m), and the Red Sea Hill ranges (over 2,000 m) in the north-east.

Sudan has a range of tropical continental climates. In the south the rainy season lasts up to eight months, producing over 1,000 mm of rainfall while north of Khartoum there is a one-month rainy season and only 50 mm of rainfall. In the north, very high summer temperatures are common. In Khartoum the mean daily maximum reaches about 40° C. In the south temperatures are lower.

FAO Production Yearbook 1971 and WFI 1970 give the following information about land use:

Land use	Area, 1000 ha	
	FAO Production Yearbook 1971 ^{1/}	WFI 1970 ^{2/}
Arable land and land under permanent crops	7,100	
Permanent meadows and pastures	24,000 ^{3/}	7,770
Forest and other wooded areas (Forest land)	91,500	110,334 ^{4/}
Forest	..	28,749
Open woodland	..	58,534
Scrub and brush land	..	23,051
Other land	127,981	119,399
Land area	237,600	237,503
Total area	250,581	250,453

1/ Information from 1968

2/ Information from 1970

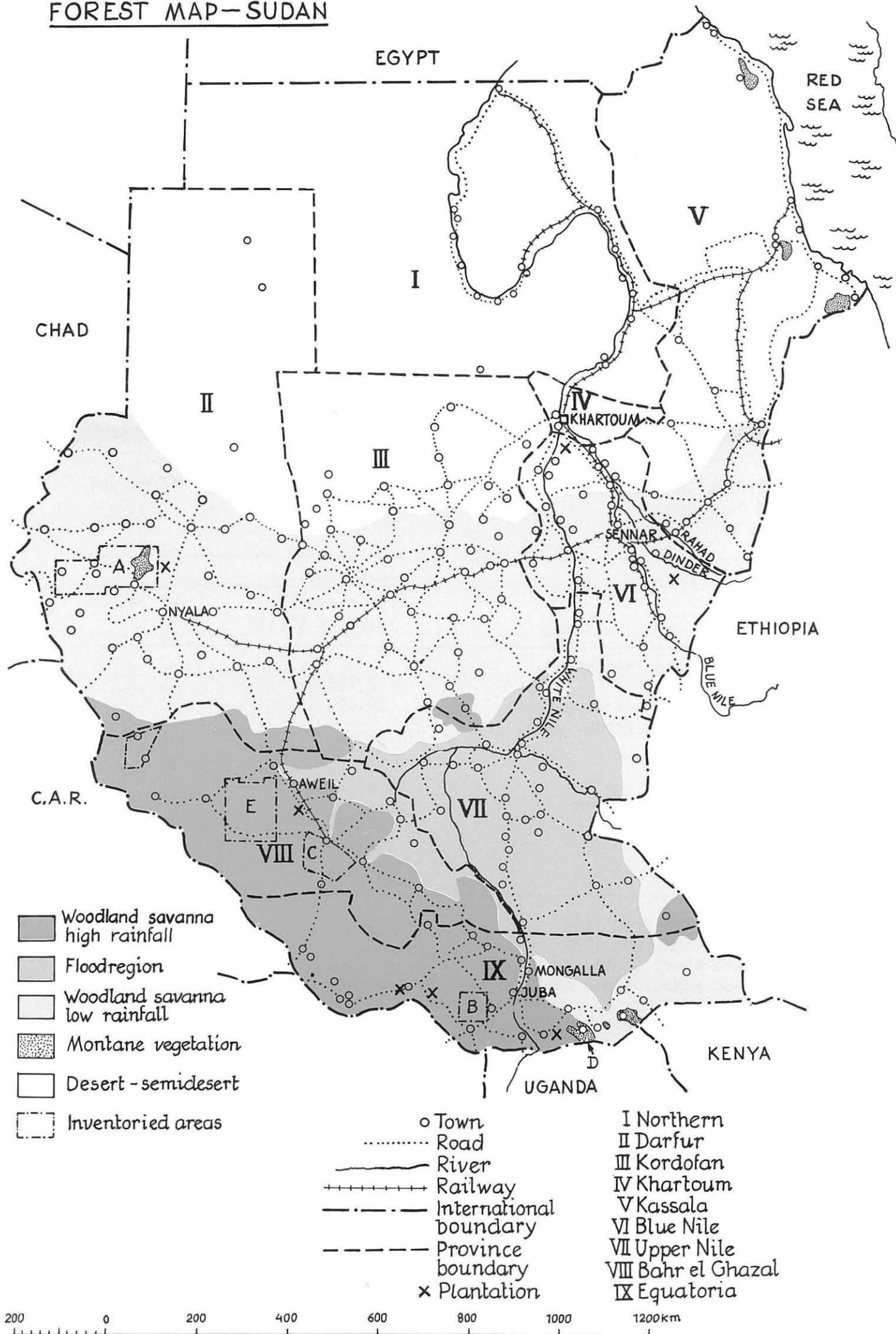
3/ Acacia short grass scrub

4/ Forest area include pastoral land as the mode of animal tenure is nomadic.

Natural vegetation

The natural vegetation in Sudan has been described in "Ecological Classification of the Vegetation of the Sudan" by M. N. Harrison and J. K. Jackson. A detailed breakdown of the different vegetation types and the productive area of these are given in the table on next page (source: Sudan Almanac 1962-Khartoum 1962, pp 129-130):

FOREST MAP—SUDAN



Main vegetation types and rainfall	Sub-division of vegetation types	Approximate area 1000 ha	Area of productive "forests"
I. Desert 0-75 mm		72,580	-
II. Semi-desert 75-300 mm	(a) Acacia tortilis - Maerua crassifolia desert scrub	18,600	1,900
	(b) Semi-desert clay grassland	10,400	-
	(c) Semi-desert grassland on sand	8,500	-
	(d) Acacia mellifera - Comiphora semi-desert scrub	8,500	1,700
	(e) Acacia glauco- phylla - Acacia etbaica scrub	3,100	600
Sub-total		49,100	4,200
III. Woodland savanna			
A. Low rainfall 400-570 mm	1. On Clay (a) Acacia mellifera - thornland	14,800	4,100
570-800 mm	(b) Acacia seyal - Balanites - savanna	12,000	6,900
800-1,000 mm	(c) Anogeissus - Combretum hartmannianum savanna woodland	5,000	2,200
280-450 mm	2. On Sands (a) Acacia senegal savanna	6,500	1,300
450-600 mm	(b) Combretum cordofanum, Dalbergia - Albizia sericecephala woodland	8,500	4,300
600-900 mm	(c) Terminalia-Sclerocarya-Prosopis savanna woodland (mixed deciduous)	6,500	3,200
400-1,000 mm	3. Special Areas	15,800	1,400
Sub-total		69,100	23,400

Cont.

Cont.

Main vegetation types and rainfall	Sub-division of vegetation types	Approximate area 1000 ha	Area of productive "forests"
B. High rainfall 900-1,300 mm	(a) Anogeissus-Khaya-Isoberlinia savanna woodland	31,100	15,500
1,300-1,800 mm	(b) Woodland savanna recently derived from rainforests with small areas of rainforests	3,600	900
Sub-total		34,700	16,400
IV. Flood region 700-1,600 mm	-	24,600	1,200
V. Montane vegetation 500-2,000 mm	-	6,000	300
Grand total		250,680	45,500

It must be emphasized that adequate and reliable data is not available at present and many of the figures in the previous table are merely guesswork. There are no clearcut boundaries between the various forest types.

In the following are given short descriptions of the different vegetation types. These have in the main been taken from FAO Report No. 1820.

a. Desert

The desert lies almost entirely in the Northern Province with some small areas in Darfur, Kordofan and Kaasala Provinces. The vegetation in the desert is limited to some xerophytic shrubs around the water courses.

b. Semi-desert

Semi-desert conditions prevail in the northern half of Kordofan and Blue Nile Provinces, the whole of Khartoum Province and about three-quarters of the Kassala Province with some parts of Darfur adjoining Kordofan. The only product from these regions is fuelwood and small poles for building construction. However, considerable quantities of *Hyphaene thebaica* (dum palm) and other wood are floated down the rivers and sawn locally for use in building construction.

c. Woodland savanna

The woodland savanna region lies in the central parts of Sudan on clay to the east and on sand to the west. The vegetation is of mixed grass types with bushes or trees, or both. Various species of *Acacia* predominate, with some deciduous broadleaved species occurring in wetter parts. The best *Acacia nilotica* (sunt) forests in this region are found along flooded areas on the Blue Nile and its tributaries. They extend all the way down to Egypt along the main Nile and are also found along the White Nile and other water courses.

i. Low rainfall savanna:

The low-rainfall woodland savanna occurs on the greater part of stabilized sand dunes in Darfur and Kordofan. *Acacia senegal* (the gum tree) is the dominant tree in the northern drier parts and grows in large pure stands. The other species found in this region are *Combretum cordofanum*, *Dalbergia* and *Albizia*. *Terminalia*, *Anogeissus* and *Prosopis* are found in the high-rainfall parts of the region.

ii. High rainfall savanna

The high-rainfall woodland savanna extends into most parts of Bahr el Ghazal and Equatoria provinces. The trees are tall and broadleaved. *Khaya senegalensis* (mahogany), *Isobertinia doka* (vuba) and *Anogeissus leiocarpus* (schlag) are found in pure patches in parts with rainfall under 1,300 mm, while *Terminalia glaucescens*, *Albizia zygia* and *Vitex doniana* occupy areas of over 1,300 mm of annual rainfall.

d. Flood region

Nearly 10 per cent of the total area of the country lies in the Flood region, which includes about one-third of Bahr El Ghazal and three-quarters of the upper Nile Province. Palms and some poorly developed broadleaved species occur in the highlands, grasses with *Acacia seyal* occur in the intermediate lands, and *Cyperus papyrus* dominates the swamps.

e. Montane vegetation

There are four mountain ranges in the Sudan. As regards the vegetation, they have nothing in common with one another but they differ entirely from their surrounding areas. The Imatong and Dongotona mountains are in Equatoria. The important species of this area are *Boswellia papyrifera*, *Combretum* and *Terminalia* at lower elevations, and *Syzygium gerardii*, *Olea hochstetteri* and *Podocarpus milanjanus* in the upper elevations. The Didinga mountains are also in Equatoria. The vegetation in the higher parts of these mountains is similar to that in the lower elevations of Imatong and Dongotona, while that in the lower parts is mainly grasslands with scattered clumps of evergreens including *Podocarpus*.

The Red Sea Hills are situated on the north-eastern edge of the Sudan. The forest vegetation consists of *Juniperus procera*, *Olea*, *Pittosporum viridiflorum* and *Diospyros abyssinica*.

The Jebel Marra Range is located in Darfur Province. The area is largely cultivated up to an elevation of about 1,800 m above sea level. The growth is very sparse and most of the area is open grassland. The important tree species are *Cordia*, *Ficus*, *Olea* and *Acacia albida*.

Since 1958 the "forest area" has always been reported to be 58.5 million ha. Of this area 45.3 million ha is estimated to have a crown-cover of more than 5 per cent. In 1969 a new estimate was prepared which estimated that the annual decrease in "forest area" was 1.5 million ha. In total 16.5 million ha may have been lost to other uses. In 1969 the area occupied by "forest" was therefore given as 42 million ha. Another recent estimate reports an area of 39.8 million ha. The area of gazetted Forest reserves is 1,190,265 ha (25 per cent of these in the high forest regions).

Man-made forests

Areas planted to the end of 1969:

Species	Area, 1000 ha
Pines	210
Other coniferous	1,580
Total coniferous	1,790
Eucalyptus ^{1/}	7,560
Teak	9,210
Other broadleaved	62,300
Total broadleaved	79,070
Total	80,860 ^{2/}

1/ Main species is *E. microtheca* (76 per cent)

2/ WFI 1970 gave the planted area as 26,000 ha

The distribution in age classes is as follows:

Age class, years	Area, 1000 ha
0- 5	62,260
6-10	
11-20	16,330
21-40	2,270

Estimated annual planting the years 1970-1974 was 4,500 ha per year. It will mainly be other broadleaved species. In 1969/70 2,940 ha was planted and in 1970/71 4,650 ha.

Of the planted area, 4,769 ha are irrigated.

Failures and replantings are not always deducted from the total areas quoted.

Inventories

The WFI 1970 reports that 10.6 million ha have been inventoried. The following inventories have been identified (inventories here are mainly reconnaissance surveys):

a) Dum palm survey - Eastern Sudan:

Aerial survey of the dum palm (*Hyphaene thebaica*) forests of the eastern part of country. The area covered was 3.6 million ha. In all 98 sample plots were measured.

b) Jebel Marra survey - Western Sudan (Code A on the map):

Photo-interpretation of 3.1 million ha.

c) Yei-Loka area - Southern Sudan (Code B on the map):

The area covered was 1.9 million ha. Photo-interpretation and field work was carried out. In all 205 sample plots were enumerated.

d) Yirol area - Bahr El Ghazal Province (Code C on the map):

Aerial reconnaissance survey of 310,000 ha. The area showed to be very poor.

e) Imatong mountains - Equatoria Province (Code D on the map):

The area covered was 38,000 ha. Field plots were measured.

f) Reconnaissance of the area between Raga and Wau (Code E on the map):

The area covered was 1.7 million ha. In all 700 sample plots were measured.

g) Acacia senegal survey - Kordofan Province:

A rough type map covering about 4.2 million ha was prepared and types of forest area which contain Acacia senegal were distinguished.

h) Reconnaissance in Bahr El Ghazal Province:

The aerial survey covers 450,000 ha.

i) Jebel Marra area:

Land and water survey by UNDP/FAO.

This list covers inventories carried out up to 1967. No further information is available.

Sawn timber resources

In FAO Report No. 1291, J. K. Jackson (1960) gives a very crude description of the availability of wood in Sudan. The main results are summarized here although it must be kept in mind that the results are rough estimates and to be taken merely as an example of the amount of wood that can be made available. It is also an example on how scattered information can be used to give an overall picture of the forest resources, and on the amount of wood that can be made available in open woodland areas.

Northern Sudan

a) Acacia nilotica (sunt)

This species, which grows in areas inundated annually by the Nile flood, is the most important timber produced in the north Sudan. The most important areas in which sunt forests are managed for timber production are along the Blue Nile, south of Sennar, and along the Rahad and Dinder rivers. Surveys have been made of the Blue Nile forests and it is estimated that the annual permissible yield of sawn timber is about 4,200 m³. The Rahad and Dinder areas have not been completely surveyed, but a rough estimate would be of a further 2,000 m³. Other areas at present (1960) exploited are small, but sunt exist

near pools in southern Darfur. Quantities available are unknown but increment is unlikely to exceed a further 1,000 m³ per year.

Sunt is a very hard, dense, durable wood, very good for railway sleepers but, owing to difficulties in working it, of limited use for construction work.

b) *Acacia albida*

This tree occurs in large quantities in river flats in the south and west of Darfur, and scattered along rivers elsewhere. It is not at present (1960) exploited on a large scale as its timber is not very durable. However, it might have some applications for work where an inferior timber is acceptable, or for railway sleepers after preservative treatment.

According to Hunting Technical Service Ltd. "Jebel Marra Investigations; Report on Phase I Studies" the standing volume of *Acacia albida* in the 3 million ha covered by the report is equivalent to 13 million railway sleepers. At present (1960), some is inaccessible, but the extension of the railway to Nyala has made a part of the area accessible. *Acacia albida* has important functions in preserving microclimatic and agricultural conditions, and large scale clear felling would be undesirable. However, an annual cut from accessible areas of, say 5,000 m³ of sawn timber probably could be obtained, if the timber could be sold.

c) Other species of the northern Sudan

Trees which are large enough to be cut for timber and which could be utilized include *Anogeissus leiocarpus*, *Prosopis africana*, *Pterocarpus lucens*, *Cordia africana* and *Khaya senegalensis*. Many of these trees occur widely scattered through savanna and no estimate of total volumes is possible. A volume of 5,000 m³ of sawn timber per year has been put as a possible annual yield.

Southern Sudan

a) *Khaya senegalensis* (Senegal mahogany)

Savanna forest containing this species occurs in a broad belt extending from Mongalla in the east to Aweil in the west; its total area may be estimated at 8 million ha.

The proportion of this area containing exploitable timber may be one-third. The exploitable area will then be approximately 2.7 million ha.

Even in exploitable areas the volume of mahogany timber is low. About 14 logs, from trees over the exploitable girth of 167 cm, may be expected per km². The logs average about 0.6 m³ of sawn timber, which comes to 2.8 m³ of sawn timber per km².

Thus, the total volume in terms of sawn timber over exploitable girth may be estimated at 75,000 m³. Allowing a cutting cycle of 30 years, this gives an allowable annual cut equivalent to 2,500 m³ of sawn timber.

All the area included is accessible.

b) *Daniellia oliveri* (bu)

The volume of this species may be estimated to be half that of Senegal mahogany, producing a potential yield of about 1,250 m³ per year, of sawn timber. It is more easily worked than mahogany and is in good demand in Khartoum for furniture manufacture.

c) *Isoberlinia* spp. (vuba)

Vuba extends in a belt south of the mahogany belt from about 50 km west of Juba nearly to the western frontier of the Sudan. Its total area is about 16 million ha and about half is inaccessible. Considering only the accessible area, and assuming one-fifth of this contains exploitable timber, the total area of exploitable forest is about 1.6 million ha.

The stocking of timber from trees over sleeper size may be estimated at about 200 m³ of sawn timber per km². Allowing a cutting cycle of 25 years this gives a permissible annual yield of 8 m³ per km², or 128,000 m³ per annum.

d) Rain- and gallery forest trees

The main utilizable species are *Khaya grandifoliola* and *Chlorophora excelsa* for sawn timber, and *Erythrophleum suaveolens* and *Syzygium guineense* for sleepers.

The only detailed figures for stocking are from Talanga forest, which in an area of about 1,000 ha contained about 1000 *Khaya* trees averaging about 9 m³ each, or 9 m³ per ha. Allowing 50 per cent more for other utilizable species this will give 13.5 m³ per ha. The total accessible area of rain- and gallery forest may be estimated at about 10,000 ha, growing a total standing volume of 135,000 m³. The allowable cut has been given as 1,350 m³ (r) per year.

This leaves aside the question of whether exploitation of trees in gallery forests is desirable from the point of view of soil conservation.

In forests such as Talanga there are a large number of other species such as *Chrysophyllum albidum*, *Celtis zenkeri*, and *Cola cordifolia* (the last also found in gallery forests) which are not in commercial demand as yet. If these species could be utilized, an increase of yield could of course be allowed.

e) Montane forest species

The montane forest of the Imatongs has as its most important species *Podocarpus milanjianus* and *Olea hochstetteri*, with smaller number of *Pygeum africanum*, *Ocotea kenyensis* and others.

It is difficult to estimate the available yield. At present (1960) a small sawmill exists at Gilo, cutting *Podocarpus* and producing about 400 m³ a year of sawn timber. *Olea* is commoner and a total cut of 1,000 m³ of sawn timber a year for the next 10-20 years may be possible. At the end of this period recently planted conifer plantations should be ready for felling, and future yield would be obtained from them.

f) Other species in the southern Sudan

Terminalia glaucescens is at present (1960) utilized for sleepers in the Kati area, but the total accessible area of well-stocked forest is small, and the total growing stock in terms of sawn timber is unlikely to exceed 20,000 m³. Allowing a 50-years rotation which, judging by the annual rings

on the trees is fairly reasonable, a yield of 800 m³ per year could be expected.

Albizia zygia, Vitex doniana, Lannea kerstingii, etc. These species have rather inferior timbers which might however be utilized for such purposes as box making and other needs where quality is not very important. They might yield 2,000 m³ a year.

Acacia sieberiana, A. polyacantha. There are fairly large stands of Acacia sieberiana along the Nile. The trees would be big enough for railway sleepers, but the wood is not durable and preservative treatment would be needed. If this could be done successfully there would be possibilities of some sleeper production from these forests.

Acacia polyacantha is common in parts of the south Sudan, and could possibly be used for railway sleepers. A large proportion of the stands are however inaccessible.

The table below shows the estimated annual yields of sawn timber from all potential sources:

Species	Estimated annual yield, m ³ (s)
<u>North Sudan</u>	
<u>Acacia nilotica</u>	7,200
<u>Acacia albida</u>	5,000
<u>Anogeissus leiocarpus</u> , <u>Khaya senegalensis</u>	
<u>Cordia africana</u> , etc.	5,000
<u>South Sudan</u>	
<u>Khaya senegalensis</u>	2,500
<u>Daniellia oliveri</u>	1,250
<u>Isoberlinia spp.</u>	128,000
<u>Khaya grandifoliola</u> , etc.	800
Montane forests	1,000
Other species (approx.)	4,000
Grand total	154,760

It should be noted that: (a) the figures include some species which are at present not marketable, and thus the estimate may be on the high side; (b) most of the potential production is from timber suitable for railway sleepers, but rather inferior for other purposes; (c) about 80 per cent of the resources are in Isoberlinia spp.

