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Forest Resources of Africa

An Approach to International Forest Resource Appraisals

Part II: Regional analyses

Afrikas skogsresurser

En metodansats för uppskattning och beskrivning av världens skogstillgångar

Del II: Regionala analyser

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Abstract

This report describes the present forestry situation of Africa and the future. Country-by-country summary-tables of the most important figures about different aspects of forestry are given in an Appendix.

The total closed forest area is 190 million ha or a few million more if a wider definition is accepted. The area of open woodlands of different types is about 600 million ha.

The area covered by man-made forests is at least 3 million ha and may be as much as 3.5 million ha in 1976. Of this area, one-third consists of pines and one-third of eucalypts. The planned yearly planting rate is around 200,000 ha.

The total gross volume of wood is roughly calculated as about 60,000 million m^3 of which about two-thirds is found in closed forest types.

If the present exploitation of the wood resources continues large regions of Africa will suffer in the future from a deficit of fuelwood. In many countries the known timber species will also be exhausted. For a successful future the establishing of man-made forests is essential.

FOREWORD

This is the second part of a report which aims at a detailed appraisal of the forest resources of Africa. In Part I detailed country notes and maps were prepared for all countries. Here the information is summarized and further analysed.

This work was initiated at FAO Headquarters in Rome where I worked for four years. Completion of the work has been made possible by an agreement of cooperation between FAO and The Royal College of Forestry in Stockholm. SIDA has given financial support.

Many people have helped me. I am in debt to the officers at FAO:s Forestry Department. At The Royal College of Forestry in Stockholm Professor N-E. Nilsson has always been very interested and has supported my work for many years. Without this support it would have been impossible to finish the job.

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General notes

The terms used throughout the report are defined in the "Glossary" (Appendix I) in Part I. Definitions of the terms used in the summary-tables are found in Appendix I of this report (Part II).

The designations and the presentations of the material employed here does of course 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 time of writing.

Abbreviations and symbols

-	Nil
..	Information not available
o	Small areas. Less than one unit.
+	Known to exist. Not known exactly how much.
D	Dominating
()	Figure known to be incomplete or very uncertain (e.g. some of my guesstimates).
E	Own estimate based on inadequate background information.
*	Crude guesstimate
mm	Millimetre
cm	Centimetre (1 cm = 0.3907 inch)
m	Metre (1 m = 3.281 feet)
ha	Hectare (ha = 2.471 acres)
km^2	Square kilometre
m^3	Cubic metre (often standing volume)
m^3 (r)	Cubic metre of roundwood
m^3 (s)	Cubic metre solid volume
m^3WRME	Cubic metre wood rawmaterial equivalent
m.t.	Metric ton
US $	US Dollar
c.i.f.	Cost, insurance, freight
f.o.b.	Free on board
d.b.h.	Diameter at breast height
o.b.	Over bark
Sp.	Species (singular)
Spp.	Species (plural)
inh.	Inhabitants
CIDA	Canadian International Development Authority
CTFT	Centre Technique Forestier Tropical
FAO	Food and Agriculture Organisation (of the United Nations)
IBRD	International Bank for Reconstruction and Development
SIDA	Swedish International Development Authority
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WFI	World Forest Inventory
TPY	Tonnes (m.t.) per year

Conversion factors

1 m^3 (s) sawnwood = 1.8 m^3 (r)
1 m^3 (s) plywood and veneer = 2.2 m^3 (r)
1 m^3 (s) particle board and fibreboard = 1.4 m^3 (r)
1 m.t. paper and paperboard = 3.3 m^3 (r)
1 m.t. wood pulp = 4.1 m^3 (r)
1 m.t. paper and paperboard = 0.8 m.t. pulp

Common species names used in the text

Avodiré	Turraeanthus africana & spp.
Cork oak	Quercus suber
Doussié	Afzelia bipindensis & spp.
Iroko	Chlorophora excelsa
Khaya	Khaya spp.
Limba	Terminalia superba
Makoré	Tieghemella heckelii & spp.
Okoumé	Aucoumea klaineana
Rhodesian teak	Baikiaea plurijuga
Samba	Triplochiton scleroxylon
Teak	Tectona grandis
Wattle	Acacia spp.
Zambian teak	Baikiaea plurijuga

Map 1. The continent of Africa showing the six regions as denoted in this study.

1 INTRODUCTION

1.1 Background, objectives and limitations

This is the second part of a report which describes the forest resources of Africa and their possible utilization. Both Part I and Part II of this report are attempts to improve the World Forest Inventories (WFI) which were earlier undertaken by FAO.

While Associate Expert in the Forest Economics and Statistics Branch of FAO in Rome I worked on the assembly of forest resource statistics (mainly for the WFI) for four years. Since FAO lacked resources to prepare a publication, the material assembled on Africa since 1968 was put at my disposal to make possible the publication of a Forest Resource Appraisal for Africa. FAO has, as far as I know, been keen to have a pilot study completed and supported my work in the beginning. Naturally this does not mean that they necessarily agree with my final presentation or with my opinions.

The primary objective of both parts of this report has been to prepare an encyclopedia of Africa´s forest resources. Part I therefore contained information about the forest resources of Africa in the form of descriptive country notes and country maps. These country notes and maps are the basic information presented. They summarize all the information of interest which it has been possible to collect at this time.