Fuelwood

No accurate estimates of fuelwood resources are available. A rough figure would be a total growing stock of 1,500 million m³ for the whole country, but this might easily be in error to the extent of 50 per cent. Taking the country as a whole, this would cover present demands, and future demand as foreseeable for several decades ahead. In certain regions there will certainly become (and is) a serious lack of fuelwood.

S W A Z I L A N D

General

Swaziland has a total area of 1.7 million ha. From the high-veld on the west, averaging 1,000 to 1,200 m in altitude, there is a steplike descent eastwards to the low-veld (up to 450 m).

The eastward descent is accompanied by a rise in temperature and by a decrease in mean annual rainfall from 1,100 to 1,900 mm in the west to 500 to 750 mm in the low-veld.

FAO Production Yearbook 1971 gives the following information about land use (information from 1970):

Land use	Area, 1000 ha
Arable land and land under permanent crops	251
Permanent meadows and pastures	1,268
Forest land	129
Other land	88
Land area	1,736
Total area	1,736

Natural forest land

Swaziland has practically no natural forest cover. There are however 40,000 ha of savanna forest in the low-lying eastern part of the country.

Man-made forests

The only forest areas of any commercial importance are the plantations of pines, Eucalyptus and wattle. These plantations were started in 1948. An inventory of commercial timber plantations undertaken in 1970 gives the following main results:

Species	Area, ha
Pines ^{1/} and other coniferous	68,381
Eucalyptus	7,569
Wattle	542
Other broadleaved	2
Total	76,494 ^{2/}

1/ Main species *P. patula* (60 per cent), *P. taeda* and *P. elliottii*.

2/ WFI 1970 gives a planted area of 89,000.

All plantations are privately owned, in the main by two big companies. The "natural forest" is public.

The pine plantations are situated in seven locations along the western border. Four of the estates are integrated establishments - three sawmills and one pulp mill.

The average yield of utilizable wood for pulping has been estimated to be 15 m³ per ha and year. Fires present a difficult problem in the dry season.

T A N Z A N I A

General

Tanzania has a total area of 94 million ha. The main mountain areas occur in a northern belt - the Usambara, Pare, Kilimanjaro and Meru mountains. A central and southern belt consist of the Southern Highlands, the Ukaguru and the Uluguru mountains. A north-south running belt, runs from the Ngongoro crater and southwards. Fault movements have resulted in the depressed areas of the Rift valley. Much of the inland Tanzania outside these regions is made up of gently sloping plains and plateaus broken by low hill ranges and scattered isolated hills. Along the coast is found a narrow Coastal plain.

Mean monthly temperatures are very closely correlated with altitude. Rainfall is variable, both from place to place and time to time. For much of the country most rain falls in one rainy season (November-May). Only three per cent of the country receive more than 1,250 mm. About 50 per cent of the country receives less than 750 mm a year.

According to two different sources the land use is as follows:

Land use	Area, 1000 ha	
	FAO Production Yearbook 1971 ^{1/}	WFI 1970 ^{2/}
Arable land and land under permanent crops	11,702	} 56,300 ^{3/}
Permanent meadows and pastures	44,754	
Forest and other wooded areas (Forest land)	31,074	44,384 ^{3/}
Forest	..	1,358
Open woodland	..	37,739
Scrub and bushland	..	5,287 ^{4/}
Other land	6,440	..
Land area	88,622	88,699
Total area	93,970	89,230

1/ Information from 1966

2/ Zanzibar and Pemba not included in these figures. Information from 1969.

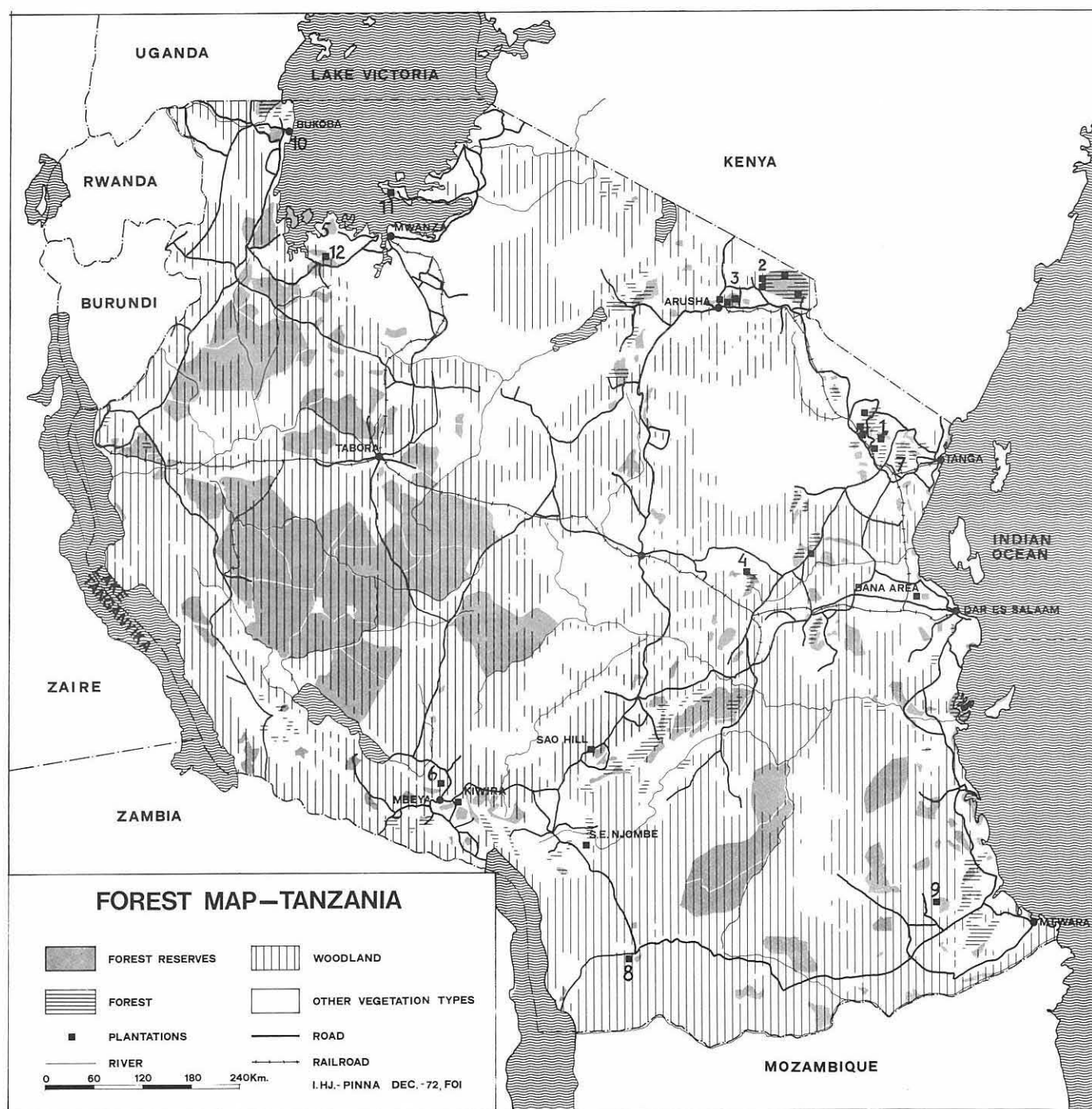
3/ One of these figures is too high. If the area of the different land use categories are added together the sum by far exceeds the total area.

4/ Included is 80,000 ha of mangrove

Vegetation types

Mountain forest:

This is a dense high-altitude rainforest. The main species are *Podocarpus* spp. (podo), *Ocotea usambarensis* (camphor), *Juniperus procera* (cedar), *Olea* wel-



witschii (loliondo), *Cephalosphaera usambarensis* (mtambara), and *Cassipourea malosana* (pillarwood).

These forests supply the timber. They also regulate water flows and protect the soil from erosion. They are typically heterogenous forests with a low stocking of good timber species within a mixture of less-desirable species. The terrain is, normally difficult. Besides the mountain forest there also exist some ground-water forest and submontane rainforest.

Open woodlands

Open woodlands occur in the foothills, along the coast as ground-water woodlands and in the widely distributed so called Miombo woodland.

The main tree species are *Chlorophora excelsa* (mvule), *Khaya nyasica* (African mahogany), *Brachylaena hutschinsii* (muhuhu) and *Dalbergia melanoxylon* (blackwood) in the foothills and along the coast, and *Pterocarpus angolensis* (muninga), *Brachystegia spiciformis* (mtundu), and *Azelia quanzensis* (afzelia) in the Miombo.

It has been estimated that there are around 15 exploitable trees per km². Secondary species being around 60 per km². The trees are small and rarely over 60 cm d.b.h. The best Miombo stands can give 35-80 m³/ha. From the logging point of view these open woodland areas are excellent.

Only a part of the open woodlands are reserved.

Mangrove

Mangrove is to be found along the coast, especially at rivermouths. These forests are of little interest for industrial development. They are mainly a source of timber for use as building poles for local consumption. Earlier a great deal of bark was exported but this is now decreasing.

Forest reserves

The area of forest land is distributed among the following categories:

Category of forest	Area, 1000 ha
Permanent State Forest reserves	11,210
Permanent Local Authority Forest reserves	1,670
Private forests	60
Unreserved woods on public lands	31,290
Total forest land	44,230

The distribution of reserved and unreserved forest land between different vegetation types is shown on next page.

Vegetation type	Forest land		
	Unreserved	Reserved	Total
	Area, 1000 ha		
Closed forest	355	975	1,330
Woodlands	26,140	11,440	37,580
Mangrove	-	80	80
Open areas and grasslands	4,855	355	5,210
Plantations	-	30	30
Total	31,350	12,880	44,230

This information is rather unreliable.

The unreserved areas of closed forest will probably disappear.

Unreserved forest land supplies quite a lot of timber. In the middle sixties these areas supplied over 80 per cent of the saw-log production. In 1968 unreserved forest land gave 45 per cent of the saw-log production.

Man-made forests

These will in future supply the major part of the timber required by forest industries. The species distribution of the areas planted by the end of 1969 were as follows:

Species	Area, ha
Cupressus (mainly <i>C. lusitanica</i>)	4,905
<i>Pinus patula</i>	10,959
<i>Pinus radiata</i> ^{1/}	2,015
<i>Pinus caribaea</i>	2,750
<i>Pinus elliottii</i>	2,605
Other pines	770
Cedar	260
Broadleaved ^{2/}	2,425
Others ^{3/}	1,873
Eucalyptus	..
Total	28,562

1/ Is attacked by needle blight and is now discontinued.

2/ *Maesopsis eminii*, *Tectona grandis*, *Olea welwitschii*, *Chlorophora excelsa*.

3/ Mixed pine/cypress and mixed hardwood/softwood

4/ The WFI 1970 gives the total area planted as 38,000 ha.

In addition to the areas given above is reported to exist considerable areas with wattle plantations (30,000 ha).

Preliminary investigations show that *Pinus patula* and *Cupressus lusitanica* could yield 27-30 m³/ha. *Pinus caribaea* gave 131 m³/ha in 6.5 years. At present the plantations are only producing a little more than 50 per cent of the quoted amount.

Most important plantation areas:

a) Ruvu project: Located on the river Ruvu (60 km from Dar-es-Salaam). At present (1971) 400 ha of plantations exist. Forty thousand ha is presently planned for plantations. An area of 100,000 ha is reserved for plantations. The planned planting rate is 2,000 ha/year. This seems to be the most important planting project. (Bana area)

b) Mbeya area (Kawetire and Kiwira):

Planted area: 3,000 ha

Available land: 45,000 ha

c) Sao Hill:

Planted area: 6,000 ha

Available land: 85,000 ha

d) Matogoro and Rondo

Available land: 65,000 ha

The plantations were earlier established inland. Now there is a move towards the coast.

Information for different plantation projects are given in the table below: (information from 1970):

Project	Planted area (inclusive 1969)	Area to be planted (inclusive 1974)	Provisional annual plant- ing target after 1974
	ha		
Ruvu	382	7,695	(2,025)
Buhindi	209	2,025	(405)
Kawetire	1,191	-	..
Kiwira	2,018	-	..
Kwamkoro	236	243	(61)
Matogoro	582	354	..
Meru	3,370	1,931	..
North Kilimanjaro	3,005	1,246	..
Rondo	924	1,093	(223)
Rubare	396	..	..
Rubya	1,586	..	..
Sao Hill	5,779	3,239	(810)
Ukaguru	1,613	-	..
Usa	506	-	..
West Kilimanjaro	1,451	1,822	(486)
West Usambara	3,462	243	..
Total	26,710	19,891	(4,010)

Concessions:

In indigenous forests an area of 11,700 ha is under short-term concessions. There are only a few concessions since cutting-licences are given instead. The exploitation is scattered and sporadic - most of it is undertaken in the Tabora area.

Inventories

- a) The coniferous plantations have been inventoried.
- b) Approximately 75 per cent of the Forest reserves were enumerated between 1950 and 1964. Only commercial species have been enumerated. The results are of very little use for planning at a national level.
- c) A CIDA team have recently undertaken inventories of selected areas (according to the plans 8.5 million ha). No results available.

T O G O

General

Togo has an area of 5.6 million ha. From a coastline of 56 km Togo extends inland for about 540 km. In the western part against the Ghana border the terrain is quite mountainous. The peaks reach up to 1,000 m. To the east and in the south there is a vast peneplain.

The coastal area has an annual rainfall of 780 mm. Away from the coast the dry season increases in length.

According to FAO Production Yearbook 1971 the land use is as follows (information from 1965):

Land use	Area, 1000 ha
Arable land and land under permanent crops	2,160
Permanent meadows and pastures	200
Forest land	530
Other land	2,710
Land area	..
Total area	5,600

1/ Of which 1,140,000 ha is fallow fields

2/ Of which 1,500,000 ha is unproductive

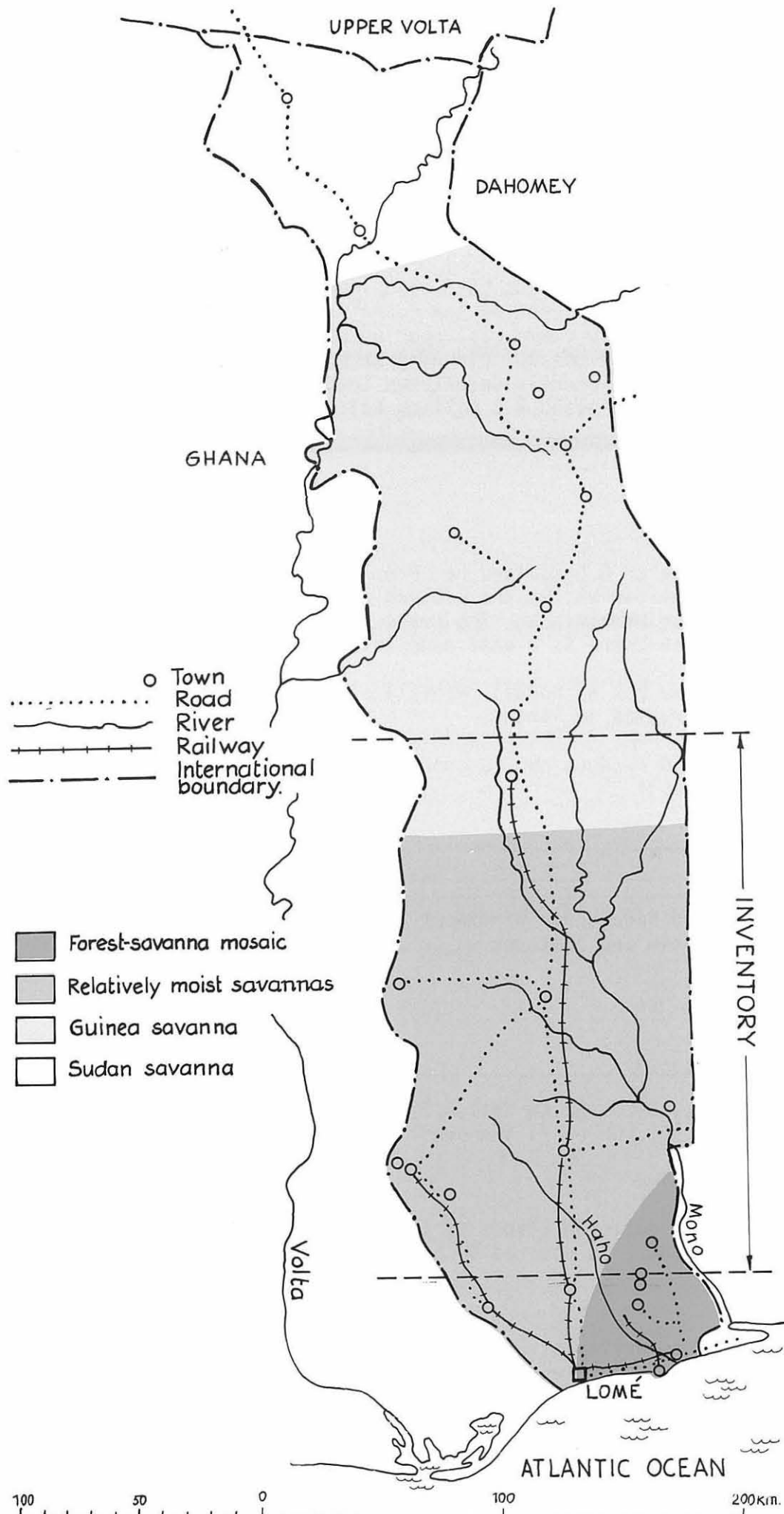
Natural vegetation

There are some scattered stands of closed forests in the southern part, but most of the country is covered by open woodlands and grass savannas.

Inventories

A reconnaissance survey of 2,555,000 ha has been undertaken in the southern half of the country, between the parallels 6°30'N and 8°50'N. In this area practically all closed forest is found.

FOREST MAP—TOGO



Land use (and vegetation types) in this area were as follows:

Land use	Area, ha
Semi-deciduous forest	293
Low dense forest on slopes	86
Dry dense forest	70
Secondary growth	116
Wooded savanna	1,292
Grass and bush savanna	514
Agriculture	184
Total	2,555

The standing volume of the two main commercial species is as follows:

Species	Standing gross volume, million m ³
Fromager	7
Ako	3

These two species make up two-thirds of the potential of known commercial species. Red-woods (bois rouge) are not common. It is difficult to use this potential volume as it is quite scattered.

The potential volume in species groups, diameter classes and vegetation types are shown in the table below:

Species group	Diameter class, cm	Vegetation type			
		Dense dry semi-deci- duous forest	Dense dry forest	Wooded savanna	Low dense forest on slopes
		Volume, 1000 m ³			
Principal species	≥ 62	2,695	165	600	1,075
	62-80	960	65	305	350
	≥ 80	1,735	100	295	725
Secondary species	≥ 62	5,870	810	1,170	3,165
	62-80	1,250	145	510	585
	≥ 80	4,620	665	660	2,580
Complementary species	≥ 62	9,195	1,280	2,590	3,240
	62-80	4,680	720	1,945	2,610
	≥ 80	4,515	560	645	630
All species	≥ 62	17,760	2,255	4,360	7,480
	62-80	6,890	930	2,760	3,545
	≥ 80	10,870	1,325	1,600	3,936

Man-made forests

There exist 6,000-8,000 ha of teak plantations. They are very small and scattered village plantations which have in many cases suffered from damageable extraction. No thinnings are undertaken and the plantations give very little production. Fire is a great problem. The real area of utilizable teak plantations at present is said to be 3,000 ha.

T U N I S I A

General

Tunisia is situated in the extreme north of the African continent and covers an area of 16.4 million ha. Northern Tunisia is crossed by two parallel chains of hills and there are some mountainous areas along the border to Algeria. However, the main part of the country is formed by widespread flat or slightly undulating regions with altitudes not extending 200 m above sea level.

The climate varies considerably from one year to the other, from one season to the other and from the north to the south. It is influenced both from the Mediterranean and from the vicinity of the desert. In summer, temperatures can reach over 40°C and the annual average of Tunis is 18°C. The rainfall varies from one year to the other, but is highest in the north (120 days/year) whilst in the deep south it is next to nil.

The land use is as follows according to two different sources:

Land use	Area, 1000 ha	
	FAO Production Yearbook 1971 ^{1/}	WFI 1970 ^{2/}
Arable land and land under permanent crops	4,510	10,099
Permanent meadows and pastures	3,250	
Forest and other wooded areas (Forest land)	1,240	690
Forest	..	367
Open woodland	..	-
Scrub and brushland	..	323
Other land	7,415	4,000
Land area	15,590	15,415
Total area	16,415	16,415

1/ Information 1961

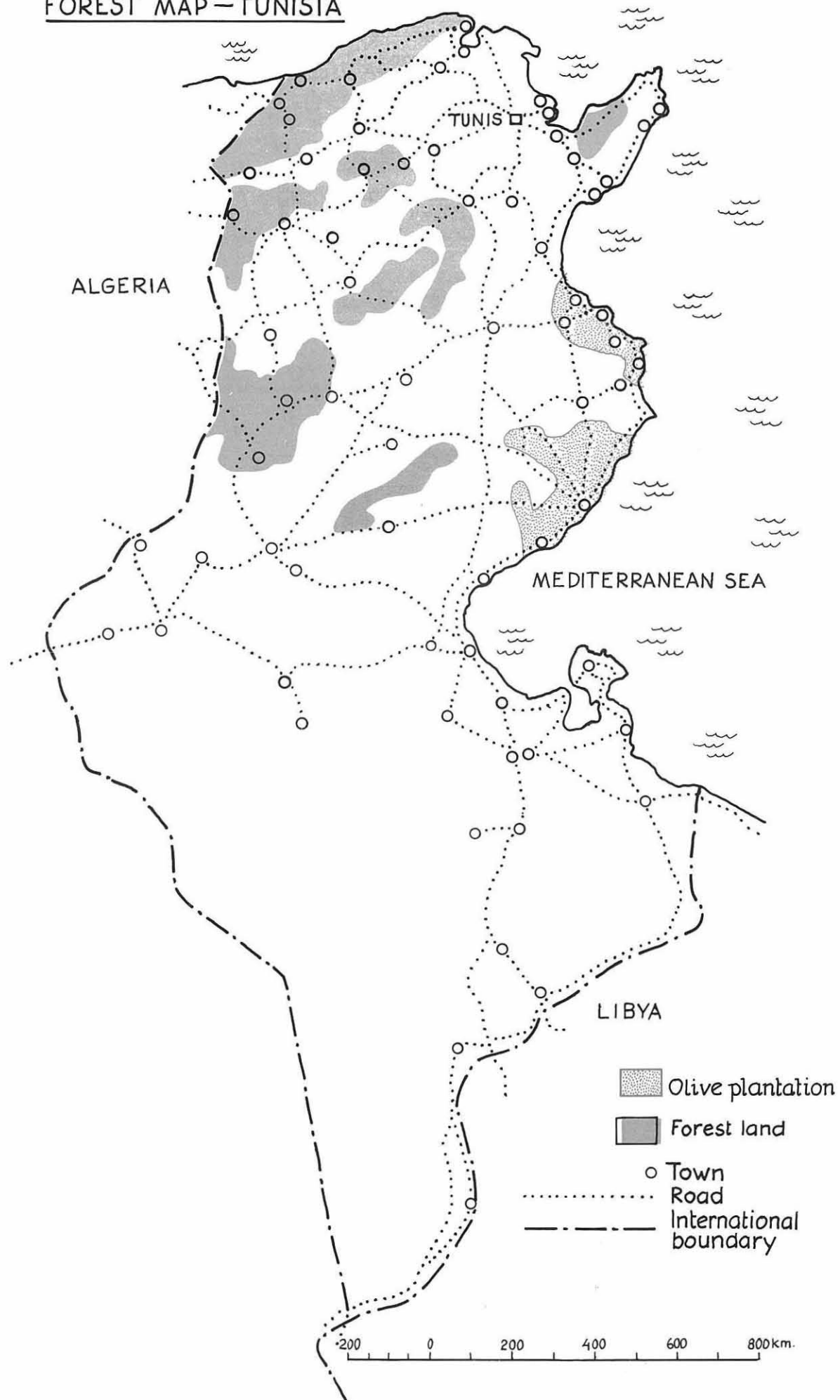
2/ Information from 1969

Natural forest land

Tunisia reported to the WFI 1970 253,000 ha as natural forest. These forests are found in the two parallel chains of hills running from south-west to north-east.

Those of the northern massif (100,000 ha) are predominantly of cork oak

FOREST MAP-TUNISIA



(*Quercus suber*) either pure or in mixture with *Q. faginea* or *Pinus pinaster*. These forests have been well managed for a long time and are relatively well equipped with roads. Current cork production per hectare is about 85 kilos/year.

The forests of the southern massif, the "Dorsal", consist mostly of *Pinus halepensis*, or *Quercus ilex* (150,000 ha). The pines are slow growing and of poor form and have never been properly managed. Current removals of industrial wood are about 0.05 m³/ha and year. Working plans are being prepared for these forests. In the pine forests containing 30-50 m³/ha, the increment is estimated to be 0.5 - 0.6 m³/ha and year.

One estimate gives an area of 180,000 ha dense enough for utilization; 80,000 ha of this is *Pinus halepensis*, the rest is *Quercus suber* and *Q. faginea*.

An area of 323,000 ha of scrub and brushland was also reported (WFI 1970).

Man-made forests

The planted area is said to be 114,000 ha. These plantations are mainly *Pinus pinaster*, *P. radiata*, *P. halepensis* and *Eucalyptus* spp.

The present plans are to plant 18,000 ha. The actual planting rate is reported to be 11,000 - 14,000 ha/year. Of the annual plantings, 5,000 - 6,000 ha are for production, the rest are protective.

All the forests in Tunisia are state-owned.

Inventories

It was reported that all the forests were covered by an extensive inventory (WFI 1970). The same source gave the following information about standing timber.

Species	Standing timber 1000 m ³ o.b.
<i>Quercus suber</i> , <i>Q. lusitanica</i> ssp. <i>canariensis</i>	4,750
<i>Pinus halepensis</i> , <i>P. pinaster</i> , <i>P. pinea</i>	2,531
<i>Eucalyptus camaldulensis</i> , <i>E. gomphocephala</i> , <i>E. occidentalis</i> , <i>Acacia cyclopis</i> , <i>A. cyanophylla</i>	445
<i>Cupressus sempervirens</i> , <i>C. macrocarpa</i> , <i>Casuarina glauca</i>	50
Total	7,776

In these figures about 90 per cent of the total volume is included (certain species not included). All ages and diameters as well as natural and man-made forests are included. If bark is excluded the total volume is 6.8 million m³.

Other

1) The following estimates concerning crown-density was given (WFI 1970):

Crown-density	Area, 1000 ha	
	Natural forest	Man-made forest
Good (1.0-0.7)	70	23
Medium (0.69-0.4)	60	57
Poor (less than 0.4)	114	34
Forests temporarily unstocked	10	-

U G A N D A

General

The total area is 23.6 million ha but 18 per cent of this is made up of freshwater lakes. Of the land area 84 per cent forms a plateau at between 900 and 1,500 m. The highland point is 5,029 m on Ruwenzori in the west, but large areas of highland are also included in the Mount Elgon massif in the east.

Temperature varies little throughout the year giving the country an equatorial climate modified by altitude. Rainfall is greatest bordering Lake Victoria and on the mountains, where small areas have over 2,000 mm.

The land use is as follows according to two different sources:

Land use	Area, 1000 ha	
	FAO Production Yearbook 1971 ^{1/}	Ugandan Authorities 1972
Arable land and land under permanent crops	4,888	} 12,047
Permanent meadows and pastures	5,000	
Forest land	9,172	2,759 ^{2/}
Other land	4,544	4,544
Land area	19,365	19,350
Total area	23,604	23,589

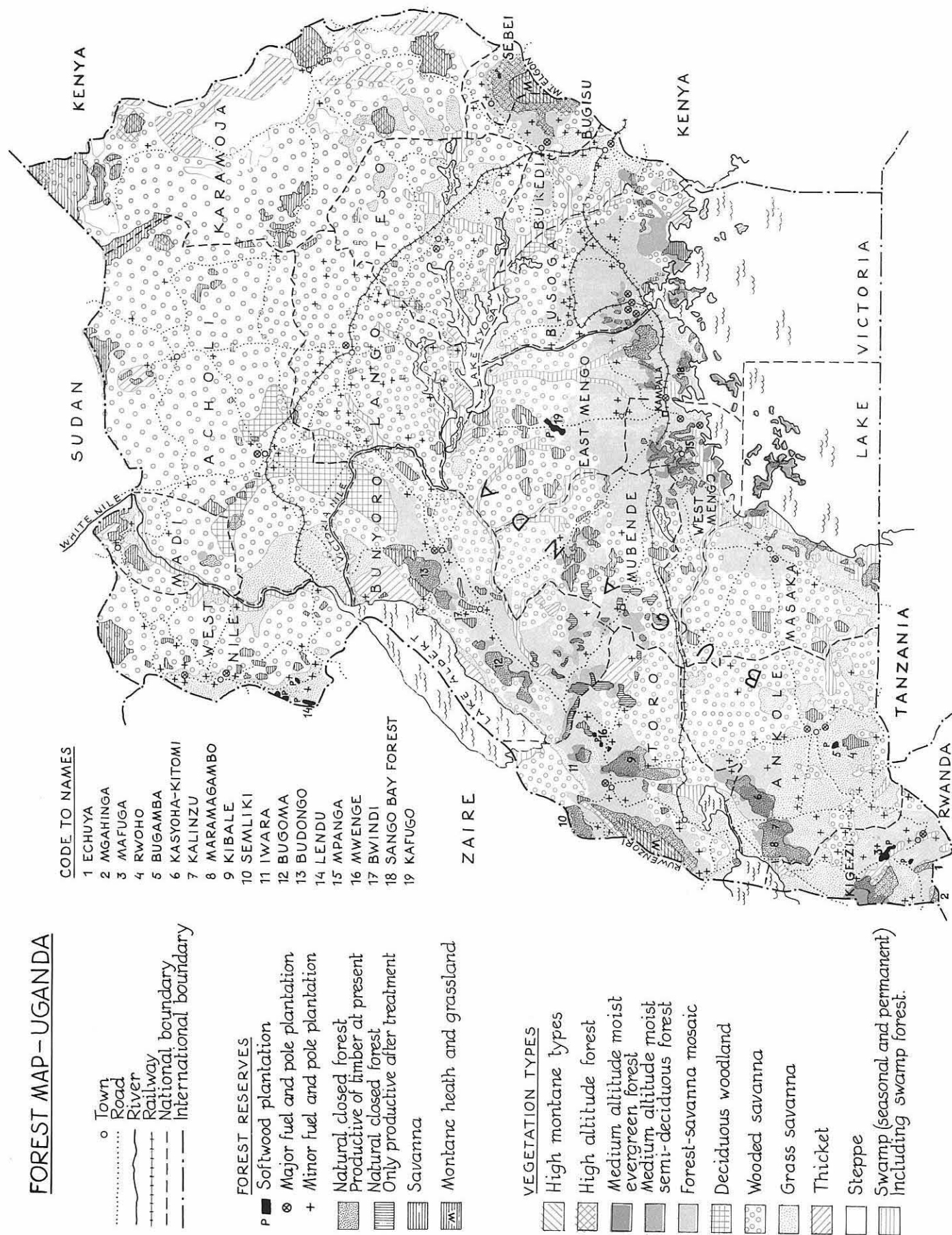
1/ Information from 1967

2) The area of forest land has been decreased to 2,759,000 ha from the 9,172,000 ha given in earlier publications because of transfers for agricultural development.

Vegetation typesA. High altitude forest

a) Moist montane forest (1,500 - 2,700 m):

FOREST MAP-UGANDA



This type forms a dense canopy that varies in height from about 12 to 24 m. Three subtypes of this vegetation type can be recognized.

There are not so many species in this forest although it is quite varied. Much of the forest is small, 60 cm in diameter, 18 m in height. The canopy is usually very broken. This type is mainly of importance for soil and water conservation.

b) Dry montane forest (1,500 - 2,700 m):

This is a *Juniperus* - *Podocarpus* forest. It is mostly reduced to *Protea* scrub by cutting. Some forests of this type do still exist but they are mainly needed for conservation. This forest seldom exceeds 18 m and has fewer epiphytes and less understoreys than the moist type.

c) Montane bamboo forest (2,250 - 2,700 m):

An irregular belt of the montane bamboo (*Arundinaria alpina*) often lies between the two types mentioned above. The following areas of bamboo are reported to be found:

Region	Area, 1000 ha
Mt Elgon	20
Ruwenzori	20
Echuya	3
Mgahinga	0.6
Acholi bamboo reserve	3

B. Medium altitude forest

This type forms closed stands, 30 - 45 m high with an abundant number of species. The trees often reach 2 m in diameter. Two subtypes are identified.

a) Moist evergreen forest

b) Moist semi-deciduous forest

In the closed forests over 100 species can give saw-logs of 57 cm d.b.h. (many more could give saw-log quality of smaller sizes). In all over 400 species of trees and larger shrubs have been recorded. The table below gives an idea of the species distribution in different closed forest types:

Diameter class	Forest reserve		
	Mpanga ^{1/}	Kibale ^{2/}	Bugoma ^{3/}
No. of species of trees and shrubs			
Commonly 85 cm diameter (above buttress) and over	60	30	31
Commonly 48 cm diameter but rarely over 85 cm	33	23	52
Commonly 9.5 cm diameter but rarely over 48 cm	58	50	44
Rarely 9.5 cm diameter	28	30	11+
Total	179	133	133+

1/ Medium altitude moist evergreen forest

2/ Moist evergreen forest at higher altitudes

3/ Moist semi-deciduous forest at medium altitudes

Due to different altitudes etc. a large number of different types of closed forest can be found. The border line between closed forest and open woodland is decided mainly by fire.

The total volume of all species in closed forest has been given as 155 m³/ha of which 33 m³/ha is above d.b.h. 50 cm.

C. Woodland

This type differs from forest in that the wooded species form a single layer which is underlaid by a more or less continuous grass layer. The canopy is closed and the height varies from 9 - 15 m.

D. Wooded savannas

Its range is from scattered shrubs 2 to 5 m high in grassland through scattered trees 5 to 12 m high in grassland, to an open canopy of trees 5 to 12 m high underlaid by grass. The canopy is always open.

The savanna areas produce fuel and building poles. Plantations of fast growing species are laid out in selected areas.

The land cover of different types is crudely as in the table below (information roughly 10 years old):

Land cover	Area, 1000 ha
Well drained woodland and savanna	11,400
Seasonally swampy savanna	2,000
Thicket, shrubland and steppe	1,950
Altimontane heath, moorland and grassland	50
Forest (including Arundinaria)	800
Permanent freshwater swamps	1,000
Cultivated crops	2,800
Open water	3,600
Total	23,600

Forest reserves

The distribution of the Forest reserves between different types is as follows:

Type	Area, 1000 ha
Total Forest reserves	1,552
Closed forests	722
Plantations	19
Wooded savannas and other types	810

In all 685 reserves have been established. Their distribution in size-classes is as follows:

Size, ha	No. of reserves	Percentage of area
10 - 500	477	58%
500 - 5,000	149	22%
5,000 +	59	20%

There are also some closed forests outside the reserves. One estimate some years ago gave 55,000 ha of private forests in Buganda and 22,000 ha of "public land" in Bunyere. These unreserved forests will probably disappear. Their present area - if any - is unknown.

Man-made forests

The position at September 1st 1971 was as follows:

Type of plantation	Area, ha
Coniferous	9,050
Firebreaks	291
Fuel and pole plantations (Eucalyptus)	7,528
Mixed broadleaved	2,080
Other	700
Total	19,469

There should also be about 6,900 ha (in 1970) of private fuel and pole plantations.

The main coniferous species planted are: *Pinus caribaea*, *P. occarpa*, *P. kesiya*, *P. patula*, and *Cupressus lusitanica*.

The main broadleaved species planted are: *Maesopsis eminii*, *Chlorophora excelsa*, *Khaya* spp., *Olea*, *Fagara* and some *Tectona grandis*.

For poles and fuel the main species are *Eucalyptus saligna*, *E. robusta* and *Cassia siamea*.

The annual planting target for coniferous is 2,000 ha. This area is to be planted in 13 areas. The main species will be *Pinus caribaea*, *Cupressus lusitanica*, *Pinus patula* and *P. occarpa*. The six main groups of plantations are located in Mwenje, Kibale, Kapwata-Suam, Lendu, Bugamba-Rwoho and Mafuga.

The rotation period varies from 20 to 30 years. At present clearfellings take place at the age of 22 years.

An investigation gave an area of 276,000 ha as potentially available and suitable for plantations within the savanna areas. A breakdown of this area by regions looks as follows (the information for a couple of regions are missing):

Region	Area suitable for planting, ha
Mubende	50,000
E. Mengo	48,800
Masaka	29,300
W. Mengo	7,100
Sebei (Bugisu)	700
Bukedi	4,500
Busoga	32,300
Teso	13,800
Acholi	26,490
Lango	17,700
W. Nil	11,500
Madi	800

Inventories

In the closed forest the following inventory work has been done:

- a) Most reserves (80%) have been type mapped from aerial photographs and by ground sampling between 1955 and 1960.

Half of the area not type mapped is accounted for by mountain forests with a mainly protective function at present.

The ground sampling done for type mapping enabled estimates to be made of available volume by a comparison with data from similar forest which had been enumerated.

- b) Seventy per cent of the reserves, have been enumerated by what is called exploratory sampling usually by a stratified random system at 1-2 or 3% intensity between 1950 and 1960.

In one-third of the enumerations only representative blocks were sampled, not the whole forest. In these cases the sample was less than 1-3% of the reserve area.

Before exploitation all closed forest areas are stock mapped for all species which must be felled, and for a few optionals, usually down to a limit of 50 cm d.b.h. but sometimes lower.

A CIDA team has recently updated the above information. This information is

given for different Forest reserves and is close to impossible to summarize. The commercial volume seems to be about 20 m³/ha. An old estimate gave the volume of commercial and potentially commercial species above 50 cm d.b.h. in Forest reserves as 15 million m³ u.b. In unreserved forests the volume was given as 3 million m³ u.b.

Most Forest reserves are under working plans. The volume recorded in these are exploitable volume above 50 to 60 cm.

Description of some more important reserves

Budongo

Mahoganies (*Entandophragma* spp., *Khaya* spp.) are present in large quantities.

Bugoma

In this reserve there is a dominance of *Cynometra*. Mahoganies are rare.

Kibale - Iwara

In the northern part there are mature forests dominated by *Parinari excelsa* with *Carapa grandiflora*, *Olea welwitschii*, *Aningeria*, *Strombosia*, etc. In the central part the forest is very mixed. The principal species are *Chrysophyllum* spp. and *Celtis* spp. The southern part is dominated by *Pterygota meladraedii* and *Olea welwitschii*. *Cynometra alexandri* is dominant in parts. These reserves produce mainly construction and mining timber and some furniture wood.

Kalinzu

There are many species with *Parinari excelsa* dominant. It sometimes forms pure stands. Mining timber is exploited in this reserve.

Kasyoha-Kitomi

No data about these reserves are available but the most common species are *Parinari excelsa*, *Strombosia*, *Schefflera*, *Maesopsis eminii* and *Entandophragma excelsum*. The species are suitable for mining, construction, match wood, peelers and furniture.

Maramagambo

This reserve has a mixture of many species. Some mahogany and *Cynometra alexandri* are found. Sixty per cent of the reserve is situated in Queen Elisabeth National Park.

Bwindi

Many mahogany species are found in this reserve. In the north the most common genera are *Parinari*, *Entandophragma* and *Newtonia*. In the south mainly *Chrysophyllum*, *Entandophragma*, *Newtonia*, *Prunus* and *Podocarpus* are found. The exploitation is mainly done by pit-sawyers.

Ruwenzori

This reserve has mainly a protective role. It is inaccessible and contains only a small area of productive forest. Bamboo is said to cover 20,000 ha.

Semliki

Very little is known about this forest. It is type mapped but no volume information is available. *Cynometra* which is the most common species sometimes forms pure stands.

Lake Shore forest

This forest is formed mainly of *Piptadeniastrum africanum*, *Lovoa trichilioides*, *Mimusops bagshawei*, *Maesopsis*, *Antiaris*, *Pycnanthus* and in some parts, *Canarium schweinfurthii*.

Sango Bay forest

In this reserve dry sites are dominated by *Chrysophyllum albidum* and *Baikia insignis* while wet sites are dominated by *Mitragyna* and *Sapium*. *Podocarpus usambarensis* is found on dry and wet sites. This forest has been heavily felled since 1920 and the present growing stock is young. Exploitation is not possible within 30 - 40 years.

South Mengo

This reserve is strongly influenced by man. The harvesting is controlled and enrichment planting is undertaken. The crop is mixed, the dominating species are *Albizia* spp., *Celtis* spp., *Antiaris toxicaria*, *Lovoa* spp, and *Maesopsis eminii*. In Mabira forest the species found are *Celtis* spp., *Chrysophyllum*, *Albizia* and *Antiaris*.