Part II summarizes the most important information about forest resources from Part I in short regional descriptions and discusses forestry conditions - especially potentials for forest production - in Africa as a whole. The summary-tables crudely summarize most of the basic facts given.

It must be stated that Part II does not aim at giving a detailed description of all aspects of African forestry. Many questions of importance can only be discussed briefly and incompletly. In spite of this the report has become very voluminous. For a number of subjects summaries of existing knowledge are normally too short to allow adequate references to sources. In these cases one should refer to the reports in the Bibliography. In the case of sources to the regional summaries and the summary-tables reference is made to the Bibliography in Part I.

Ideally a Regional Forest Resource Appraisal of this type should give the resource information needed for a detailed Regional Timber Trends and Prospects Study (Timber Trends Study). But it is difficult to do this without considering the future domestic consumption and the potential external export markets. And if this information was complete it would mean that the report would change from a Forest Resource Appraisal to a Timber Trends Study. This has been avoided but certain indicative information concerning consumption and production has been given. It is clear that this report can be completely finalized only in connection with a Timber Trends Study which through detailed analyses of consumption and production trends will identify all the important questions about forest resources. Many of the discussions in this report end up with questions more than definite conclusions.

Information given in Part I and Part II sometimes overlaps. This is mainly because Part I is to be considered a reference book and not a

report to be read from the first to the last page. Part II has also been written partly after the publishing of Part I. A new version of this report - which may be published in due time - would certainly look quite different. New facts would be included and the chapters would be arranged in a different and, perhaps, more logical order.

I have a very limited personnel experience of African conditions. Studies of literature cannot give a complete picture. If a report of this type is considered valuable, a new version would be based on more extensive travels and intense discussions with African specialists in different fields. My report then, is an outsider's view of African forestry.

I am not fully satisfied with this report: It is difficult to discuss such a vast subject. Further background: methods used etc. are given in Part I and also in the report World Forest Resources (1974). The Preface to Harrison Church's excellent book "West Africa" (Seventh Edition) states "No apology is necessary, therefore, for this study of Africa, based on over thirty-six years of wide reading in scattered literature in several languages, and on very extensive field work throughout the area". If I could say the same on the publication of the 7th edition of this report, I would feel more satisfied.

1.2 Grouping of countries

This report discusses the following regions:

North Africa

Western Sahara (earlier Spanish Sahara), Morocco, Algeria, Tunisia, Libya, Egypt

Northern Savanna Region

Mauritania, Senegal, Gambia, Mali, Upper Volta, Niger, Chad

West Africa

I Guinea Bissau, Guinea, Sierra Leone, Togo, Benin (earlier Dahomey)
II Liberia, Ivory Coast, Ghana, Nigeria

Central Africa

Cameroon, Equatorial Guinea, Gabon, Central African Republic, Congo, Zaire, Angola

East Africa

Sudan, Ethiopia, Fr. Terr. Afars and Issas, Somalia, Uganda, Kenya, Rwanda, Burundi, Tanzania, Zambia, Malawi, Mozambique, Madagascar

Southern Africa

Rhodesia, Botswana, Namibia, Swaziland, Lesotho, South Africa

The extension of the different regions is shown on map no 1.

Islands are sometimes shown as a separate region (see e.g. page 83).

Within each region the countries are dealt with in tables etc. grouped in order from west to east and from north to south.

It should be mentioned here that "region" in the UN-terminology means a continent (e.g. Africa) or some other large geographical area (e.g. Near East), while "region" in this report means a group of countries (e.g. North Africa). When no misunderstanding seems possible it is occasionally also used in other senses (e.g. to refer to a specific region in a country).

2 RELIABILITY OF THE INFORMATION

The information in the country notes in Part I has been basic in the preparation of this report (Part II). Limitations of the information given in the country notes was discussed in 3.1 - 3.3 in Part I. Some additional comments on this topic will be given here.

It is well known that detailed knowledge about forest resources must be based on proper forest inventories. As has been clearly explained in the country notes, inventories cover only parts of forest and other wooded areas. This information is summarized in summary-table S VII. (Some new information has been added compared to Part I.)

Inventories can be of different types and give different kinds of information. They can be National inventories giving information for planning at the national level; they can cover a selected area to give information for the planning of investments in this area; they can be reconnaissance surveys giving a first broad picture of the forest resources in an area or they can give detailed data for the preparation of management plans for forest districts.

All these types of inventories can be found in Africa. Most inventories undertaken cover the closed forests. The open woodlands are only inventoried to a minor extent. The areas of closed forests and open woodlands covered by different kinds of inventories are summarized in table 2.1.

Table 2.1. Areas of closed forest and open woodland covered by inventories (up to approx. 1973)[1/]

Region	Closed forest				Open woodland[2/]	
	Rel. detailed inv.		Reconnaissance surveys	Management plan inv.	Rel. detailed inv.	Reconnaissance surveys
	Nationwide	Preinvestment or regional				
	million ha					
North Africa	-	0.03	0.15	0.4	-	-
Northern Savanna	-	-	-	-	0.3	-
West Africa I	-	0.09	0.4	0.2	-	1.5
" " II	10.6	0.4	-	1.1	-	-
Central Africa	-	9.2	3.3	-	-	2.6
East Africa	-	2.7	0.03	0.55	5.7	51.2
Southern Africa	-	-	1.2	-	0.5	-
Total	10.6	12.6	5.1	2.3	6.5	55.3

1/ An area may occasionally be covered by different types of inventories.
2/ Management plan inventories cover 4.6 million ha in East Africa.