Mt Elgon and Namatale

Mt Elgon has large quantities of furniture timber including *Entandophragma excelsum* and *Olea welwitschii*. Half of the forest is on steep slopes. In Namatale forest the most common genera are *Celtis*, *Albizia*, *Antiaris* and *Ficus*.

Accessibility

A detailed description of the accessibility in different reserves was made by a CIDA team in 1971. For the whole country the situation in the closed forests can be summarized as follows:

Accessibility class ^{1/}	Area, 1000 ha
1	333
2	65
3	123
4	22
5	181
Total	724

1/ Definition of accessibility class:

Accessibility class 1: Area under systematic intensive exploitation.
 " " 2: Areas very important for further exploitation and quite accessible.
 " " 3: Areas with very difficult accessibility. Exploitation will probably not start in the near future.

- Accessibility class 4: Unimportant areas - because of the size of forests, accessibility and species composition. Exploitation will probably not be economical.
- " " 5: Protective areas - areas on very steep rocky ground, inaccessible, important for water catchment and soil protection.

Exploitation

More species are used now than before. The table below gives an indication of this:

Year of exploitation	Percentage of exploited volume from 5 species
1953	70
1963	49
1969	40

The cutting of certain species is compulsory (around 25), others are optional.

The following areas are, or have been, under planned exploitation:

Areas under salvage felling:	44,981 ha
" " conversion felling:	214,769 ha
" already cut over:	26,409 ha

Around Lake Victoria clear-cutting is now undertaken. First as much timber as possible is exploited, then the rest is used for charcoal. In the clear-felled areas plantations are undertaken. In other parts (e.g. Budongo) a silvicultural system is used which in the long run aims to create a uniform forest of desirable species. But production will in any event go down in the near future. In these areas the average cut is now 25-30 m³/ha.

Possible volume from forest under exploitation at present and in 1987 is shown in the table below:

Species group	Year of exploitation	
	1972	1987
	1000 m ³	
Mvule and mahogany	41	11
Other compulsory	131	72
Optionals	41	36
Total	214	119

As production decreases exploitation will have to start in forests which are unexploited at present.

U P P E R V O L T A

General

Upper Volta has an area of 27.4 million ha. It is a dry and rather infertile country. The annual rainfall is only some 625-1,100 mm and comes in a rainy season of, at most, five months.

FAO Production Yearbook 1971 gives the following information about present land use (information from 1970):

Land use	Area, 1000 ha
Arable land and land under permanent crops	5,377
Permanent meadows and pastures	13,755
Forest land	4,101
Other land	4,187
Land area	27,380
Total area	27,420

Forest land

Upper Volta is mainly covered with Sudan savanna. In the south-western corner areas of Guinea savanna are found. The annual rainfall in this area is 800-1,300 mm. The so-called "forest reserves" cover about 3.5 million ha. Recent estimates give the area of "forest" (Guinea savanna) as one million ha. The present forest products are mainly fuelwood and poles.

Some forest plantations of an experimental nature have been started in three different areas, mainly in the south-western region. The area planted amounts to 2,000 ha. The main species are teak and Anacardium.

Z A I R E

General

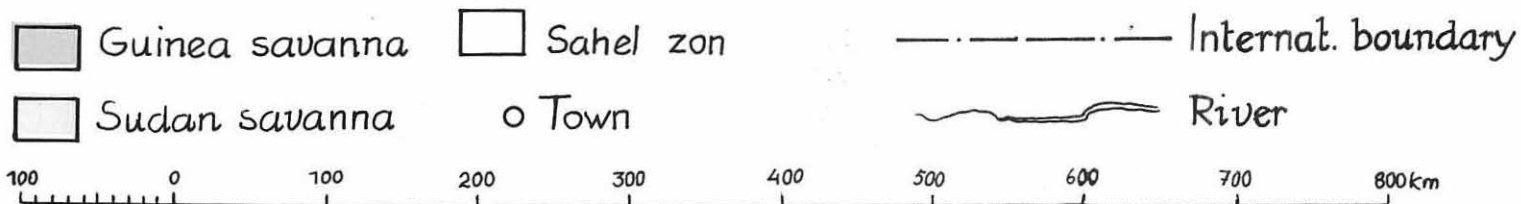
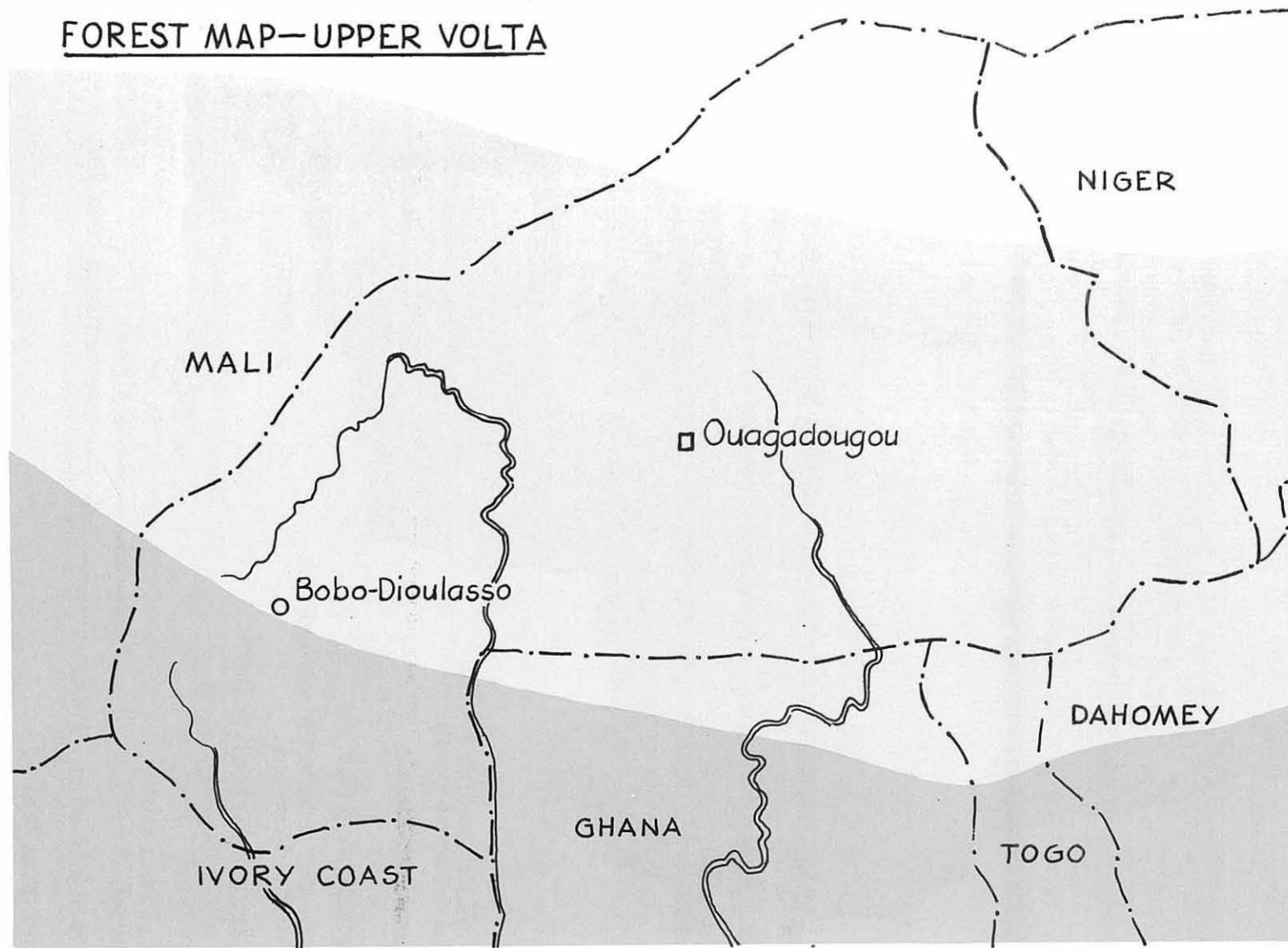
With an area of 234.5 million ha Zaire covers the main part of the Zaire (Congo) basin. In the centre this is a peneplain at an altitude of 300-500 m. This plain is surrounded by a plateaus zone with an altitude of 500-1,000 m. The most broken-up parts of this periphery are found in the west, in the lower Zaire, and above all in the east. In this eastern, partly volcanic, mountain range Ruwenzori reach above 5,000 m.

The internal part of the Zaire basin is a landscape of horizontal terraces. The sections that have been flooded and are easily flooded cover a small area.

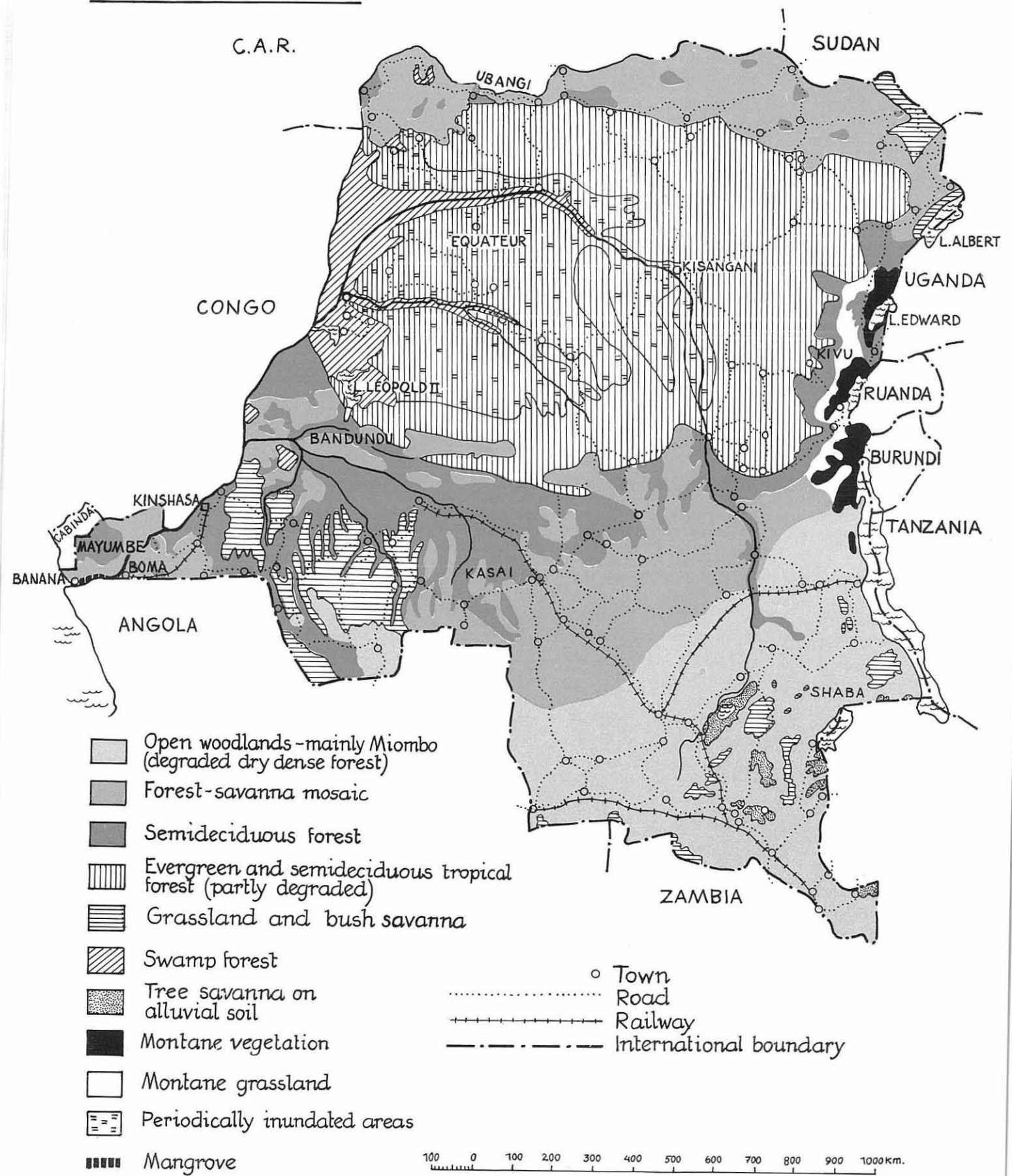
Zaire has a really equatorial climate in the whole of the central region. It has an average temperature of 26° C in the coastal and basin areas and 18° C in the mountainous regions. Rainfall is plentiful in all seasons.

FAO Production Yearbook 1971 gives the following data about land use (information from 1962):

FOREST MAP—UPPER VOLTA



FOREST MAP—ZAIRE



Land use	Area, 1000 ha
Arable land and land under permanent crops	7,200
Permanent meadows and pastures	65,500
Forest land	129,141
Other land	32,700
Land area	..
Total area	234,541

Natural forest land

In 1972 the Forest Service provided the following breakdown of the land area in vegetation-classes:

Vegetation type	Area, 1000 ha
Dense forest in the Zaire basin	101,000
Gallery forest and patches of forest	760
Dense forest in the Mayumbe	240
Montane forest	300
Dry forest of Shaba	20,000
Guinea savanna	85,000
Sudan - zambezi savanna	27,000
Total	234,300

The same source gives 2.3 million ha as cultivated.

The closed forest covers, according to different sources, a total of 90 - 110 million hectares. The remaining part of the country is mainly covered by different savanna types. The moist forest at low and medium altitude covers the whole Zaire basin, with evergreen forests and semi-deciduous types, these mainly along the boundaries of the evergreen forests. In this forest more than 300 species per hectare can sometimes be found. In all, 2,000 species might be represented in the Zaire forest. The moist forest zone is flanked to the north and south by a belt marking the transition towards woodlands and savannas and known as "forest-savanna mosaic". Therein the moist forest occurs along the streams and in patches surrounded by savanna. Some 280,000 ha of swamp forests and 300,000 ha of montane forests are also to be found, but these are of lower economic value. The Miombo woodlands, also of some forestry value, are largely found in the drier south-eastern areas of Zaire.

Large areas of moist forests have been or are under the system of shifting cultivation. Therein, the primary forest is intermingled with secondary forests of different ages. The moist forest contains per unit area a great number of different economically or potentially economic valuable species, although pure stands of *Gilbertiodendron* (at l'Ubangi) and *Cynometra* sometimes occur.

Gilbertiodendron is found everywhere in the Zaire basin where it forms pure stands of small extensions. North of the Zaire river *Gilbertiodendron* forms a compact area from Ubangi to Kisangani.

The Cynometra forest is especially dense in the Bunia region between Lake Albert and Lake Edward. Cynometra is also found in the forests east of Kisangani.

The gross volume per ha of all species is 200-350 m³ per ha. The volume actually extracted is 6 to 10 m³ per ha. In exploitations by the Forest Service a volume of 15 m³ per ha is considered as the probable volume. If all secondary species were utilized it would probably be possible to utilize 50 to 80 m³/ha.

In the drier surrounding forests, the volume both available and extracted is somewhat lower, but quality or species distribution may be better. In the best Miombo stands the available saw-log volume averages around 5 m³ per ha.

Man-made forest

There are 50,000 - 60,000 ha of plantations in Zaire. Of these conifers account for 2,000 ha. The reforestation programme was abandoned at the end of the sixties but during the last years it has been restarted. The existing plantations are in a rather poor condition. Most of the plantations have been established in the Mayumbe area. Plantations of limba in the Mayumbe go back to 1941. Since 1960 the plantations have been neglected.

Plans for the establishment of large-scale fuelwood-plantations in the neighbourhood of Kinshasa have been reported recently.

Inventories

No inventory has been made to date but now CIDA will undertake an inventory of around 3 million ha in the area of Lake Leopold II (the zones Djolu, Befale, and Basankusu). In this area there should be 10 m³ of commercial wood per ha.

An inventory in the Mayumbe region has also been discussed.

Exploitation

For five years the geographical distribution of the exploitation has been as follows:

Regions	Year of exploitation				
	1966	1967	1968	1969	1970
	Volume, 1000 m ³				
Lower-Zaire (Mayumbe)	291	290	208	223	160
Bandundu	71	95	61	95	75
Equateur	60	36	37	38	49
Upper-Zaire	29	30	9	27	41
Kivu	13	14	31	24	26
Kasai	21	23	31	41	54
Shaba	43	6	23	7	21
Total	528	494	400	455	426

The main exploitation areas are:

a) Mayumbe region (240,000 ha):

This is a semi-deciduous forest. The most characteristic species are:

<i>Celtis mildbraedii</i>	<i>Celtis brieyi</i>
<i>Entandophragma angolense</i>	<i>Gossweilerodendron balsamiferum</i>
<i>Entandophragma utile</i>	<i>Guarea cedrata</i>
<i>Hannoa klaineana</i>	<i>Oxystigma oxyphyllum</i>

In this area the exploitation is mainly for limba (*Terminalia superba*). The forest can give 10 m³/ha in untouched areas.

Local reserves of limba and other commercial species are more or less used up by now. With the present rhythm of exploitation it is estimated that limba will be exhausted in five years time. The industry must therefore start to take timber from the Zaire basin.

In 1971 the principal species were exploited as follows:

Species	Volume, m ³
<i>Terminalia superba</i>	87,900
<i>Gossweilerodendron balsamiferum</i>	33,600
<i>Chlorophora excelsa</i>	6,600
<i>Bombax</i> and <i>Ceiba</i> spp. (Fromager)	5,500

About 40 different species are actually exploited.

- b) The Banana-Boma area is a potential area for pulp and paper industry to be established within the next decade.
- c) The region of Lake Leopold II in the Bandundu Province: It is mainly an evergreen forest - partially swampy and inundated (up to 60 to 80 per cent in north and east).

In humid parts are found:

<i>Alstonia</i>	<i>Uapaca guinensis</i>
<i>Beilschmiedia</i>	<i>Didelotia</i>
<i>Mitragyna stipulosa</i>	<i>Guibourtia</i>
<i>Pycnanthus marchalianus</i>	<i>Parinari</i>
<i>Symphonia globulifera</i>	

In dry parts are exploited:

<i>Chrysophyllum flacourtianum</i>	<i>Sarcocephalus diderrichii</i>
<i>Angokea klaineana</i>	<i>Staudtia yangambiensis</i>
<i>Pentaclethra eetveldiana</i>	<i>Ocypetes armoraica</i>
<i>Guarea thompsonii</i>	<i>Blighia wildemania</i>
<i>Pycnanthus kombo</i>	<i>Tylostemon</i>
<i>Antiaris toxicaria</i>	<i>Albizia globulifera</i>
<i>Turraeanthus africana</i>	<i>Symphonia globulifera</i>
<i>Anopyxis klaineana</i>	<i>Ochthocosmus africanus</i>

Brachystegia laurentii
 Morus mesozygia
 Millettia laurentii
 Piptadenia africana

Amphimas pterocarpoides
 Chlorophora excelsa
 Erythrophleum suaveolens
 Gossweilerodendron balsamiferum

In the South and West the forest is semi-deciduous on firm soil. From this area the Zaire stream provides transport facilities although these are limited by the falls in Cristal Mount area. A rough estimate gives 10 m³/ha of commercial species.

- d) L'Ubangi in the Equateur Province is covered by evergreen forest. Many industries are set up in this area and in 1975 the production is expected to reach 400,000 m³.

Most of the wood exploited in the Zaire basin is floated on the river Zaire to Kinshasa. Wood for export is then taken by rail to Matidi.

Z A M B I A

General

Zambia covers an area of 75.3 million ha. It is a gently modulating plateau, mostly between 915 and 1,500 m above sea-level. In the northern half of the territory and along the eastern border there are small elevated regions of more resistant rocks. Three quarters of Zambia drains to the Zambesi.

The climate is mainly subtropical. The rainfall is highest in the north and falls mainly from November to April. The average rainfall is 600 mm to 900 mm in the south and over 1,250 mm in the north.

The land use is as follows (FAO Production Yearbook 1971 - information from 1962):

Land use	Area, 1000 ha
Arable land and land under permanent crops	4,800
Permanent meadows and pastures	33,800
Forest land	34,000 ^{1/}
Other land	2,661
Land area	..
Total area	75,261

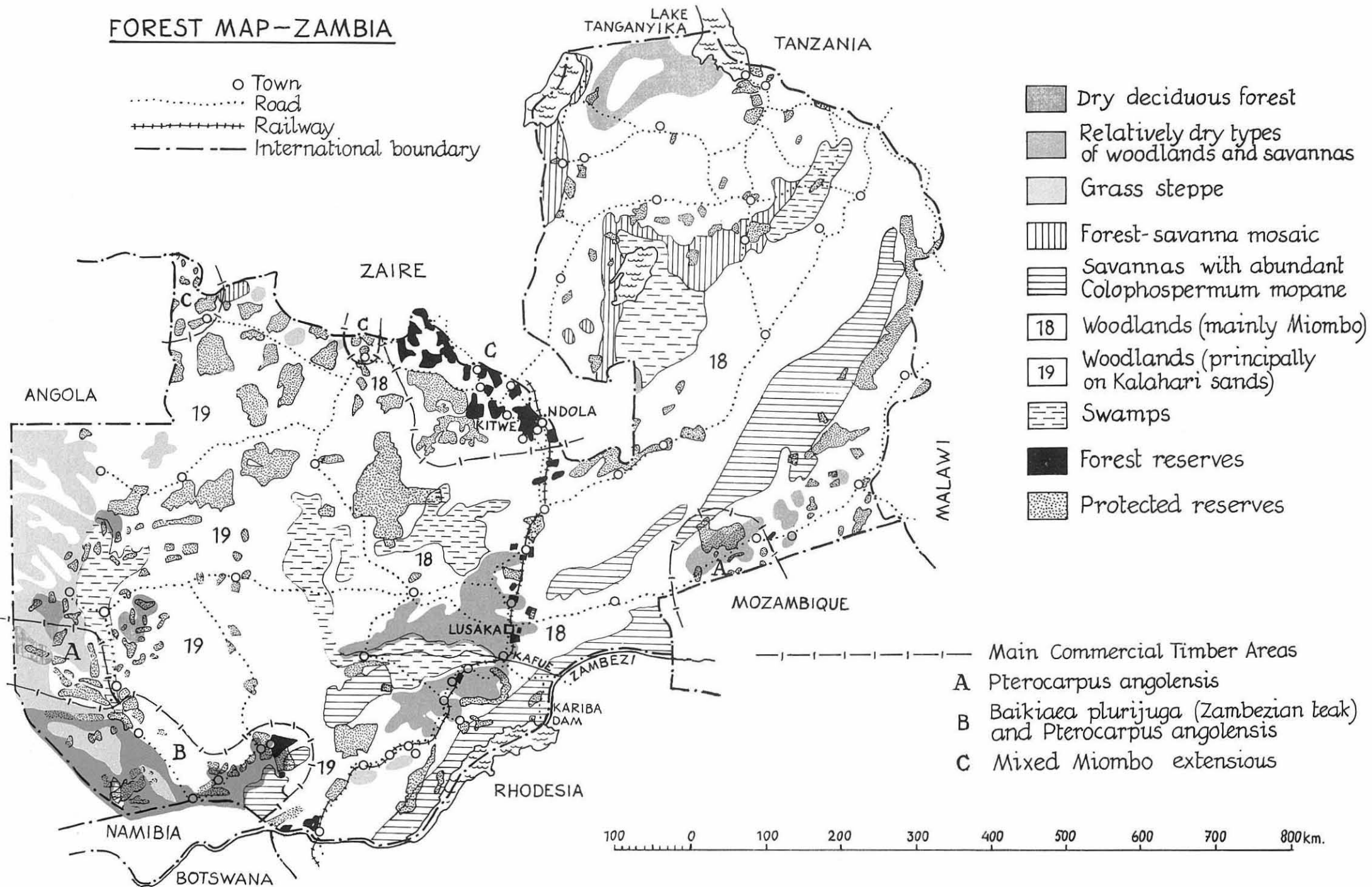
1/ This is the area of open woodlands.

The natural vegetation

Miombo woodlands dominated by Brachystegia - Isoberlinia - Julbernardia species cover large areas in the northern part of the country. The best area of Miombo is found in the north-western corner of the country. Here the yield is 15 m³/ha of sawn wood. The normal yield is 2-5 m³ of sawn wood and 50 m³ of fuelwood per ha. An inventory of 108,000 ha in the Copperbelt gave a total mean value of 125 m³/ha(?). Large parts of the Miombo woodlands are situated too far away from any market to be worth exploiting. The quality of the Miombo woodlands falls off very rapidly as one goes to the south.

FOREST MAP-ZAMBIA

- Town
- Road
- +++++ Railway
- International boundary



In the central part of the country woodland savannas or grasslands are found.

On the heavier soils in south and east the woodland is of *Acacia-Combretum-Terminalia* type. These woodlands are quite low and open. In the wetter north and north-west riparian evergreen forest occurs along streams and around springs but on a limited scale.

The heavy clay soils of the major river valleys and the Kafue flood plains carry open woodland of *Colophospermum mopane* (Mopane woodland). This type is very open. The timber is of low quality and there is no exploitation.

The Zambian teak (or Rhodesian teak) forest (*Baikiaea plurijuga*) is said to cover 650,000 ha (230,000 ha according to another source) on the Kalahari sands north of the Zambesi river in Barotseland. This type has a dense understorey of thorny growth including *Acacia* species.

This forest has been exploited for a long time and exploitable teak will probably disappear within 15 years. It can produce 15-20 m³/ha on better sites. A recent FAO report states that the stocking rarely exceeds 70 m³/ha. The total amount of exploitable teak is estimated to be 2.3 million ha.

The only other species occurring in commercial quantities in the Zambian teak forest is *Pterocarpus angolensis* (mukwa). Available exploitable quantities may be in the order of only 100,000 m³. Recovery in sawing is very low because the main demand is for brown heartwood.

Inventories

A district-by-district survey of Zambia's forest resources which began 15 years ago was completed in 1967, but the compilation of data is still continuing. No summarized results are as yet available at FAO Headquarters (in 1973).

Man-made forests

Plantations started as early as 1935. Originally they were planned to supply timber to the mining industry. They are located in the Copperbelt, west of Kitwe city and between Kitwe and Ndola. Over 40,000 ha are available for planting.

In 1974 the planted areas were given as follows (up to 1973):

Species	Area, 1000 ha
Pines (mainly <i>P. kesiya</i>)	12.8
Eucalyptus (mainly <i>E. grandis</i>)	5.8
Total	18.6

In 1972 the area planted was reported to be 2,600 ha. The present planting programme aims at planting 800 ha of Eucalyptus and 1,600 of pines each year.

Plans for 1985 (total area):

Species	Area, 1000 ha
Pine	26
Eucalyptus	15
Total	41

The total round wood supply from existing and planned plantations has been estimated as follows:

Year	Species		Total
	Pine 1000 m ³	Eucalyptus	
1975	42	85	127
1980	130	230	360
1984	185	180	365
1990	270	180	450

Other

- 1) The "forest estate" is, according to some sources estimated to be 37.5 million ha. Forest reserves occupy an area of 576,000 ha while Protected forest areas occupy 5,320,000 ha. All land belongs to the state.
- 2) Shifting cultivation is very common. Each family is said to need 25 ha of woodland to farm.

4. Conclusions

Although this report will be followed by a second part it may be advisable to give a few concluding remarks.

As has been explained several times the country notes sometimes contain doubtful information. They are to be considered as a working stage and future work will fill in gaps and sort out uncertain information.

The combination of this report as a working document and a reference book is somewhat unfortunate. In a pure reference book certain unclear information would have been left out. This would have made the report easier to read.

When more information becomes available the country notes can be kept shorter and become more standard. In their present form they are sometimes difficult to interpret. All the background facts and comments given in this report can then also be decreased.

An unedited version of these country notes has been accepted by the Forest Services. Certain additions have been made since then. The maps have not been checked by the Forest Services but on the other hand, they have often been provided by the Forest Service.

The different type of information given for different countries may hopefully give ideas to the Forest Services. Many countries could certainly pick up information of similar type. Many items on which information is missing in the present report is certainly (or hopefully) available.

A contact with the Forest Service in the different countries could no doubt add a considerable amount of new information. Information which has not always been available to me when preparing the maps is no doubt available e.g. main plantation areas, main exploitation areas, regions with deficit of fuelwood, unexploited areas, exploited areas, degraded areas, inventories, better information concerning each location of high forest, undisturbed dense savanna, at present inaccessible areas.

Much of this information can be included in a future version without a complete redrafting of the maps.

A continuous updating of the maps and country notes could in some years time give a much more complete picture of the forest resources in Africa.

Bibliography

It has not been possible to provide a complete list with all the documents utilized in the preparation of the country notes. Neither would it have been meaningful as the information very often is based on unpublished materials - travel reports, working documents, interviews, correspondence etc. The second-hand reports normally utilized by me certainly often include information from published reports. These original documents have not always been traced. The list below gives the most important publications that have been found about forest resources in African countries. Reports considered to be of general interest have been included even when they have not been of great use for the preparation of this report. Many of the references given are incomplete. This is because the original publications have not been traced by me (second-hand references).

One of the basic tasks for future reports must be to publish the names of all published reports about the forest resources in a country which are of general interest. Due to time-pressure a detailed library check has not been possible for this report. Many basic standard works are therefore certainly not included in this list. It is merely to be taken as an example of the type of reports which ought to be included. Additional sources will hopefully be given in part II of this report.

Only a few of all the FAO reports have been listed. A complete list with all titles can be found in:

FAO: List of UNDP reports. Forestry Department.

The publications and articles issued by CTFT can be found in:

CTFT: Repertoire des Articles Publiés dans la revue "Bois et Forêts des Tropiques" de 1947 à 1966. Nogent-sur-Marne.

The above list is supplemented each year.

The different maps used have been quoted in as many details as possible, but many working sketch maps have been used and these cannot be attributed to any specific source. All the maps mentioned have not been used. It is often impossible to give clear references to the maps.

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Appendix IGlossaryMain sources:

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FAO 1968: Guideline for Questionnaire on man-made forests. Revised version.

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Note: The definitions taken from those sources have sometimes been modified.

It is quite certain that the terms when used in the country notes do not always exactly follow the definitions given. These definitions do principally give the intention with (or the normal meaning of) a certain term. It has often been necessary to give certain comments in addition to the definitions.

Afforestation: Forests established artificially by afforestation on land which previously did not carry forest. This is the most clear-cut example of a man-made forest and invariably involves the extension of the area of the forest. A clear definition of the period of time for which the land previously carried no forest is needed. "Within living memory" is suitable for areas where there are no records, but "within 50 years" is suggested as an alternative for areas where records exist.

Agricultural area: Agricultural land is sub-divided in three categories; arable land, land under permanent crops and land under permanent meadows and pastures. See the definitions of these terms.

Alfa grass: *Stipa tenacissima* is a grass found on the high plateaus in North Africa. It is used for pulp production.

Arable land: Means all land generally under rotation whether it is under temporary crops, used as temporary meadows, or market and kitchen gardens (including cultivation under glass) temporarily fallow or lying idle.

Arid climate: A climate in which the rainfall is insufficient to support vegetation. The aridity of a region depends in part on temperature. The word is often used with the meaning of "dry".

Artificial regeneration: Forests established by artificial regeneration on land which carried forest within the previous 50 years or within living memory, and involving the renewal of what is essentially the same crop as before. In as much as the new crop is essentially the same as its predecessor, this is a forest remade, rather than made, by man.

Broadleaved (Non-coniferous, hardwoods): All trees classified botanically as "Angiospermae" - e.g. maple (*Acer*), alder (*Alnus*), ebony (*Diospyros*), beech (*Fagus*), poplar (*Populus*), oak (*Quercus*), sal (*Shorea*), teak (*Tectona*), casuarina (*Casuarina*).

Browsing: (B) Feeding on twigs or shoots, with or without attached leaves of shrubs, trees or woody climbers.

Bush: (B) Shrub vegetation and stands of tree species that do not produce marketable timber.

Bush: (B) See shrub.

Bush fallow: (B) Secondary woody growth developing between periods of cultivation.

Climax: (T) The culminating stage in plant successions for a given environment, the vegetation being conceived as having reached a highly stable condition.

Closed forest: Land with a "forest cover", i.e. with trees whose crowns cover more than 20 per cent of the area, and not used primarily for purposes other than forestry. (Forestry purposes: Wood production and benefits from the environmental effects of forests.) All open woodlands as defined on page 259 are excluded even if trees cover more than 20 per cent of its area.

The following general rules are applied concerning all "closed forest":

Includes:

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

- h) Forest roads and streams and other small open areas, as well as forest nurseries that cannot be readily excluded by the survey system used.
- i) National parks covered by forests (if possible shown separate).

Excludes:

- a) City parks and gardens.
- b) Areas occupied by orchards of fruit or nut trees, and plantations for non-forestry crops such as rubber and cinchona.
- c) Wooded pastures and range lands.
- d) Areas not meeting the conditions of forest as described above, even if administered by Forest Authorities.
- e) Isolated tree groups smaller than 0.5 ha.
- f) Land under shifting cultivation which is at present being prepared or used for agricultural crops or which is unlikely to return to forest in the foreseeable future.

List of vegetation types that are included in forest:

Yangambi scheme (Boughey 1957)	Vegetation map of Africa
Closed forest formations except non-bamboo thickets	<ul style="list-style-type: none"> (a) Montane evergreen forest (b) Temperate and subtropical evergreen forest (c) Moist forest at low and medium altitudes (d) Dry deciduous forest: - with abundant <i>Baikiaea plurijuga</i> and - Madagascar types. Excludes, when possible, areas degraded to savanna. (e) Forest which occur in other types, not described in detail due to their lack of homogeneity, such as "Montane communities undifferentiated" and "Ditto", with Afro-alpine communities (f) Bamboo thickets (g) Mangroves and coastal palm forests

In running text "forest" is normally used instead of closed forest.

Coffee forest: Coffee is normally grown under a shelter of trees. *Grevillea robusta* is a species often used in coffee plantations.

Colombo plan: A plan for development within the Commonwealth. The Canadians have undertaken many forest inventories under this plan.

Commercial (merchantable) volumes: When this term is added to the terms "industrial", "log" or "other usable volume" or to specified portions of the volume it distinguishes the volume which can be economically removed under given conditions.

Note: If the term "commercial" is used a "utilization study" is necessary. For details see FAO 1973: Manual of Forest Inventory.

Concession (timber): (B) A contract, licence or permit granted to a firm or person, to extract and market timber commercially from a defined area of forest or a certain number of trees in a given time. Syn. Timber lease.

Coniferous (softwoods): All trees classified botanically as "Gymnospermae" - e.g. fir (*Abies*), parana pine (*Araucaria*), deodar (*Cedrus*), ginkgo (*Ginkgo*), larch (*Larix*), spruce (*Picea*), pine, chir, kail (*Pinus*).

Coppice: Forest composed of stool-shoots or root suckers with or without scattered trees of seedling origin and treated to produce mainly small-sized trees on a short rotation basis.

Coupe: (B) A felling area, usually one of annual succession unless otherwise stated.

D.b.h.: The diameter at 1.30 m (4.3 feet) above ground level. In certain countries the height of the d.b.h. differs somewhat from the 1.30 m mentioned. In North America d.b.h. is e.g. 4 feet 6 inches.

If buttresses exist and are higher than the breast height level, d.b.h. measurements are useless. In this case the diameter is measured just above the swelling or irregularity or at a given distance above that point (d.r.h. = diameter at reference height).

Deciduous: (B) A term applied to perennial plants which are normally leafless for some time during the year.

Degradation (of natural vegetation): This means a continuous thinning without sufficient regeneration of the natural vegetation. This can then cause erosion problems and a drying out of the soils.

The term is used mainly for areas where the land use is not yet stabilized or in areas where no productive use is made of the land after it has been cleared of forest. See also "destruction".

Dense forest: See closed forest.

Derived savanna: Savanna that have been derived from moist forest due to human influence. See under Forest - savanna mosaic.

Destruction (destroyed, lost for forestry): This is an emotional loaded term used by foresters to describe a decrease in the forest (or wooded) area. Naturally this is not always negative. This term should not be interpreted as implying a critical judgement. When it is a question of unplanned destruction (e.g. because of fire) it is anyhow normally negative.

These words are normally used only in tropical or subtropical regions where the land use pattern is not yet stabilized. In temperate regions these words are rarely used as the destruction occurred rather long ago.

Dry deciduous forest: Physiognomically these forests are similar to moist forest. Dry deciduous forests are very susceptible to fire and repeated burning leads to replacement by savanna.

Edaphic: (T) Any characteristic or condition of the soil - generally physical or chemical - that influences organisms.

Equatorial climate: The climate in tropical lowland regions to a latitude of 5° to 10°. The temperatures and rainfalls are high throughout the year. The seasonal variations are small. See tropical climate.

Equatorial forest: The wet evergreen forest of the tropics.

Evergreen (B): Never entirely without green foliage, leaves persisting until a new set has appeared.

Forest: See closed forest.

Forest and other wooded areas: Areas covered with trees and/or shrubs and not used primarily for agriculture or other non-forestry purposes. In the FAO definition forest, open woodland, scrub and brushland are included in this category. All lands of some forestry interest (a wooded cover) should be included in this category.

Forest land: The term forest land used in the FAO Production Yearbook has often been taken as synonymous with "forest and other wooded areas". The exact wording of the definition of this term in this publication is as follows:

"Forest land refers to land under natural or planted stands of trees, whether productive or not. It includes land from which forests have been cleared but which will be reforested in the foreseeable future. Permanent meadows and pastures on which scattered trees and shrubs are grown should not be included under forest land".

Forest reserves: Forest (or forest land), effectively protected against destruction and in which provisions (such as obligatory regeneration after clear-cut) are established to ensure maintenance of the forestry vegetation, e.g., the Forest reserves which exist in many English-speaking countries.

Destruction here means removal or severe disturbance of the forestry vegetation through shifting cultivation, burning, disorganized cutting etc., but not conversion under organized forms into other land utilization than forestry.

The French word is "forêt classé". In French speaking countries the protection of the reserves are normally not as strong as in English speaking countries.

Forest Resource Appraisal (Regional): The name World Forest Inventory is no longer used by FAO. Instead "Forest Resource Appraisals" is used. These appraisals will probably become regional.

Forest-savanna mosaic: In this mosaic, patches of moist forest (not confined to streamsides) are surrounded by savanna of tall grasses.

If the fires are excluded for several years the savanna may be invaded by moist forest species. In much of the country classified as forest-savanna mosaic the climate is not more dry than parts of the moist forest regions, and it is generally agreed that the savanna in the mosaic has been derived by degradation from moist forest. (Vegetation map of Africa.)

Gallery forest: (B) Tree growth which owes its existence or condition to its proximity to a water course, lake, swamp or spring. Syn. Fringing or riparian forest.

Grazing: (B) The eating of any kind of standing vegetation by domestic livestock or wild animals. Sometimes limited to the eating of herbage, in contrast with browsing. Grazing is often a serious problem in dry areas. It may make natural regeneration impossible.

Gross volume: The volume of a specified portion of a tree without bark or deduction for defects. Note that gross volumes include bark in many inventories. The term should be qualified by a word or statement specifying the portion of the tree to which it refers, e.g. total tree gross volume. In the tropics, the gross volume is often given up to the first living branch.

Gross volumes as well as all other volumes refer to a minimum d.b.h. (or d.r.h.) of the relevant trees and also to a minimum diameter of the small end of the stem and branches.

Guesstimate: A word built up of the words guess and estimate. Means a qualified guess which is probably (hopefully) not far from the truth.

Guinea savanna: Is the West African name for the relatively moist type of woodland which covers considerable areas north of the moist forest belt. (Isoberlinia doka and I. dalzielii occur often abundant.)

Hardwood: (T) A conventional term for the timber of broadleaved trees, and the trees themselves, belonging to the botanical group Angiospermae.

High forest: (B) Sometimes used for a closed forest of tall trees, in contrast to savanna woodland or scrub.

Humid climate: A climate with enough rainfall to support a forest vegetation. The minimum rainfall may be as little as 375 mm in cool regions.

Hygrophil: The vegetation of moist areas.

Hydrophyte: (B) A plant which grows wholly or partly immersed in water.

Industrial volume: The potentially usable net volume of round wood, without deduction for losses due to utilization standards of logging and manufacturing processes; it equals the sum of log volumes plus other usable volume.

Land under permanent meadows and pasture: Means land used permanently, i.e. five years or more, for herbaceous forage crops, either seeded and cared for or existing naturally (wild prairie or grazing land). Permanent meadows and pastures on which trees and shrubs are grown are recorded under this heading only if the growing of forage crops thereon is the most important use of the area.

Land under permanent crops: Means land cultivated with crops which occupy the land for a long period of time, and do not need to be planted for many years after each harvest, such as cocoa, coffee, rubber, shrubs and fruit trees, nut trees and vines, but excluding wood and timber. It includes nurseries, except those for forest trees which should be classified under "Forest and other wooded areas". It excludes permanent meadows and pastures.

Log volume: The net volume of a tree considered suitable for veneer logs, sawlogs, sleeper logs, piling and poles; this volume may also be used for pulpwood, chipboard or other industrial use.

Mangrove: Mangrove vegetation occurs in brackish swamps by river estuaries along tropical and subtropical coasts.

Man-made forests: According to "FAO, Forestry and Forest Industries Division: Guideline for Questionnaire on Man-made Forests. Revised Version, 1968" man-made forests consists of the following three categories; afforestation, re-forestation and artificial regeneration. The same rules are followed in this report. See the definitions of these categories.