The percentage of wooded areas inventoried in different regions is summarized in table 2.2. The data about wooded areas used for the calculations and comparisons comes from summary-tables S II, S III and S IV.

Table 2.2. Percentage of wooded areas inventoried in different regions

Region	Closed forest		Open woodland covered by some form of inventory
	Covered by some form of inventory	Covered by relatively detailed inventories	
	per cent		
North Africa	(30)	2	-
Northern Savanna R.	..	..	0
West Africa I	29	4	6
" " II	68	62	-
Central Africa	8	6	1
East Africa	21	17	30[1/]
Southern Africa	(75)	..	1
Total	16	12	11

1/ This high figure depends mainly on some form of reconnaissance survey for the whole of Zambia.

Tables 2.1. and 2.2. give the basic information about inventories undertaken and indicates parts of the basis for existing knowledge. The tables however contain probably many errors. Results from many of these inventories were not available for the preparation of this report (and Part I), some of the results are old and conditions may have changed, and some reconnaissance surveys give very little information.

It must also be mentioned here that management plan inventories - which are rather common - are difficult to use for planning at the national level as the information collected is normally of a type that is suitable for planning at the local level. Information is not always comparable between the different inventories. Occasionally however management plan inventories give detailed results which can be used at the national level.

Even without considering all these difficulties it is clear that the areas covered by inventories are very limited. Of the closed forest areas, around 10-15 per cent may be covered by "acceptable" inventories while for open woodland areas the figure would appear to be about 10 per cent (mainly reconnaissance surveys).

Inventories are presently being made in many parts of Africa but it will be a long time before African forests and other wooded areas are well documented. It must be remembered too, that inventory results date quickly.

Firstly inventories are needed for volume estimates. Without inventories volume estimates for most parts of Africa must be unreliable. Crude estimates can be made concerning the total wood volume but it is not possible to make guesses concerning the total volume of valuable timber species. First of all the occurrance of these species is only known in a few cases like avodiré, doussié, iroko, khaya, limba, makoré, okoumé and samba. Within these areas the species are often concentrated to scattered localities. Sometimes too, the quality of the species varies within the area of distribution. The best quality of

limba e.g. is found in the Mayombe region which ranges from south-western Gabon to western Zaire. Limba grows in most other countries in West and Central Africa but is not much exploited as the quality is poor. This is because borer holes caused by lycthus-attack during the growing period and a yellow-greyish colour affect the wood. (Erfurth 1973.)

The actual volume of different valuable species can therefore not be known until complete inventories of the African forests (or the whole of Africa) have been undertaken. The crude figures for commercial volume that have been calculated in this report are consequently of rather doubtful value. Even if they were accurate they could be dated within a few years. Due to selective cutting the volume of commercial species is decreasing.

Information from some sort of land use study or mapping or other sources can give the area of "forest and other wooded areas" even if forest inventories have not been undertaken. Normally such studies do not have the forests as their main subject so the information is often not detailed. Degraded formations can - for instance - be classified as forest. Any economic classification of the wooded areas is also rare.

An effort has been made while preparing some of the summary-tables in Appendix I to classify the information for each country in accuracy classes. This is a very subjective classification which naturally has many limitations. Information may be good for one part of the country but bad for another part. But in spite of obvious limitations this was still felt to be an useful exercise.

In table 2.3., this classification has been given for the area of closed forest. (For definitions of the accuracy classes se page175.) Note that accuracy class 1 means that closed forest area is thought to be well known.

Table 2.3. Classification of the information about closed forest in accuracy classes

Region	Accuracy class			
	2	3	4	5
	million ha			
North Africa	-	0.6	0.5	0.1
Northern Savanna R.	-	-	0.2	-
West Africa I	0.4	0.5	0.8	0.7
" " II	-	13.0	4.4	-
Central Africa	21.5	37.5	92.0	-
East Africa	-	1.7	3.0	11.0
Southern Africa	-	0.3	-	-
Total	22(3)[1/]	56(12)	101(15)	12(7)
%	12	29	53	6

1/ Within brackets the number of countries placed in each accuracy class.

Table 2.3. shows that the information about closed forest in most countries have been placed in the accuracy classes 3 and 4. As can be seen in summary-table S III, estimates for open woodlands have, in most cases, been placed in the accuracy classes 4 and 5. It is difficult to say how accurate information about open woodlands is. The extent of open woodland areas is evidently relatively well known in some countries in East Africa while the extension of these areas in the northern savanna zone is less well known. Information about the area of relatively undisturbed open woodlands or open woodlands of different types (e.g. savanna woodland, tree savanna) is poor in most countries. (See further discussions in 3.1.3.)

The areas of man-made forests are usually better known than the areas of natural forests. Volume information is normally not available but the age distribution of plantations of interest for industrial utilization can often be traced. The areas covered by small scattered fuelwood and pole plantations are - quite naturally - often badly known.

This chapter has discussed the limitations of much of the basic information in the country notes. Other information may be weak too but it is not possible here to discuss the reliability of all kinds of information in a meaningful way. Often it is simply not possible to say exactly how reliable different estimates really are.

For some items it has been necessary to make "guesstimates" to complete the picture. For any kind of overall analysis such guesstimates are nearly always necessary. Of course one may discuss to what extent such guesstimates are useful. Some readers will probably find some of my guesstimates far too wild. Usually the intention is to indicate the relative size or importance of some factor. It is the regional figures which are of interest for the discussions here. The country figures which have sometimes been given without adequate background information (e.g. exploited area) merely aim at provoking an improvement of country figures till a later study. The reliability of the information in the summary-tables is discussed in some detail in Appendix I.

3 GENERAL BACKGROUND INFORMATION

3.1 The natural vegetation

3.1.1 General

The vegetation for Africa as a whole has been described in chapter 2 of Part I while the vegetation in the different countries have been described in the country notes. In this sub-chapter certain regional descriptions will be given (see the vegetation map on page 19 in Part I.)

Table 3.1. gives the distribution of the "present vegetation cover" in the different regions. It is based on summary-table S VI. This information has been calculated from the "Vegetation map of Africa (south of the Tropic of Cancer)" (Anon. 1959) and in the case of North Africa from a Vegetation map published by Oxford University Press (published in FAO 1974 e).

The information given in these maps is naturally limited. The limitations can be summarized as follows (based on the Introduction to the Vegetation map of Africa by R. W. J. Keay).

a) The maps show vegetation as it is today, not the presumed climax types.

b) The boundaries between the type zones are seldom precise on the ground. Sometimes there are intermediate types or a mosaic of the two types.

c) The vegetation within each zone is naturally, not completely uniform.

d) The scale of the maps precludes small detail. Riverine forests for instance cannot be shown.

These remarks should be kept in mind when studying the following regional tables. The figures given do not show the existing vegetation but rather the type of vegetation that should occur in an area under present anthropogenic conditions if it were not used for anything else. Agricultural land, bush fallow and so on are not subtracted from the area shown as presently being of a specific vegetation type. Within e.g. the moist woodlands there are also a number of diverse types.

The information given here firstly indicates the areas that are more or less naturally suitable for tree vegetation. The actually remaining area of different wooded vegetation types will in more detail be discussed in chapter 4. It should be noted that the dot-counting used for the area calculation can give errors for infrequent types.

Table 3.1. Vegetation types in Africa

Region	Moist forest[1/]	Other closed forest types	Maquis, montane communities	Moist savanna[2/]	Dry savanna[3/]	Wooded steppe	Thicket, bamboo	Grasslands	Desert, subdesert
	million ha								
North Africa	-	19	22	-	-	-	-	37	523
Northern Savanna R.	-	0.2	-	24	101	137	-	-	264
West Africa I	5	1.4	0.9	39	4	-	-	-	-
" " II	43	3.3	1	78	31	3	-	-	-
Central Africa	194	(0.2)	(6)	272	41	2	-	15	2
East Africa	13	20	13	206	102	200	17	54	174
Southern Africa	1	(4)	0.6	21	69	86	6	37	76
Total	256	48	44	640	348	428	23	143	1039
%	9	2	1	22	12	14	1	5	35

1/ Mainly rainforest
2/ Relatively moist woodlands and savannas
3/ Relatively dry woodlands and savannas

3.1.2 North Africa

According to the "Bioclimatic map of the Mediterranean zone" (UNESCO/FAO 1963) the land area is distributed into main bioclimatic (ecological) zones as in table 3.2.

Table 3.2. Bioclimatic zones in North Africa

Zone	Morocco	Western Sahara	Algeria	Tunisia	Libya	Egypt	%
	million ha						
Desertic-sub-desertic	22.3	26.6	221.5	10.9	173.2	100.2	92
Xero-thermo-mediterranean	4.0	-	3.6	1.7	2.1	-	2
Thermo-mediterranean	8.9	-	7.2	2.1	0.7	-	3
Meso-mediterranean	8.7	-	5.6	1.8	-	-	3
Sub-mediterranean	0.5	-	0.4	0.01	-	-	0.1

These bioclimatic zones can be defined as follows:

a) Desertic and subdesertic:
Rainfall is generally below 150 mm per year with a yearly drought of over 200 days. Forestry vegetation is nil.

b) Xero-thermomediterranean:
The summer drought is normally 150-200 days and the yearly rainfall 150-200 mm. The woody vegetation is limited to thorn scrub species. Alfa grass (Stipa tenacissima) is found in this region from Morocco to Tripolitana.

c) Thermo-mediterranean:
The summer drought is 100-150 days and the yearly rainfall 250-500 mm. Some forest of dry type starts to occur. The main species are Pinus halepensis, Tetraclinis articulata, Juniperus phoenicea, J. oxycedrus, J. thurifera, Quercus coccifera, Q. ilex and Pistacia lentiscus.

d) Meso-mediterranean:
The summer drought season is 40-100 days and the yearly rainfall 500 to 900 mm. Species as in the previous type but with an admixture of mesophytic species like Quercus suber, Q. faginea, and Q. afares becoming more frequent in the areas of higher rainfall.

e) Sub-mediterranean:
This zone covers small areas and is generally associated with the more elevated parts of the mountain ranges. The summer drought season is below 40 days and the annual rainfall 800 to 1,200 mm or occasionally up to 1,800 mm in the higher mountain districts. In winter snow and frost occur in higher areas. In this type, most of the xerophytic forest genera disappear or are only sparsely represented. They are replaced by important coniferous forest associations mainly Cedrus atlantica, and to a lesser extent Pinus pinaster. Abies numidica occurs in two small

areas in the Rif mountains of northern Morocco. Quercus suber, Q. faginea, Q. afares, and Q. ilex dominate among the hardwood species.