Maquis: (T) Scrub vegetation, generally rather dense composed of much branched thorny and often aromatic shrubs found in the Mediterranean region in areas where climax forest has been destroyed. In some areas thought to be the climax vegetation.

Mediterranean climate: This climate has mild winters of light to moderate rainfall and warm to hot summers with a considerable period rainless. The natural vegetation consists partly of drought-resistant trees and shrubs.

Mesophyte: (B) A plant whose normal habitat is neither very wet, nor very dry.

Miombo: This is the local African name of the relatively moist types of woodlands with abundant *Brachystegia* and *Julbernardia* that are found over extensive areas in Angola, Mozambique, Tanzania and Zambia.

Moist forest: See Equatorial forest and tropical rainforest.

Monsoonal climate: The climate in areas with monsoons. The rainfall in the winter is small while it is abundant in the summer.

Mopane: Mopane is the local African name for the relatively dry type of woodland with abundant *Colophospermum mopane* which is found in Southern Africa.

Net volume: The volume of a specified portion of a tree without bark and with deductions made for defects or unusable material; the term should also be qualified according to the portion of the tree to which it refers.

Open woodland: Land, with trees whose crowns cover 5 to 20 per cent of the area and not primarily used for agricultural or other non-forestry purposes (such as grazing of domestic animals).

The category includes mainly the savanna belts found north and south of the equatorial forest region. Broadly speaking, the term savanna denotes vegetation of which the characteristic feature is a more or less dense graminaceous or herbaceous layer. Woody cover may or may not be present and if so, is invariably irregular. Open woodlands may be the natural vegetation but are

often a degraded form of a vegetative cover with a more closed and higher canopy. It is normal that the degrees of degradation vary within an area under the influence of such factors as distance from villages, steepness, slope aspect etc.

The category "open woodland" used for the purpose of this report includes only areas which have a certain tree cover and excludes sheer shrub or grasslands. This is to distinguish areas which, besides their use as grazing land are able to produce a substantial supply of wood, at least fuelwood and poles for local consumption.

Open woodland, (savanna forests) as broadly defined above may be covered with trees whose crowns cover more than 20 per cent of the area. Such areas are to be included in open woodland and not in forest.

List of vegetation types that are included in open woodland:

Yangambi scheme (Boughey 1957)	Vegetation map of Africa	West African Terminology (Keay 1953)
(a) Woodland	(a) Forest - savanna mosaic	(a) Derived savanna
(b) The following categories of savanna: 1. Savanna woodland 2. Tree savanna	(b) Coastal forest - savanna	(b) Southern Guinea zone
(c) The following sub-categories of steppe: Tree and/or shrub steppe	(c) Woodlands, savannas (and steppes)	(c) Northern Guinea zone
	(d) Wooded steppe with abundant Acacia and Commiphora	(d) Sudan zone
	(e) Such areas of dry deciduous forest that are degraded to savanna	(e) Sahel
	(f) Part of montane "communities - un-differentiated" and "ditto, with Afro-alpine communities"	

The term open woodland has occasionally also been used for Mediterranean maquis vegetation.

Other usable volume: The net volume of a tree not suitable for purposes listed under Tog volume but usable for posts, pulpwood, chipboard and other industrial use.

Rainforest: See Tropical rainforest.

Reconnaissance: (B) A preliminary inspection or survey of a forest area, made in order to gain a general knowledge of all facts likely to be useful in determining future management.

Red-woods: A term with many different meanings (normally pines). In Africa often used as a common name for commercial species with a reddish coloured wood, e.g. *Khaya* spp., *Entandophragma* spp. and *Afrormosia* spp. (bois rouge).

Reforestation: Forests established artificially by reforestation on land which carried forest within the previous 50 years or within living memory and involving the replacement of the previous crop by a new and essentially different crop. The change most frequently involved is species conversion, but the use of seed orchards consisting of superior genotypes demonstrated by progeny trials, would also qualify. In as much as the forest established artificially by man is essentially different from its predecessor, this is a clear-cut example of a man-made forest, though it does not involve any change in forest area.

Riparian forest: (B) See gallery forest.

Riverine forest: (B) Forest growing along or on islands in river beds.

Sahel: This is the West African name for the "wooded steppe with abundant *Acacia* and *Commiphora*" that are found in the dry areas north of the Sudan savanna.

Savanna: A tropical or subtropical grassland normally containing trees or shrubs. The Spanish word *zavana*, from which it derived, means a grasscovered treeless plain. See open woodland.

Savanna woodland: (B) Open tropical or subtropical forest having an undergrowth mainly of grass. The trees are of moderate height and usually deciduous, or if evergreen have small leaves. Syn. Savanna forest.

Shrub: (B) Inferior growth consisting chiefly of small or stunted tree or shrubs.

Scrub and brushland: This is a residual category which in WFI 1970 is distinguished since the areas concerned may have some forestry characteristics in their vegetation or administrative status and some countries may therefore have shown them together with the other forestry categories.

The following vegetation types of this type are distinguished:

Yangambi scheme	Vegetation map of Africa	West African terminology
(a) Scrub savanna	(a) Part of "montane communities - undifferentiated" and "ditto, with Afro-Alpine communities"	Not covered by this terminology
(b) Grass savanna	(b) Thickets: Itigi type. Madagascar types and Ethiopian evergreen types - all excluding Bamboo thickets	
(c) Dwarf-shrub steppe	(c) Cape Macchis	
(d) Succulent steppe	(d) Madagascar grass savanna and grass steppe	
(e) Grass and/or herb steppe	(e) Grass steppe with thicket clumps: - Western Uganda type	
(f) Thickets other than bamboo	(f) Subdesert steppe: - Karoo shrub and grass, transitional and mixed Karoo and tropical types	

Secondary forest: A forest that has developed after the old mature forest has been exploited or cut over. Secondary forests often (but not always) contain species of little value.

Secondary species: (T) Species of inferior quality and/or size, and of relatively little or no silvicultural value, associated with the principal species.

Selective cutting: (T) A type of exploitation cutting that removes only certain species above a certain size or of high value.

Semi-: Latin meaning half, but also somewhat, more or less. Ex. semi-tropical.

Semi-arid climate: The characteristic climate of the regions intermediate between the true deserts and subhumid areas.

The upper limit of the average annual rainfall is as much as 900 mm in hot regions. The vegetation is close-growing or scattered short grass, bunch-grass, or shrubs.

Shifting cultivation: (B) A method of cyclical cultivation, chiefly in the tropics, where cultivators cut some or all the tree crop, burn it and raise field crops for one or more years before moving on to another site and repeating the process.

Shrub: (B) A woody perennial plant differing from a perennial herb in its persistent and woody stem, and less definitely from a tree in its low stature and its habit of branching from the base. Often restricted to plants up to 6 m in height. Syn. Bush.

Softwood: (T) A conventional term for both the timber and the trees belonging to the botanical group Gymnospermae.

Steppe: (B) A wide, treeless plain of grassland, characteristically xerophytic. See also the Yangambi scheme.

Sub-: Latin meaning under. Ex subtropical.

Subhumid climate: The climate intermediate between semi-arid and humid with sufficient rainfall to support a moderate to heavy growth of short and tall grasses, or shrubs, or of these and widely spaced trees or clumps of trees. The upper limit of rainfall may be as high as 1,500 mm in hot regions.

Subtropical (semi-tropical) climate: This is the type of climate found at the tropical margins of the temperate zone.

Sudan savanna: Is the West African name for the relatively dry type of woodland which is found north of the Guinea savanna.

Sustained yield: (B) a/ The material that a forest can yield annually (or periodically) in perpetuity. b/ As applied to a policy, method or plan of management (sustained yield management), implies continuous production with the aim of achieving, at the earliest practical time and at the highest practical level, an approximate balance between net growth and harvest, either by annual or somewhat longer periods.

Temperate climate: The climate in the midlatitudes, characterized by cool or cold winters and warm or hot summers.

Tidal (forest): (T) Forest within reach of the influence of tides.

Total volume: The volume included in the main stem of a tree; for deliquescent-formed trees, up to the crown point; for excurrent-formed trees up to the tip of the tree.

Tropical climate(or zone): The climate zone lying between the two tropics. The climate can be both dry and wet, e.g. dry tropical. The wet type is often called equatorial climate. In this case tropical climate means tropical areas with a seasonal variation in the climate.

Tropical rainforest: (B) One of the many terms used to describe the luxurious natural forests found in the moist tropical regions. Syn. Equatorial rainforest (High forest belt).

Tropophyte: (T) A plant that markedly changes its character, particularly its water requirements, with seasonal changes of climate, e.g. a deciduous tree.

UNDP/FAO: FAO is often the executing agency for forestry projects paid by the UNDP.

White woods: A term used in certain African countries for commercial woods which are not red-woods (e.g. samba). The normal meaning of white wood is spruce.

Volume: This term can mean very different things. In FAO's Manual of Forest Inventories the following different terms have been defined: gross volume, net volume, total volume, industrial volume, log volume, commercial volume and other usable volume. See the definitions of these terms.

Woodland: Generally a wooded area. In certain connections it means a wooded area of scrub or brush type. See also the definition in the Yangambi scheme.

Xerophyt: (B) A plant that can subsist in dry situations.

Appendix II

Names of species

General

As far as possible the scientific names have been used in the country notes. In certain dense tables, in the case of species with a well known common name etc., the common names have been used. The common names used in different countries are also often given together with the scientific names.

In Appendix II A the common names and corresponding scientific names of the best known commercial species are given. The species for which the common names have been used alone in certain connections are also given. It has not been possible to identify the scientific names of all the common names used alone.

Appendix II B gives the scientific names of all the species mentioned together with the most-used trade or common names (note that all the species mentioned are trees). In this table the softwood species are marked with an S. The exotic species used for planting are marked with an P.

In the column showing occurrence the following symbols have been used.

Algeria	Al	Mali	Mi
Angola	An	Mauritania	Mau
Botswana	Bo	Mauritius	Ms
Burundi	Bu	Morocco	Mor
Central African Rep.	CAR	Mocambique	Moc
Cameroon	Ca	Namibia	Na
Chad	Ch	Niger	Nir
Congo	Co	Nigeria	Nia
Dahomey	Da	Rhodesia	Rh
Equatorial Guinea	EG	Rwanda	Rw
Ethiopia	Et	Senegal	Se
French Terr. of Afars, Issas	AI	Seychelles	Sey
Gabon	Gab	Sierra Leone	SL
Gambia	Gam	Somalia	So
Ghana	Gh	South Africa	SA
Guinea	Gu	Sudan	Su
Guinea Bissau	GB	Swaziland	Sw
Ivory Coast	IC	Tanzania	Ta
Kenya	Ke	Togo	To
Liberia	Lib	Tunisia	Tu
Libya	Li	Uganda	Ug
Madagascar	Mad	Upper Volta	UV
Malawi	Mw	Zaire	Ze
		Zambia	Za

These symbols are also used to show where the different common names are used.

As there seems to be quite a lot of confusion in the naming of species certain errors are probably unavoidable. It is, for instance, not always

possible to find out if the different scientific names said to correspond to a common name depend on the use of synonymous names, or on a wrong species decision or if the common name corresponds to a group of species.

Several species of the same or even different genera may actually correspond to one single common name.

The common names naturally change from country to country. In the country notes the local names have been used.

As a rule the most common synonymous names are given within brackets in Appendix II B. The names used in this report have then been underlined.

Appendix II A

Common names of species mentioned in the text

<u>Trade (or common) name¹⁾</u>	<u>Scientific name</u>
Abale (Ca)	Combretodendron macrocarpum
Abe (EG)	Canarium velutinum
Aboudikron (IC,Gu)	Entandophragma cylindricum
Abura	Mitragyna stipulosa
Acajou (Ca,CAR, Co,Da,EG,IC)	Khaya ivorensis and K anthoteca
Afo (Gab)	Poga oleosa
Agba (Co,Gab)	Gossweilerodendron balsamiferum
African pencil cedar	Juniperus procera
Aiélé (Ca,Co,Gab,IC)	Canarium schweinfurthii
Ako (IC,To)	Antiaris toxicaria
Akoga (EG)	
Alep (Gab,EG)	Desbordesia glaucescens
Alfa grass	Stipa tenacissima
Aleppo pine	Pinus halepensis
Alone (Gab)	Bombax brevisuspe & spp.
Amazakoué (IC)	
Andoung (Gab)	Monopetalanthus heitzii & spp.
Angoa (Gab)	Brismadelphus exsul
Aniègré	Aningeria spp.
Antiaris	Antiaris toxicaria
Anzem (Gab)	Copaifera religiosa
Assamela (IC)	Afrormosia elata
Atlas cedar	Cedrus atlantica
Avodiré (Co,IC)	Turraeanthus africana & spp.
Awougha (Gab)	Paraberlina bifoliolata
Ayous (Ca,CAR,Co,Gab)	Triplochiton scleroxylon
Azobé (Ca,Gab,IC,Gu)	Lophira alata
Azodau (Doussié) (IC)	Azelia bipindensis & spp.

1) The names of countries where the names have been used are given within brackets. Not all the common names mentioned have been used in this report.

Badi (IC)
 Bahia (Ca,Co,Gab,IC)
 Baobab
 Bêté (Ca,CAR,Co,IC)
 Bilinga (Ca,Co,Gab,Gu)
 Black wattle
 Blackwood (Ta)
 Bossé (Ca,Co,IC)
 Brown olive (Ke)
 Bubinga

Cadde (Se)
 Cailcédrat (Da,Ca,Mau)
 Camphor (Ke,Ta)
 Canarium
 Cork oak
 Ceiba

Dabema (Ca,Gab,IC)
 Darcassou (Se)
 Diambi (Co)
 Libétou (Ca,CAR,Co,IC)
 Dum palm (So,Su)
 Douka (Co,Gab)
 Doussié (Ca,CAR,Co,Da,IC,Gab)

East African satin wood
 Ebana (Gab)
 Ebiara (Gab)
 Ebony
 Edoum (Gab)
 Ekop (Gab)
 Ekoune (Gab)
 Elgon olive (Ke)
 Elondo (EG)
 Emien (Ca,Gab)
 Essessang (Gab)
 Evino (Gab)
 Eyong (Ca)

Faidherbia (Mau)
 Famelona (Mad)
 Faro (Co,IC,EG,Gu)
 Filhao (Se)
 Fraké (IC,Da,Gu)
 Framiré (Gu,IC)
 Fromager (Ca,Ze,Gab,IC,To)

Gonakié (Se)
 Guarea
 Gum tree

Holm oak

Mitragyna stipulosa
 Adansonia digitata
 Mansonia altissima
 Nauclea diderrichii
 Acacia mearnsii
 Dalbergia melanoxylon
 Guarea cedrata
 Olea africana
 Guibourtia tessmannii & spp.

Acacia albida
 Khaya senegalensis
 Ocotea usambarensis
 Canarium schweinfurthii
 Quercus suber
 Ceiba pentandra

Piptadeniastrum africanum
 Anacardium occidentale
 Guarea spp.
 Lova trichilioides
 Hyphaene thebaica
 Tieghemella africana & spp.
 Afzelia bipindensis & spp.

Fagara macrophylla
 Guibourtia demeusei
 Berlinia bracteosa & spp.
 Diospyros spp.
 Cylicodiscus gabonensis
 Tetraberlinia & Didelotia spp.
 Coelocaryon klainei & spp.
 Olea welwitschii

Alstonia congensis
 Ricinodendron africanum
 Vitex pachyphylla & spp.
 Eriobroma oblonga & spp.

Acacia albida
 Gambeya madagascariensis
 Daniellia thurifera & spp.
 Casuarina spp.
 Terminalia superba
 Terminalia ivorensis
 Bombax buonopozense (& spp.)
 Ceiba pentandra (& spp?)
 Acacia scorpioides var. pubescens
 Guarea cedrata
 Acacia senegal

Quercus ilex

Igaganga
Ilomba (Ca, Co, Gab, IC)
Iroko (Ca, CAR, Co, Da, Gab, IC)
Izombé (Co, Gab)

Kapokier (Hau)
Kévazingo (Gab)
Khaya
Kokrodua (Ca, Co)
Kondroti (IC)
Kosipo (Ca, CAR, Co, IC)
Kotibé (Gab, IC)
Koto (IC)

Landa (Ca)
Limba (Ca, CAR, Co, EG, GAB)
Limballi (Co)
Lingué (Doussié) (IC)
Loliondo (Ta, Ke)
Longhi (Co)

Mahogany
Makoré (IC)
Makulunga (CAR)
Mansonia
M'bebame (Gab)
Mediterranean cypress
Menge (Co)
Meru oak
Miamia (Gab)
Milanje cedar
Moabi (Ca, Co, Gab)
Montane bamboo
Movingui (Ca, Co, Gab, IC)
Muhuhu (Muhugu) (Ta, Ke)
Mukumari (Ca)
Muninga
Mutunya (Co)
Mvule (Ke, Ta)

Naga
Nato (Mad)
Neem
Ngollon (Ca)
Niangon (Gab, IC)
Niové (Co, Gab)
Nkanang (Ca)
Noudougou (Ca)
N'Tene (Co)

Dacryodes edulis
Pycnanthus angolensis & spp.
Chlorophora excelsa
Testulea gabonensis

Bombax buonopozenze & spp.
Guibourtia tessmannii & spp.
Khaya spp.
Afrormosia elata
Bombax breviuspe
Entandophragma candollei
Nesogordonia papaverifera & spp.
Pterygota macrocarpa

Erythroxylum mannii
Terminalia superba
Gilbertiodendron spp.
Afzelia africana
Olea welwitschii
Gambeya spp.

Endandophragma spp., Khaya spp.
Tieghemella heckelii & spp.
Aultranelia congolensis
Mansonia altissima
Chrysophyllum spp. & Gambeya spp.
Cupressus sempervirens
Millelittia laurentii & spp.
Vitex keniensis
Calpocalyx heitzii
Widringtonia whytei
Baillonella toxisperma
Arundinaria alpina
Distemonanthus benthamianus
Brachylaena hutchinsii
Cordia africana & spp.
Pterocarpus angolensis
Guibourtia arnoldiana
Chlorophora excelsa

Brachystegia nigerica & spp.

Melia indica

Tarrietia utilis (& spp.?)
Staudtia stipitata
Sterculia rhinopetala
Anopyxis klaineana

Obeche (IC,Nia)
 Ukan
 Oken (Gab)
 Okoumé (Co,EG,Gab)
 Olive
 Olon (Co,Gab)
 Ossabel (Gab)
 Ossimiale (Gab)

 Ossol (Gab)
 Ovangkol (Gab)
 Ovoga
 Ozigo (Co,Gab)
 Ozouga (Gab)

Padouk (Co,Gab)
 Palisander (Mad)
 Pau-rosa (Co)
 Pillarwood (Ta)
 Podo (Ken)

Ramy (Mad)
 Rhodesian teak (Rh)
 Rönier (Hi,Se)
 Rotra (Mad)

Samanquilla (EG)
 Sanba (IC,Da)
 Sambalatry (Mad)
 Sapelli (Ca,CAR,Co,EG,IC,Nia)
 Sipo (Ca,CAR,Co,IC,Gu)
 Sogho (Gab)
 Sougué (Gu)
 Sunt (Su)

Tali (Gab)
 Tavolo (Mad)
 Tchitola (Co,Gab)
 Teak
 Tiama (Ca,CAR,Co,IC)
 Tola (Ca,Co,Ze)

Umbrella pine
 Utile (Gh)

Vamboana (Mad)
 Varongy (Mad)

Wattle
 Wawa (Gh)

Zingana (Co)

Triplochiton scleroxylon
 Cylicodiscus gabonensis
 Swartzia fistuzoides
 Aucoumea klaineana
 Olea africana
 Fagara heitzii
 Dacryodes spp.
 Piptadenia leucocarpa and
 Hewtonia leucocarpa
 Symphonia globulifera
 Guibourtia ehie
 Poga oleosa
 Dacryodes buettneri
 Sacoglottis gabonensis

Pterocarpus soyauxii
 Dalbergia spp.
 Swartzia fistuzoides & spp.
 Cassipourea malosana
 Podocarpus spp.

Canarium spp.
 Baikiaea plurijuga
 Borassus aethiopum
 Syzygium spp.

Triplochiton scleroxylon
 Albizia spp.
 Entandophragma cylindricum
 Entandophragma utile
 Schyphocephalum ochocoa
 Parinari excelsa
 Acacia nilotica

Erythrophleum ivorense & spp.
 Ravensara spp.
 Oxystigma oxyphyllum
 Tectona grandis
 Entandophragma angolense & spp.
 Gossweilerodendron balsamiferum

Pinus pinea
 Entandophragma utile

Hespilodaphne spp.

Acacia spp.
 Triplochiton scleroxylon

Microberlinia brazzavillensis

Appendix II B:

Scientific names of species mentioned in the text

Scientific names	Trade (or common) names	<u>Planted (P), Softwood (S)</u> Occurance
<i>Abies numidica</i>	Algerian fir	S; Alg, Mor
<i>Acacia albida</i> (A. <i>faidherbia</i>)	Kenya Acacia, <i>faidherbia</i> (Mau), <i>cadde</i> (Se)	Ch, Mi, Mau, Se (P), Su
<i>A. arabica</i> (A. <i>nilotica</i>)		
<i>A. campylacantha</i> (A. <i>polyacantha</i>)		
<i>A. cyclopis</i>		Tu
<i>A. cyanophylla</i>		Liy (P), Tu
<i>A. etbaica</i>		Su
<i>A. faidherbia</i> (A. <i>albida</i>)		
<i>A. flava</i> var. <i>seyal</i> (A. <i>hockii</i>)		
<i>A. glaucophylla</i>		Su
<i>A. hockii</i> (A. <i>flava</i> , A. <i>stenocarpa</i>)	Mulaa, shittim wood	Mi, Mau, So
<i>A. mearnsii</i> (A. <i>mollissima</i>)	Black wattle	P; Ke, Rh, Rw, Mor
<i>A. mellifera</i>		Su
<i>A. nigrescens</i>	Knobithorn	Moz
<i>A. nilotica</i> (A. <i>arabica</i>)	Babul, Sunt (Su)	Ch, Mi, Su, Nia (p)
<i>A. polyacantha</i> (A. <i>campylacantha</i>)	African catechu	Su
<i>A. raddiana</i>		Mau
<i>A. scorpioides</i> var. <i>pubescens</i>	Gonakié (Se)	Mau, Se

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Acacia senegal</i> (A. verec)	Gum (arabic) tree	Gam, Mi, Mau, Su
<i>A. seyal</i>	Talh	Su
<i>A. sieberiana</i>	African rosewood	Mi, Su
<i>A. stenocarpa</i> (A. <u>hockii</u>)		
<i>A. tortilis</i>		Liy, Mi, Su
<i>A. verec</i> (A. <u>senegal</u>)		
<i>Adansonia digitata</i>	Baobab	Gam, Mad, Mi, An
<i>Adenanthera pavonina</i>	Coral wood	P; Sey
<i>Adenia hongkel</i>		Mau
<i>Adina microcephala</i>	Matumi	Mw, Moz, Rh
<i>Afrormosia elata</i> (<i>Pericopsis elata</i>)	Kokrodua, (Ca, Co) afrormosia, assamela (IC)	Ca, Gh, IC, Gab, Co, Nia
<i>A. laxiflora</i>	Satinwood	Se
<i>Afzelia africana</i>	Linguê, (Gu, IC) doussiê	Gu, GB, Mi, Nia, Se, IC
<i>A. bijuga</i> (<i>Intsia bijuga</i>)		
<i>A. bipindensis</i> & spp.	Doussiê, azodau (IC)	CAR, IC, Ca, Co, Da, Gab
<i>A. quanzensis</i>	East African Afzelia, afzelia (Ta)	Bo, Ke, Mw, Moz, So, Ta
<i>Alangium chinense</i>	Mutobolo	Bu
<i>Albizia adianthifolia</i>	Batai, mara, vaivai	Moz
<i>A. falcata</i>		Sey (P)
<i>A. globulifera</i>		Ze
<i>A. gummifera</i>	Nepepe	GB

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Albizia lebbeck</i>	Lebbeck	P; Gh
<i>A. schimperiana</i>	Ambabessa (Et), sassa (Et)	Et
<i>A. sericocephala</i>		Su
<i>A. versicolor</i>	Mtanga	Moz
<i>A. zygia</i>	Okuro	Su
<i>Alluaudia procera</i>	Fantsilotra (Mad)	Mad
<i>Alstonia congensis</i> (<i>A. boonei</i>)	Emien	Ca, Gab
<i>Amblygonocarpus andongensis</i>	Bangawanga	Moz
<i>Amphimas pterocarpoides</i>		Ze
<i>Anacardium occidentale</i>	Cashew, anacardium, darcassou (Se)	P; Da, Mad, Mi, Se, UV
<i>Androstachys johnsonii</i>	Mecrusse	Moz
<i>Angokea klaineana</i>		Ze
<i>Aningeria adolfi-friderici</i>	Muna (Ke)	Ke
<i>A. superba</i>		An
<i>Anisophyllea zaurina</i>		Gu
<i>Annona chrysophylla</i> (<i>A. senegalensis</i>)	Wild custard apple	Gam
<i>Anogeissus leiocarpus</i> (<i>A. schimperi</i>)	Kane, sclag (Su)	IC, Mi, Mau, Su, Gh
<i>Anopyxis klaineana</i> (<i>A. ealensis</i>)	Noudougou (Ca), bodioa	Ca, Ze
<i>Antiaris toxicaria</i> (<i>A. africana</i> , <i>A. welwitschii</i>)	Ako (To), bark-cloth tree. antiaris	Ke, Ug, Ze, An, Gh, GB, Nia, Se, To, IC
<i>Antrocaryon klaineum</i>	Onzabili	An

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Apodytes dimidiata</i>	White pear, cheleka (Et), wandebiu (Et)	Et
<i>Arbutus pavarii</i>		Liy
<i>Argania spinosa</i>		Mor
<i>Arundinaria alpina</i>	Montane bamboo	Et, Ug
<i>Aucoumea klaineana</i>	Okoumé	EG, Co, Gab, Ca
<i>Autranella congolensis</i>	Makulunga	CAR
<i>Avicennia marina</i>		So
<i>A. nitida</i>	Black mangrove	Gu, Se
<i>Baikiaea insignis</i>	Nkobakoba	Ug
<i>B. plurijuga</i>	Rhodesian (Zambezian) teak	An, Bo, Rh, Za
<i>Baillonella toxisperma</i>	Moabi (Ca, Co, Gab)	Ca, Co, Gab
<i>Balanites aegyptiaca</i>	Desert date	Mau
<i>B. wilsoniana</i> (<i>B. maughamii</i>)		Moz
<i>Bankinia thonningii</i>		Se
<i>Beilschmiedia hutschinsonia</i> & spp.	Kanda	
<i>Berlinia baumii</i>		An
<i>B. bracteosa</i> & spp.	Ebiara (Gab)	Gab
<i>Bersama abyssinica</i>	Azamer (Et), lolchika (Et)	Et
<i>B. africana</i>		
<i>Blighia wildemaniana</i>		Ze
<i>Bombax brevicuspe</i> & spp.	Alone (Gab), kondroti (IC)	Gab, IC

Scientific name	Trade (or common) names	Planted (P), Softwood (S) Occurance
Bombax <u>buonopozense</u> & spp. (B.flammeum)	Kapokier, alone, fromager	Mi
B. costatum	Kapokier (Mau)	Mi, Mau
B. rhodognaphalon	East African bombax, wild kapak	Moz
Borassus <u>aethiopum</u> (B. flabellifer)	Ago beam, rônier (Mi, Se) Borassus palm	GB, Mi, Mau, Nir, Se
Boscia senegalensis		Mau
Boswellia papyrifera		Su
Boxus hildebrandii		AI
Brachylaena hutchinsii	Muhuhu (Ta), muhugu (Ke)	Ke, Ta
Brachystegia boehmii	Miombo	Rh
B. laurentii	Bomanga	Ze
B. nigerica & spp.	Naga	
B. spiciformis	Mtundu (Ta), Miombo	An, Ke, Rh, Ta
Brismadelphus exsul	Angoa (Gab)	Gab
Burkea africana	Wildesering, burkea, mukarati	An, Mi, Mau, Moz, Se
Buxus hildebrandtii		So
Butyrospermum parkii	Shea butter tree	Da, Mi
Cadia purpurea		So
Callitris articulata (<u>Tetraclinis articulata</u>)		
Calophyllum parviflorum	Vintahina (Mad)	Mad
Calotropis procera	Sodom apple, swallow wort	Mi
Calpocalys heitzii	Miama (Gab)	Gab

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Canarium madagascariensis</i>	Ramy (Mad)	Mad
<i>C. schweinfurthii</i>	Aiélél (Ca), canarium	EG, Nia, Ug, Ca, Co, Gab, IC
<i>C. velutinum</i>	Abe (EG)	EG
<i>Canthium schimperianum</i>	Mungethe (Ke)	Ke
<i>Capparis decidua</i>		Mau
<i>Carapa grandiflora</i>	Uganda crabwood	Bu, Rw, Ug
<i>C. procera</i>	African crabwood	Mi
<i>Casearia battiscombei</i>	Muirungi (Ke)	Ke
<i>Cassia siamea</i>	Cassia	P; Gh, Ug
<i>C. sieberiana</i> (<i>C. kotschyana</i>)	African laburnum	Gam
<i>Cassine buechananii</i>	Muthandau (Ke)	Ke
<i>Cassipourea gummiflua</i> (var. <i>verticillata</i>)	Muzaisi	Moz
<i>C. malosana</i>	Pillarwood (Ta)	Ta
<i>Casuarina equisetifolia</i>	Beefwood, filhao	P; An, Moz, Se, So
<i>C. glauca</i>	Grey buloke	Tu
<i>Cedrela mexicana</i> (<i>C. odorata</i>)	Central American cedar	P; Gh, Gu, Nia
<i>Cedrus atlantica</i>	Atlas cedar	S; Al, Mor
<i>C. libanotica</i>		Mor
<i>Ceiba pentandra</i>	Fromager, ceiba	Gam, GB, Nia, Gh

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Celtis africana</i> (C. kraussiana)	Camdebo stinkwood, murundu (Ke), amalaka (Et), matakoma	Et, Ke
<i>C. adolfi-friderici</i>	Lonkonfi	Gh
<i>C. brieyi</i>	Diania	Ze
<i>C. mildbraedii</i> (C. soyauxii)	Gombe, celtis, ohia, muruanje (Ke)	Gh, Ke, Ze
<i>C. zenkeri</i>	Mukomukoma	Gh, Su
<i>Cephalosphaera usambarensis</i>	Mtambara (Ta)	Ta
<i>Ceratonia siliqua</i>	Carob tree, locust bean	Liy
<i>Ceriops tagal</i>		Ke
<i>Chlorophora excelsa</i> & spp.	Iroko, mvule (Ke, Ta), odoum	An,Bu,CAR,EG,Gh,Gu,GB,Ke,Mw,Moz, Nia,Su,Ta,Ze,Ca,Co,Da,Gab,IC, Ug (p)
<i>C. regia</i> & spp.	Odoum, iroko (Gu)	Gam, Gu, Se
<i>Chrysophyllum albidum</i>	White star apple	Su, Ug
<i>C. flacourtianum</i>		Ze
<i>Coelocaryon klainei</i> & spp.	Ekoune, ecun (EG)	EG, Gab
<i>C. preussii</i> & spp.	Ekoune, ecun	Gab
<i>Cola cordifolia</i>	Bamba, ntaba	Se, Su
<i>Colophospermum mopane</i>	Mopane	Nam, Rh, Za, An, Bo, Mw
<i>Combretodendron macrocarpum</i>	Abale, stinkwood tree	Ca
<i>Combretum aculeatum</i>		Mau
<i>C. cordofanum</i>		Su

Scientific names	Trade (or common) names	<u>Planted (P), Softwood (S)</u> Occurance
Combretum <u>elliottii</u> (C. nicricans var. elliottii)		Mau
C. glutinosum		Da, Mau
C. hartmannianum		Su
C. micranthum		Mau
C. schumannii	Mgongolo (Ke)	Ke
C. velutinosum		
C. velutinum		Da
Conocarpus lancifolius	Damas	So
Conopharyngia bequaertii		Bu
C. johnstonii		Bu
Copaifera arnoldiana (<u>Guibourtia</u> <u>arnoldiana</u>)		
C. religiosa	Anzem (Gab, EG)	Gab, EG
Cordia <u>africana</u> & spp. (C. abyssinica)	Mukumari (Ca), muringa (Ke)	Et, Ke, Su, Ca
C. alliodora	Salm wood	SL
C. platythyrsa	Mukumari	Nia
C. ravae		So
Cordyla africana	Mroma	Moz
C. pinnata	Dimb	Mi, Mau
Craiba brownii	Muhonde	Ke
Croton macrostachys	Mutundu, bessana (Et), baikanissa (Et)	Et

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Cryptocarya louvelii</i>	Longotra (Mad), louvelii	Mad
<i>Cryptomeria japonica</i>	Cryptomeria, Japanese cedar	P,S; Ms
<i>Cupressus lusitanica</i>	Mexican cypress	P,S; An, Ug, Ta, Et
<i>C. macrocarpa</i>	Monterey cypress	P,S; Tu
<i>C. sempervirens</i>	Mediterranean cypress	S; Liy, Tu
<i>Cylicodiscus gobonensis</i>	Edoum (Gab), okan, African greenheart	Nia, Gab
<i>Cynometra alexandri</i>	Muhimbi, angu, Uganda ironwood	Ug
<i>Cyperus papyrus</i>	Papyrus	Su
<i>Dacryodes buettnerii</i>	Ozigo (Co, Gab)	EG,Co,Gab
<i>D. edulis</i>	Olem, igaganga	EG
<i>D. pubescens</i> & spp	Safukala	An
<i>Dalbergia</i> spp.	Palisander	Mad
<i>D. melanoxylon</i>	East African blackwood, blackwood (Ta)	Moz, Ta
<i>D. sissoo</i>	Shisham, sissoo	P; Gh, Nir, Nia
<i>Daniellia ogea</i>	Gum Capal tree	Nia
<i>D. oliveri</i>	Pau inceso, bu (Su), santan (Se)	Gam,GB,Mi,Se,Su
<i>D. thurifera</i> & spp.	Copal tree, faro (Co,Gu,IC,EG)	Gu,Se,Co,IC
<i>Deinbollia kilimandscharica</i>	Muriama (Ke)	Ke
<i>Desbordesia glaucescens</i> (<i>D. pierreana</i>)	Alep (Gab, EG)	EG,Gab
<i>Detarium senegalense</i>	Tambacounda, mambode	GB, Se
<i>Dialium guineense</i> & spp.	Eyoum	GB
<i>Dichrostachys cinerea</i> subsp. <i>cinerea</i> (<i>D.glomerata</i>)		Gam

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Didelotia</i> spp.	Ekop	
<i>Diospyros</i> spp.	African ebony, ebony	
<i>Diospyros abyssinica</i> (<i>Maba abyssinica</i>)	Msambu	Su
<i>Distemonanthus benthamianus</i>	Movingui, ayan, Yellow satinwood	Nia, Ca, Co, Gab, IC
<i>Dodonaea viscosa</i>		So
<i>Dombeya goetzenii</i>	Mukeo (Ke)	Ke
<i>Dumoria heckelii</i> (<i>Tieghemella heckelii</i>)		
<i>Eclea nobilis</i>	Munderendu (Ke)	Ke
<i>Ekebergia capensis</i>	Essenhout, loel (Et), sombo (Et)	Et
<i>E. rueppeliana</i>	Mununga (Ke)	Ke
<i>E. senegalensis</i>	Kakadikro	Mi, Se
<i>Elaeis guineensis</i>	Wild oil palm	Se
<i>Entandophragma angolense</i> & spp.	Tiama, gedu nohor	An, Gh, SL, Ze, Ca, CAR, Co, IC
<i>E. candollei</i>	Kosipo	Gh, Ca, CAR, Co, IC
<i>E. caudatum</i>		Bo
<i>E. cordatum</i>		Mw
<i>E. cylindricum</i>	Sapele (Gh), aboudikron (Gu, IC), sapelli (Nia, Ca, CAR, Co, EG, IC)	An, CAR, Gh, Gu, Nia, SL, IC, Ca, CAR, Co, EG, IC
<i>E. excelsum</i>	Muyovu	Bu, Ug
<i>E. grassei</i>	Tiama	
<i>E. utile</i>	Utile (Gh), Sipo (Ca, CAR, Co, IC)	An, Gh, Gu, SL, Ze, Ca, CAR, Co, IC

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Eribroma oblonga</i> & spp.	Eyong	Ca
<i>Erythrophleum africanum</i>	Missanda, mkarati, African blackwood	An,GB,Se
<i>E. ivorense</i> & spp. (<i>E. micranthum</i>)	Tali (Gab), sasswood tree	Gab
<i>E. suaveolens</i> (<i>E. guineense</i>)	Alui, tali, mkelekele (Ke)	GB,Ke,Mi,Moz,Se,Su,Ze
<i>Erythroxylum manni</i>	Landa (Ca)	Rw,Ca
<i>Eucalyptus alba</i>		P; An
<i>E. bicolor</i>		P; An
<i>E. camaldulensis</i>	Rostrata gum, red gum	P; An,Et,Liy,Mor,Tu
<i>E. citriodora</i>	Lemon-scented gum	P; An,Gam
<i>E. cloeziana</i>	Queensland messmate	P; Mw
<i>E. globulus</i>	Blue gum	P; An,Et
<i>E. gomphocephala</i>	Tuart	P; Liy,Mor,Tu
<i>E. grandis</i>	Grandis gum	P; An,Rw,Za
<i>E. kirtoniana</i>	Bastard mahogany	P; Ms
<i>E. maidenii</i>	Maiden's gum	P; Rw
<i>E. microtheca</i>		P; Su
<i>E. occidentalis</i>	Swamp yate	P; Tu
<i>E. orofila</i> ?		P; Co
<i>E. platyphylla</i>		P; Co
<i>E. robusta</i>	Robusta gum, swamp mahogany	P; Mad,Ms,Ug
<i>E. rudis</i>	Moitch	P; Liy

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Eucalyptus saligna</i>	Saligna gum	P; An, Mw, Moz, Rw, Ug
<i>E. tereticornis</i>	Tereticornis gum	P; Co
<i>Euphorbia balsamifera</i>	Balsam spurge	Mau
<i>E. commiphora</i>		Mau
<u>Excoecaria</u> <i>venenifera</i> (Spirostachys V.)		So
<i>Fagara heitzii</i> & spp.	Olon, olonvogo	Co, Gab
<i>F. macrophylla</i>	East African satin wood, olon, muganga (Ke), olonvogo	Ke
<i>Ficalhoa laurifolia</i>	Ficolhoa	Bu
<i>Ficus sycomorus</i>	Limu (So)	So
<i>Funtimia latifolia</i>	Bastard wild rubber	Moz
<i>Gaccina ferrandii</i>		So
<i>Galineria coffeoides</i>		Bu
<i>Gambeya</i> spp.	Longhi (Co), gambeya	Co
<i>Gambeya madagascariensis</i>	Famelona (Mad)	Mad
<i>Gilbertiodendron dewevrei</i> & spp.	Limbali	Co, Ca
<i>G. preussii</i>		Lib
<i>Gmelina arborea</i>	Gmelina, yamane	P; Gam, Gh, Gu, Lib, Mw, Mi, Nia, Se, SL
<i>Gossweilerodendron balsamiferum</i>	Agba (Gab), tola (Ze, Ca, Co)	An, Nia, Ze, Co, Gab, Ca
<i>Grewia bicolor</i>		So

Scientific names	Trade (or common) names	<u>Planted (P), Softwood (S)</u> Occurance
<i>Grevillea robusta</i>	<i>Grevillea</i> , <i>kavilia</i>	P; Rw, Bu
<i>Guarea cedrata</i>	Bossé (Ca,Co,IC), scented guarea, guarea	Gh,Gu,Ze,Ca,Co,IC
<i>G. thompsonii</i>	<i>Guarea</i> , bossé, diambi, black guarea	Gh,Ze
<i>Guibourtia arnoldiana</i> (Copaifera a.)	Mutenya (Co)	An,Co
<i>G. coleosperma</i>	Mussibi, Rhodesian copalwood, copalier	An, Moz, Rh
<i>G. conjugata</i>		Moz
<i>G. copallifera</i>		GB
<i>G. demeusei</i>	Ebana (Gab)	Gab
<i>G. ehie</i>	Ovangkol (Gab)	Gab
<i>G. pellegriniana</i> & spp.	Kevazingo (Gab), bubinga	Gab
<i>G. tessmannii</i> & spp.	Kévazingo (Gab), bubinga	Gab
<i>Guiera senegalensis</i>		Gam, Mi
<i>Hagenia abyssinica</i>	<i>Hagenia</i> (Ke), <i>duchia</i> (Et), <i>kosso</i> (Et)	Et, Ke
<i>Hannoa klaineana</i>	Effeu	Ze
<i>Heritiera littoralis</i>		Moz
<i>H. utilis</i> (<i>Tarrietia utilis</i>)	Niangon	Gu