Table 3.2. shows that only 8 per cent of the land area is situated outside the desertic and subdesertic zones. According to this map forest vegetation can occur in roughly 30-35 million ha (in the thermo-mediterranean, meso-mediterranean and sub-mediterranean zones).

The Oxford University Press Vegetation map (FAO 1974 e) gives the following information about "present vegetation".

Table 3.3. Vegetation types in North Africa

Country	Forest cork-oak	Forest argon trees	Montane forest	Maquis	Montane communities	Grass-lands	Sub-desert	Desert
	million ha							
Western Sahara	-	-	-	-	-	-	-	26.6
Morocco	4.1	3.6	4.9	7.5	0.1	15.1	-	9.2
Algeria	1.9	-	3.8	4.8	-	18.6	0.7	207.9
Tunisia	0.6	-	0.1	4.4	-	3.3	-	7.1
Libya	-	-	-	4.9	-	-	11.1	159.9
Egypt	-	-	-	-	-	-	..	100.1
Total	6.6	3.6	8.8	21.6	0.1	37.0	11.8	510.8
%	1.1	0.6	1.5	3.6	0	6.2	1.9	85.1

This table must be compared with the description of the remaining forests in chapter 4. It is evident that more or less all areas that can carry a "forest crop" according to table 3.2. are shown as having a wooded cover on the vegetation map. This is certainly a serious overestimate of the wooded areas. Probably the map shows the areas where wooded vegetation occasionally occurs.

As is evident from the vegetation map in Part I, the wooded vegetation types are found in the north-western part and there mainly in the mountains. The vegetation becomes more sparse to the south.

3.1.3. The Northern Savanna Region

Wooded steppes or thornlands (Sahel) are found south of the desert and subdesert types. These occur in areas of low rainfall (below 500 mm) and with very long dry seasons (seven to eight months). The trees, mostly species of Acacia and Commiphora, are widely spaced. Occasionally, under favourable conditions, they form dense stands which may attain a height of 12 to 15 metres. The grasses of the wooded steppe are low and do not form a continuous layer. The steppes are poor producers of wood.

South of the steppes wooded savannas are found (Sudan savanna). These savannas consist of a considerable number of diverse types and occupy vast tracts of land with moderate rainfall (500-1000 mm) and severe dry seasons (five months). The trees form a canopy over tall grass. The

density of the canopy varies with edaphic conditions and the extent of human interference and often all stages from dense wooded savanna to grass savanna can be found within a few ha. Grassfires are frequent in the dry season.

Further south within the moister types of open woodlands there are large areas with abundant Isoberlinia doka and I. dalzielii. The better stands of trees usually attain a height of 15 to 25 meters. Such stands can give some sawnwood.

The most luxuriant type in the savanna zone is the so-called "dry dense forest" which nowadays is found practically only in the Casamance region in Senegal. "Dry dense forest" was much more extensive earlier, but has normally been degraded to "dry open forest" or been further degraded by fire. All these different types of moist open woodland (rainfall above 1000 mm) are called Guinea savanna in West Africa. This probably corresponds to the Miombo in Eastern Africa, but it is evidently much more influenced by human activities.

In Senegal and Gambia mangrove is found along the coast. This is reported to be the only closed forest existing.

As already mentioned there are no clear boundaries between the different types of wooded areas. They are also intermingled with each other due to edaphic factors and human interference. This makes it very difficult to decide the area of different types. This may explain the uncertainty of table 3.4, which gives the area of the different vegetation types in the countries. These areas have been calculated by dot-counting from Vegetation map of Africa and the table merely indicates the importance of different vegetation types or, rather, indicate the importance of the different climatic types which give these vegetation types under present anthropogenic factors. A rough indication of the extent of the different vegetation types in this region is given om map 1 in Part I.

Table 3.4. Vegetation types in Northern Savanna Region

Country	Mangrove	Guinea	Sudan	Sahel	Subdesert	Desert
	million ha					
Mauritania	-	-	-	27.2	19.2	56.6
Senegal	0.2	4.7	5.8	8.4	-	-
Gambia	0.02	0.9	0.1	-	-	-
Mali	-	11.0	20.8	41.5	15.9	32.9
" 1/	-	7.3	32.9	19.5	25.6	36.6
Upper Volta	-	3.8	20.5	3.0	-	-
Niger	-	-	11.4	45.6	16.5	53.2
Chad	-	3.8	41.9	11.4	30.5	39.4
Total	0.2	24.2	100.5	137.1	82.1	182.1
%	0	5	19	26	16	35

1/ This information is from a FAO report describing agricultural conditions. It is probably based on some other map or survey. This clearly shows how difficult it is to decide the boundary of a vegetation type.

As was briefly discussed in Part I, the climatic climax vegetation of the different savanna types are somewhat unclear. If one accepts the most optimistic theories, the following areas could once have been covered by dense tree vegetation.

Present type	Original type (e.g. Eyre 1970)	Area million ha
Guinea	Semi-deciduous, dry evergreen	24
Sudan	Deciduous forest	100
Sahel	Thorn forest	137

This may be merely of academic interest but 25 per cent of the land area in this region could originally have been covered by relatively closed forests. These areas are still quite suitable for plantations. Plantations can be undertaken also in the Sahel zone but the increment is rather low.

3.1.4 West Africa

West Africa has two very distinctly different forest regions - one (West Africa I) with limited forest resources and one (West Africa II) with relatively extensive forest resources.

The countries in the north-west have at present rather limited resources of closed forest. According to the Vegetation Map of Africa the coast has quite extensive areas of mangrove. Most of Sierra Leone and the southern part of Guinea was originally covered with closed forest. North of this forest region and along the coast in Guinea and Guinea Bissau there is a band of so-called forest-savanna mosaic (derived savanna). Further inland large areas of Guinea savanna are found. Again, according to the map, the central parts of Guinea has some areas covered by mountain forest. These forests however have more or less disappeared.

The belt of rainforest which goes all along the west-coast up to Sierra Leone gives place in Togo and Benin to more or less wooded savannas. This is due in part to the relatively low rainfall in this coastal region, and in part to the presence of a dense agricultural population, which has nearly completely replaced the former forests with cultivated crops. Small patches of "forest" can however still be found, mainly in the hills. The dominating vegetation type at present is the Guinea savanna except in the northern part where it changes to Sudan savanna.

The West African forest countries (Liberia, Ivory Coast, Ghana, Nigeria) originally had a belt of mangrove along the coast. Further inland there were extensive areas of rainforest. The whole of Liberia is covered with this type while in the other countries, which have a wider extension in a north-south direction, the rainforest changes to open woodland further to the north. Immediately north of the rainforest region there is a belt of forest-savanna mosaic. North of this is a wide belt of Guinea savanna. Ghana and Nigeria have, further to the north, a belt of Sudan savanna. Nigeria has also some areas with Sahel in the north-eastern corner. Northern Liberia and eastern Nigeria also have some areas of mountain vegetation.

The rainforest areas can be further sub-divided into several classes e.g. "evergreen rainforest" (or wet forest), semi-deciduous forest and transition zones between these. More details are given in the country notes.

The so-called natural vegetation described here is changing fast. The main reason for this is the shifting cultivation in the rainforest zone. Table 3.5. shows the area of the different vegetation types in the countries according to the Vegetation map of Africa.

Table 3.5. Vegetation types in West Africa

Country	Moist forest	Mangrove	Montane communities	Forest-savanna mosaic	Guinea	Sudan	Sahel
	million ha						
Guinea Bissau	..	0.7	-	0.5	1.6	-	-
Guinea	0.8	0.3	0.8	2.6	20.1	-	-
Sierra Leone	4.8	0.4	0.1	1.0	0.9	-	-
Liberia	9.9	0.1	..	1.1	-	-	-
Ivory Coast	14.9	0.2	0.1	3.4	13.6	-	-
Ghana	7.7	0.2	-	0.9	13.1	1.5	-
Togo	-	..	-	0.4	4.4	0.8	-
Benin	-	..	-	1.3	6.6	3.3	-
Nigeria	10.2	2.8	1.0	8.1	37.9	29.3	3.0
Total	48.3	4.7	2.0	19.3	98.2	34.9	3.0
%	23	2	1	9	47	17	1

3.1.5 Central Africa

The central part of this region is covered with tropical rainforest. This type can be divided into several different subtypes. The two types of basic interest is evergreen forests and semi-deciduous forests in areas where the dry season is longer. These areas are mainly found along the boundaries of the evergreen forests. The rainforest 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. The forest-savanna mosaic continues to the north and the south with different types of open woodlands and grass savannas. Dry areas are found in south-western Angola. In western Cameroon and in eastern Zaire there are some areas of montane forests.

Table 3.6. summarizes the distribution of different vegetation types according to the Vegetation map of Africa. This table indicates that closed forest is the "natural vegetation" in over half of the region. The moist savannas (open woodlands or Guinea and Miombo) cover one-third of the total area.

3.1.6 East Africa

The large area, the rough terrain and the different climatic conditions makes it quite difficult to describe the vegetation clearly. The mixture

Table 3.6. Vegetation types in Central Africa

Country	Moist forest	Mangrove	Montane communities	Forest-savanna mosaic	Moist savanna	Dry savanna	Wooded steppe	Grasslands	Desert, subdesert
	million ha								
Cameroon	22.1	0.2	2.7	6.9	8.7	4.1	2.3	-	-
Equatorial Guinea	2.6	..	0.2	-	-	-	-	-	-
Gabon	22.8	..	-	3.9	-	0.1	-	-	-
CAR	3.3	-	-	7.4	47.2	4.4	-	-	-
Congo	21.0	..	-	12.8	..	0.4	-	-	-
Zaire	119.1	..	2.8	58.8	34.5	5.3	-	13.2	-
Angola	2.7	..	..	2.4	89.2	26.6	..	1.4	2.4
Total	193.6	(0.2)	(5.7)	92.2	179.6	40.9	2.3	14.6	2.4
%	36	(0)	(1)	17	34	8	0.5	3	0.5

of different vegetation types within small distances makes it difficult also to show them on a map.