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Hernandia voyroni</i> & spp.	Hazomalanga (Mad)	Mad
<i>Holoptelea grandis</i>	Mumuli, nemba, orange-barked terminalia	
<i>Hyphaene thebaica</i> (<i>H. benadirensis</i>)	Dum palm (So, Su)	Mi, So, Su
<i>Intsia bijuga</i> & spp. (<i>Afzelia bijuga</i>)	Merbau, hintsy (Mad)	Mad
<i>Isoberlinia dalzielii</i>		Ch, Gu
<i>I. doka</i>	Abogo, vuba (Su)	Ch, Gu, IC, Mi, Su
<i>Julbernardia globiflora</i>	Muwa	Moz
<i>Juniperus phoenicea</i>	Sabina, Phoenician Juniper	S; Liy, Mor
<i>J. procera</i>	African pencil cedar, cedar (Ta,Ke)	S; Et, AI, Ke, Mw, So, Su, Ta
<i>J. thurifera</i>		S; Mor
<i>Khaya anthotheca</i>	Acajou blanc, white mahogany	An,Gh,Gu,SL,Ca,CAR,Co,Da,EG,IC
<i>K. grandifoliola</i>	Benin mahogany	Gh,Su
<i>K. ivorensis</i>	Acajou bassam, Nigerian mahogany	Gh,Gu,Ca,CAR,Co,Da,EG,IC
<i>K. klainei</i>		An
<i>K. nyasica</i>	Nyasaland mahogany, African mahogany	Mw,Moz,Rh,Ta
<i>K. senegalensis</i>	Dry-zone mahogany, cailcédrot (Mau,Da,Ca)	CAR,Ch,Gam,Gu,GB,Mi,Mau,Su,Da,Ca
<i>Klainedoxa gabonensis</i> & spp.	Eveuss	An

Scientific names	Trade (or common) names	<u>Planted (P), Softwood (S)</u> Occurance
<i>Lannea kerstingii</i>		Su
<i>Laurea glabra</i>		Rw
<i>Lecaniodiscus fraxinifolius</i>	Muremanjogu	Ke
<i>Lophira alata</i>	Azobé, Red ironwood	Gh,Gu,Mi,Nia,SL,Ca,Gab,IC
<i>L. lanceolata</i>	Dwarf red ironwood	Mi
<i>Lovoa swynnertonii</i>	Mukusu	Rh
<i>L. trichilioides</i> & spp.	Dibétou, m'bero (EG), African walnut	EG,Gh,Gu,Nia,Ug,Ca,CAR,Co,EG,IC
<i>Maba abyssinica</i> (<i>Diospyros abyssinica</i>)		
<i>Maerua crassifolia</i>		Mau, Su
<i>Maesopsis eminii</i>	Musizi, (Ke), essence	Bu,Ke,Ug,Ta (p)
<i>Malacantha heudelotiana</i> (<i>M. alnifolia</i>)		GB
<i>Mangifera indica</i>	Mango	P; Gam
<i>Manilkara butugi</i>	Ludulio	Ke
<i>M. sansibarensis</i>	Mngambo	Ke
<i>Mansonia altissima</i>	Bété, mansonia	Gh,Nia,Ca,CAR,Co,IC
<i>Marquesia macroura</i>		An
<i>Melia indica</i> (<i>Azadirachta indica</i>)	Neem	P; Gh,Nia,Ca
<i>Hesperaloe parviflora</i> spp.	Varongy	Mad
<i>Microberlinia brazzavillensis</i>	Zingana (Co)	Co
<i>Millettia ferruginea</i>		Et

Scientific names	Trade (or common) names	<u>Planted (P), Softwood (S)</u> Occurance
<i>Millettia laurentii</i> & spp.	Menge (Co)	Ze,Co
<i>M. stuhlmannii</i>	Menge, Panga panga	Moz
<i>Mimusops bagshawei</i>		Ug
<i>M. congolensis</i>		An
<i>M. degan</i>		So
<i>M. djave</i>		An
<i>Mitragyna inermis</i>		Gh
<i>M. stipulosa</i> (<i>M. ciliata</i>)	Abura, bahia	Gh,Ze,Ca,Co,Gab,IC
<i>Monopetalanthus compactus</i>		Lib
<i>M. heitzii</i> & spp.	Andoung (Gab)	Gab
<i>Morus lactea</i>	Mecodze	Moz
<i>M. mesozygia</i> & spp.	Difon	Se, Ze
<i>Myristica voury</i>	Vory (Mad)	Mad
<i>Nauclea diderrichii</i> (<i>N. trillesii</i>)	Bilinga, opepe	Ch,Gu,Nia,SL, Ca,Co,Gab
<i>Nesogordonia papaverifera</i> & spp.	Kotibé (Gab, IC), danta	Gh,Nia,Gab,IC
<i>N. fouassieri</i>	(Kotibé, danta, Aborbora)	
<i>Newtonia buchananii</i> (<i>Piptadenia b.</i>)	Mafamuti	Bu,Moz
<i>N. leucocarpa</i> (<i>N. gladulifera</i>)	Ossimiale	Gab
<i>N. paucijuga</i>	Mleha	Ke

Scientific names	Trade (or common) names	<u>Planted (P), Softwood (S)</u> Occurance
<i>Ochthocosmus africanus</i>		Ze
<i>Ociypetes armoraica</i>		Ze
<i>Ocotea bullata</i>	Stinkwood	SA
<i>O. kenyensis</i> (<i>O. viridis</i>)	Camphor Kenyensis (Ke), muzura	Ke,Su
<i>O. platidisca</i> & spp.	Varongy (Mad)	Mad
<i>O. usambarensis</i>	Camphor	Ke,Rw,Ta
<i>Oldfieldia africana</i>	Turtosa	SL
<i>O. somalensis</i>	Mbambara (Ke)	Ke
<i>Olea africana</i>	Brown olive (Ke), egersa (Et), weira(Et)	Et,So,Ke
<u><i>O. capensis</i> subsp. <i>macrocarpa</i></u> (<i>O. laurifolia</i>)	Black ironwood	SA
<i>O. hochstetteri</i>	East African olive, agerguri (Et), Damat Weira (Et)	Bu, Et, Ke, Rw, Su
<i>O. oleaster</i>		Liy
<i>O. welwitschii</i>	Loliondo (Ta,Ke), Elgon olive (Ke)	Ke, Ta, Ug
<i>Olinia aequipetala</i>	Guna (Et), tife (Et)	Et
<i>Oxystigma oxyphyllum</i>	Tchitola (Co, Gab)	An,Nia,Ze,Co,Gab
<i>Oxytenanthera abyssinica</i>	Bamboo	CAR,GB,Mw,Se,Et

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Paraberlinia bifoliolata</i>	Awougha (Gab), beli	Gab
<i>Parinari curatellifolia</i> (P. mobola)	Angili	Rh
<i>P. excelsa</i> & spp.	Sougué (Gu)	Gu,Se,Ug
<i>Parkia biglobosa</i>	Nété	Gam,GB,Mi
<i>Pentaclethra eetveldiana</i>		Ze
<i>Pentadesma butyracea</i>	Kandika, Tallow tree	Gu
<i>Pericopsis angolensis</i>		Moz
<i>P. elata</i> (<i>Afrormosia elata</i>)		
<i>Phyllogeiton zeyheri</i>	Pau-rosa	Co
<i>Piliostigma thonningii</i>	Camel's foot leaf tree	Gam
<i>Pinus brutia</i> (P. halepensis var. brutia)	Cyprus pine	S; Liy (P)
<i>P. caribaea</i>	Caribbean pine	P,S; Co,Mad,Moz,Ta,Ug
<i>P. elliottii</i>	Slash pine	P,S; An,Mw,Ms,Moz,Rh,Sw,Ta
<i>P. halepensis</i>	Aleppo pine	S; Al,Liy,Mor,Tu
<i>P. kesiya</i>	Khasya pine	P,S; An,Mad,Mw,Ug,Za
<i>P. occarpa</i>	Nicaraguan pitch pine	P,S; Ug
<i>P. patula</i>	Patula pine	P,S; An,Ke,Mad,Mw,Moz,Rh,Sw,Ta, Ug,Et
<i>P. pinaster</i> (P. maritima)	Maritime pine	S; Al,Mor,Tu
<i>P. pinea</i>	Umbrella pine	S; Tu,Al
<i>P. pinuca</i>		Mor
<i>P. radiata</i>	Radiata pine	P,S; Ke,Ta,Tu

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
Pinus taeda	Loblolly pine	P,S; Mw,Ms,Rh,Sw
Piptadenia africana		Ze
P. erlangeri		So
P. leucocarpa	Ossimiale	Gab
Piptadeniastrum africanum	Dahoma, dabéma	An,Gh,Nia,Ug,Ca,Gab,IC
Pistacia atlantica		Liy
P. lentiscus		Liy
Pittosporum viridiflorum		Su
<u>Podocarpus gracilior</u> (Decussocarpus gracilior)	East African Yellowwood, podo (Ke), zigba (Et)	S; Et,Ke
P. madagascariensis	Hetatra (Mad)	S; Mad
P. milanjanus	Tawaso, podo (Ke)	S; Bu,Ke,Rw,Su
<u>P. usambarensis</u> (Decussocarpus mannii)	Musenzi	S; Bu,Rw,Ug
Poga oleosa	Ovoga, afo (Gab)	Gab
Polyscias <u>ferruginea</u> (P. fulva)	Guduba (Et), karrio (Et)	Bu,Et
Populus deltoides var. carolina		P; Mad
Pouteria ferruginea	Karraro (Et)	Et
Premna maxima	Muchikio (Ke)	Ke
Prosopis africana	Guélé	Gam,Mi,Su
Pseudocedrela kotschyi	Dry-zone cedar	Mi
Ptaeroxylon obliquum	Sneeze wood	SA

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Pteleopsis myrtifolia</i>	Sunganhamba	Moz
<i>Pterocarpus ampbis</i>		
<i>P. angolensis</i>	Muninga (Ta), mukwa (Za)	An,Bo,Mw,Moz,Rh,Ta,Za
<i>P. erinaceus</i>	Senegal rosewood tree	Da,Gam,GB,Mi,Mau
<i>P. lucens</i>		Su
<i>P. soyauxii</i>	Padouk (Co,Gab), palo-raja (EG)	EG,Co,Gab
<i>Pterygota macrocarpa</i>	Koto (IC), pterygota	Nia,IC
<i>P. meldraiedii</i>		Ug
<i>Pycnanthus angolensis</i> & spp.	Ilomba (Ca), Calabó (EG)	EG,Nia,Ca,Co,Gab,IC
<i>P. kombo</i> & spp.	Ilomba (Gu)	Gu,Ze
<i>P. marchalianus</i>		Ze
<i>Pygeum africanum</i>	Red stinkwood, Mueri (Ke)	Et,Ke,Rw,Su
<i>Quercus afares</i>		Mor
<i>Q. coccifera</i>		Liy
<i>Q. faginea</i> (Q.zeen)		Mor,Tu
<i>Q. ilex</i>	Holm oak	Al,Mor,Tu
<i>Q. lusitanica ssp. canariensis</i> (<i>Q. mirbeckii</i>)	Portugal oak	Mor,Tu
<i>Q. suber</i>	Cork oak	Al,Mor,Tu
<i>Q. tozae</i>		Mor

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Rapanea simensis</i>	Algie (Et), tula (Et)	Et
<i>Ravensara</i> spp.	Tavolo	Mad
<i>Rhizophora harrissoni</i>	Red mangrove	SL
<i>R. mangle</i>	Mangle	SL
<i>R. racemosa</i>		Gu,Se,SL
<i>Rhus tripartitus</i>		Liy
<i>Riciodendron africanum</i> (<i>R. heudelotii</i>)	Erimado, essesang (Gab)	An,Nia,Gab
<i>Sarcocephalus diderrichii</i>		Ze
<i>Sacoglottis gabonensis</i>	Ozouga (Gab)	Gab
<i>Salvadora persica</i>	Tooth brush tree	Mau
<i>Schefflera abyssinica</i>	Buto (Et), gatama (Et)	Bu,Et
<i>Schrebera arborea</i>	Pau goiaba	Se
<i>Schyphocephalum ochocoa</i>	Sogho (Gab)	Gab
<i>Sclerocarya birrea</i>	Mgongo	Mau
<i>S. caffra</i>	Marula	Moz
<i>Scotellia coriacea</i> & spp.	Odoko	Nia
<i>Sideroxylon buxifolium</i>		So
<i>Staudtia stipitata</i>	Niové (Co,Gab)	An,Co,Gab
<i>S. yangambensis</i>		Ze

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Sterculia africana</i>		Moz
<i>S. guineloba</i>	Mbalamwezi	Moz
<i>S. rhinopetala</i>	Nkanang (Ca), wawabimo, wawatima	Ca
<i>S. setigera</i> (<i>S. tomentosa</i>)		Mau
<i>Stipa tenacissima</i>	Alfa grass	Alg, Mor
<i>Strombosia scheffleri</i>	Msangana	Bu,Rw
<i>Strychnos mitis</i>	Njirimba (Ke)	Ke
<i>Swartzia fistuzoides</i> & spp.	Oken (Gab), pau-rosa (Co), kasanda	Gab,Co
<i>S. madagascariensis</i>		Moz
<i>Symphonia clusoides</i> & spp.	Kiji (Mad)	Mad
<i>S. globulifera</i>	Ossol (Gab), manil	Bu,Rw,Ze,Gab
<i>Syzygium gerardii</i>		Su
<i>S. parvifolium</i>		Bu,Rw
<i>S. guineense</i>	Waterberry, badessa (Et), dogma (Et)	Et,Moz,Se,Su
<i>Tamarindus indica</i>	Tamarind, mkwadju (Ke)	Ke,Mi
<i>Tamarix articulata</i>	Arabian tamarisk	Liy
<i>T. senegalensis</i>		Mau
<i>Tambourissa thonvenotii</i>	Ambora (Mad)	Mad
<i>Tarrietia densiflora</i>	Niangon, Ogoué	
<i>T. utilis</i> (<i>Heritiera utilis</i>)	Niangon (Gab, IC)	Gh,SL,Gab,IC,Ca,Gu

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Tectona grandis</i>	Teak	P; Ca, Da, Gam, Gh, Gu, IC, Lib, Mi, Nia, Se, SL, Ta, To, Ug, UV
<i>Terminalia albida</i>		Da, Gam
<i>T. bispindosa</i>		So
<i>T. glaucescens</i>	Koma	Su
<i>T. ivorensis</i>	Framiré (Gu, IC), Idigbo, Black afara	Gh, Nia, Gu (p), IC, SL (p), Ca
<i>T. macroptera</i>	Ouolotie	GB
<i>T. pycnanthus</i>		
<i>T. sericea</i>	Sandvalbos	Rh
<i>T. superba</i>	Limba (Ze, Ca, Co, Gab), afara, akom (EG) fraké (IC, Da, Gu)	An, Da, EG, Nia, Ze, IC, Gu (p), Ca, CAR, Co, EG, Gab, SL (p)
<i>Testulea gabonensis</i>	Izombé	Co, Gab
<i>Tetraberlinia bifoliata</i>	Kopribi, ekaba (EG)	EG
<i>Tetraclinis articulata</i> (Callitris a.)	Cypress pine	S; Al, Mor
<i>Thespesia somalica</i>		So
<i>Thymelaea hirsuta</i>		Liy
<i>Tieghemella africana</i> & spp.	Makoré, douka (Co, Gab)	Co, Gab
<i>T. heckelii</i> (Dumoria h., Mimusops h.)	Makoré (IC), douka	Gh, IC
<i>Trachylobium verrucosum</i>	Msandarusi (Ke), Gum Copal tree	Ke
<i>Trichilia chirindensis</i>		Rh
<i>T. jubensis</i>		So
<i>T. roka</i> (T. emetica)	Natal mahogany	Rh
<i>Triplochiton scleroxylon</i>	Wawa (Gh), obeche (Nia), samba (Da, IC) ayous (CAR, Ca, Co, Gab)	Gh, Nia, Ca, CAR, Co, Gab, IC, Da, SL (p)

Scientific names	Trade (or common) names	Planted (P), Softwood (S) Occurance
<i>Turraeanthus africana</i> & spp.	Avodiré (Co,IC)	Gh,Ze,Co,IC
<i>Uapaca guineensis</i> & spp.	Rikio, assam	Ze
<i>U. kirkiana</i>		Moz,Rh
<i>U. togoensis</i>		IC
<i>Vernonia merana</i>	Merana (Mad)	Mad
<i>Vitex ciliata</i>	Evino	
<i>V. doniana</i>	Meru oak	Su
<i>V. keniensis</i>	Meru oak (Ke),muhuru (Ke)	Ke
<i>V. pachyphylla</i> & spp.	Evino	Gab
<i>Widringtonia whytei</i>	Mlanje cedar	S; Mw
<i>Xymalos monospora</i>	Lemon wood	Bu
<i>Zizyphus lotus</i>		Liy
<i>Z. abyssinica</i> (<i>Z. jujuba</i>)	bertree,jujube	Mi

Appendix III

Yangambi scheme for the classification of African vegetation

Source: Boughey 1957

I. Closed forest formations

A. Climatic forest formations

(a) Forest at low and medium altitudes

(1) Moist forest (Forêt dense humide)

Closed stand with several strata including an upper stratum of large trees; understorey of evergreen shrubs; grass stratum generally absent or, if present, of species with broad leaves.

(i) Moist evergreen forest (Forêt dense humide sempervirente)

(ii) Moist semi-deciduous forest (Forêt dense humide semi-décidue)

Note - Secondary forest - derived by degradation from the preceding types: forest regrowth, forest fallow, and cut-over-forest.

(2) Dry deciduous forest (Forêt dense sèche)

Closed stand with several strata, of lower stature than the preceding type; most trees of the upper strata deciduous; understorey of shrubs evergreen or deciduous; grass stratum generally discontinuous.

Note - Certain types of dry forests are almost evergreen, and the term Dry Evergreen Forest is then applied.

(3) Thicket (Fourré)

Shrubby vegetation, evergreen or deciduous, usually more or less impenetrable, often in clumps, with grass stratum absent or discontinuous.

Note - Certain thickets may be dominated by bamboos.

(b) Forests at high altitudes (Forêts de montagne)

Note - In South Africa this may occur also at lower altitude

(1) Moist montane forest (Forêt dense humide de montagne)

Similar to moist forest at low and medium altitudes, differing in the habit and smaller height of the trees, and in other characters, including often greater abundance of epiphytic bryophytes.

(2) Dry montane forest (Forêt dense sèche de montagne)

Same definition as dry forest at low and medium altitudes, but with the upper stratum reduced in size. These forests are sometimes sclerophyllous.

(3) Bamboo forest (Forêt de bambous)

Note - Secondary forest: same definition as moist forest at low and medium altitudes.

B. Edaphic forest formations (Formations forestières édaphiques)

- (a) Mangrove
- (b) Swamp forest (Forêt marécageuse)
- (c) Periodic swamp forest (Forêt périodiquement inondée)
- (d) Riparian forest (Forêt ripicole)

II. Mixed forest-grassland formations and grassland formations

A. Woodland (Forêt claire)

Open forest; tree stratum deciduous of small or medium sized trees with the crowns more or less touching, the canopy remaining light: grass stratum sometimes sparse, or mixed with other herbaceous and suffrutescent vegetation.

Ex. Isoberlinia doka woodland (Keay, 1953:An outline of Nigerian Vegetation)

B. Savanna (Savane)

Formations of grasses at least 80 cm high, forming a continuous layer dominating a lower stratum. Usually burnt annually. Leaves of grasses flat, basal and cauline. Woody plants usually present.

- (a) Savanna woodland (Savane boisée)
Trees and shrubs forming a canopy which is generally light.
- (b) Tree savanna (Savane arborée)
Trees and shrubs scattered
- (c) Shrub savanna (Savane arbustive)
Trees absent, shrubs scattered
- (d) Grass savanna (Savane herbeuse)
Trees and shrubs normally absent

C. Steppe

Open herbaceous vegetation, sometimes also with woody plants: usually not burnt. Perennial grasses widely spaced, usually less than 80 cm high. Leaves of grasses narrow, rolled or folded, mainly basal. Annual plants very often abundant between the perennials.

- (a) Tree and/or shrub steppe (Steppe arborée et/ou arbustive)
Small trees and/or shrubs and undershrubs present
- (b) Dwarf-shrub steppe (Steppe buissonnante)
Dwarf-shrubs dominant (undershrubs may be present)
- (c) Succulent steppe (Steppe succulente)
Succulent plants widespread, trees and shrubs absent
- (d) Grass and/or herb steppe (Steppe herbacée et/ou graminéenne)
Trees and shrubs virtually absent

D. Grassland (Prairie)

Closed grass or herbaceous formations affected by special environmental factors.

- (a) Aquatic grassland (Prairie aquatique)
- (b) Herb swamp (Prairie marécageuse)
- (c) High-montane grassland (Prairie altimontaine)