If starting the description from the north the northern half of Sudan is covered by desert and subdesert. South of these types and along the border to Ethiopia are extensive areas of wooded steppe. In the south-western part of the Sudan bordering Central African Republic and Zaire are savannas with low and high rainfall (roughly corresponding to Sudan and Guinea savanna). Some small areas with forest exist in the scattered mountain massifs in the south and west. Along the southern part of the Nile there are extensive inundated areas.

Somalia and the French Territory of the Afars and the Issas are mainly covered with desert, subdesert and steppe. Only a few relicts of wooded areas are found in mountain ranges in the north. Originally these mountain areas had a wooded cover.

The central and western part of Ethiopia is a plateau, with an altitude ranging between 2,000 and 3,000 m but with hill ranges considerably higher. Isolated blocks of montane evergreen forests are found scattered over the plateau, on areas which catch relatively high rainfall and which have not been destroyed by agricultural activities. The rest of the plateau is covered by grassland, brushland, some open woodland and of course agricultural land.

In the lower altitudes of the south-east, open woodlands with Acacia and some subdesert steppe are the dominant vegetation, while desert and subdesert steppe covers a considerable area along the Red Sea shore.

All the closed forests existing in the mountains belong to the so called "tropical montane forests". The principal types being broadleaved rain-forest, Podocarpus and Juniperus forest. Some sources maintain that the forests of Ethiopia may once have covered 45 million ha (SFODA 1974).

The coast region in Kenya and Tanzania is covered by coastal forest-savanna mosaic. According to the map there are small areas of coastal rainforest and mangrove too.

Further inland the vegetation types are considerably drier. Northern Kenya for instance has subdesert and even desert vegetation. Otherwise the dominating vegetation is wooded steppe down to the middle of Tanzania. The south-western corner of Kenya has relatively moist woodlands and savannas. Closed forest are, in these two countries, found mainly in the mountains (Kenya highlands, Kilimanjaro, Meru).

Outside the scattered rainforest areas in Uganda the dominating vegetation is forest-savanna mosaic, and open woodlands of relatively moist types.

The southern half of Tanzania and practically the whole of Malawi and Zambia and large parts of Mozambique are dominated by open woodlands of Miombo type. The Miombo vary very much in density. In drier areas (especially on ill-drained soils in river valleys) it may be replaced by dry types of open woodlands (mainly Mopane).

In the southern part of Zambia some areas of so-called dry deciduous forest is found. This still contains some Zambian teak (Baikiaea plurijuga). On several maps this type is classified as closed forest.

Rwanda and Burundi have some open woodlands in the eastern part. The western part is covered mainly with montane grasslands. The higher parts of the Congo-Nile divide are still partly covered with montane forests. They are being quickly transformed into agricultural land.

The eastern coast of Madagascar is covered by rainforest of the so-called Madagascar type. The western coast is covered by dry deciduous forest of the Madagascar type. This is a low and relatively open forest. Along the southern and south-western shores bush formations are found. The stands are composed of xerophytic trees and shrubs. The central parts of Madagascar are at present covered by grass savanna and grass steppe.

According to the Vegetation map of Africa the distribution in different vegetation types is as in table 3.7.

It is very difficult to comment on these figures. Closed forest for instance, covers only around 5 per cent of the area. The considerable dry areas are mainly situated in the northern part of the region. Large areas have a climate that can support plantations. About 70 per cent of the area have now some sort of tree cover (or rather could have).

3.1.7 Southern Africa

This region has a lot of different vegetation types. This summarized description is therefore very crude.

Montane evergreen forests as well as other montane communities are still found in a few mountainous areas along the eastern escarpment. In the extreme south of the region a few remnants of temperate and subtropical evergreen forests still exist. These were originally much more extensive.

The northern part of the region in Rhodesia is dominated by the Miombo. To the south, this type is continued by drier types of open woodland - often so-called Mopane. On the border between Rhodesia and Botswana there are areas of dry deciduous forest with abundant Baikiaea plurijuga.

The south-western part of Botswana, the eastern part of Namibia and the northern part of South Africa is covered by wooded steppe.

The coast of Namibia and the south-western half of South Africa is covered with desert, subdesert steppe and other dry formations. The eastern part of the South Africa, except the coast-region where humid formations are found is covered by grasslands.

At present, closed forest should be the "natural vegetation" in about one million ha. In addition dry deciduous forest should be found in an area of 4 million ha. Vegetation containing trees should cover around 30 per cent of the area while dry vegetation types or desert should cover 50 - 60 per cent. Part of the grassland and thicket areas are thought to have once been covered by forests.

Table 3.7. Vegetation types in East Africa

Country	Moist forest	Other closed forest types	Montane[1/] communities	Forest-savanna mosaic	Moist savanna	Dry savanna	Wooded steppe	Grasslands	Thicket	Desert, subdesert
	million ha									
Sudan	-	-	0.6	0.5	16.4	32.8	72.7	..	..	115.0
Ethiopia	-	5.0	0.6	-	-	19.1	40.8	16.7	12.7	15.5
Fr.Terr. Afars,Issas	-	-	0.07	-	-	-	-	-	-	2.1
Somalia	-	0.1	0.9	2.3	-	-	31.6	-	-	27.8
Uganda	0.8	-	0.7	3.9	9.1	3.3	0.7	0.7	..	-
Kenya	0.4	..	4.2	3.5	5.1	..	30.3	..	..	13.4
Rwanda	-	-	0.4	..	1.1	-	-	1.0	..	-
Burundi	-	..	0.3	..	0.7	-	-	1.6	..	-
Tanzania	0.7	0.5	4.6	5.7	46.6	6.6	23.5	..	0.4	0.2
Zambia[2/]	-	2.1	-	1.5	53.4	8.5	-	2.7	-	-
Malawi	-	-	0.4	-	6.1	2.9	-	-	-	-
Mozambique	0.1	1.4	0.4	2.1	45.8	28.5	-	-	-	-
Madagascar	11.1	10.4	..	2.0	..	..	..	31.2	3.5[3/]	-
Total	13.1	19.5	13.2	21.5	184.3	101.7	199.6	53.9	16.6	174.0
%	2	2	2	3	23	13	25	7	2	22

1/ Partly closed forest
2/ 6 million ha of swamps not included
3/ Normally called scrub forest

Table 3.8. Vegetation types in Southern Africa

Country	Closed forest	Dry deciduous forest	Montane communities	Coastal forest-savanna mosaic	Moist savanna	Dry savanna	Wooded steppe	Thicket	Grasslands	Desert, subdesert
	million ha									
Rhodesia	..	2.4	0.4	-	19.0	15.7	0.6	-	-	-
Botswana	-	1.9	-	-	-	13.0	39.5	-	..	-
Namibia	-	-	-	-	-	14.1	34.5	-	..	33.6
Swaziland	-	-	-	-	-	1.1	-	-	0.6	-
Lesotho	-	-	-	-	-	-	-	-	3.0	-
South Africa	1.3	-	0.2	2.3	-	24.9	11.7	6.0	33.7	42.1
Total	1.3	4.3	0.6	2.3	19.0	68.8	86.3	6.0	37.3	75.7
%	0.4	1	0	1	6	23	28	2	12	25

3.2 Land use

3.2.1 General

Existing information about land use gives only a very crude idea about the real land use. In few countries have been undertaken any detailed land use studies. Table 3.9. which summarizes the information in FAO Production Yearbook 1973 is mainly to be taken as an indication of the importance of different categories. The figures say little about how intensive the land is utilized.

Table 3.9. Land use

Region	Total area	Agricultural land		Forests and woodlands (Forest land)	Other area
		Arable land and land under permanent crops	Permanent meadows and pastures		
	million ha				
North Africa	602	24	60	9	509
Northern Savanna R.	530	45	137	58	290
West Africa I	52	9	7	5	31
" " II	160	34	44	49	32
Central Africa	533	22	82	219	210
East Africa	844	59	273	226	286
Southern Africa	309	16	193	39	61
Islands	1.2	0.3	0.04	0.2	0.7
Total	3,031	209[1/]	797	605	1,420
% of total area		7	26	20	47

1/ Of which at least 10 million ha is under permanent crops

The table indicates that the areas of arable land are relatively small while the areas of pastures are very extensive. Also a considerable proportion of the area given as arable land is fallow.

Strangely, no geographer as far as I know has tried to analyse these data in detail for the continent as a whole. A crude comparison between the area under arable land plus land under permanent crops and the agricultural population indicates that the figures given can mean different things from country to country. Quite naturally, it is often difficult to decide whether a fallow area shall be considered as agricultural land or not. Fallow areas are probably not always included in the figures. Likewise it is evident from comparisons between countries that the term "permanent meadows and pastures" can be interpreted in a number of ways. Logically then it must also be difficult, if not to say impossible, to describe the grazed areas in the savanna zone in one single figure.

Forest land as given in this table sometimes includes open woodlands and sometimes it does not. A wooded cover is often to be found also in agricultural areas, especially in permanent meadows and pastures and

naturally in areas under bush fallow.

It should be noted that the term "forest land" has been replaced by the term "forest and woodlands" in the last version of the FAO Production Yearbook. These two terms mean the same. It is a fact that the term "woodland" has a very specific meaning in the English language (see Appendix III in Part I). The so called tree-covered savannas is not covered by this term The figures given in the Production Yearbook have, however, changed very little.

The areas of so-called "other area" are very extensive covering almost half of the total area.

3.2.2 Comments on regions

Country figures concerning land use are given in summary-table S I. Here will be given a few scattered comments concerning the conditions in different regions.

North Africa

In this region 15 per cent of the land area is classified as agricultural or forest land. According to table 3.2. around 92 per cent of the land area is situated in desertic and subdesertic zones. This means that considerable areas in the subdesertic zones must be utilized at least for grazing.

Of the area that - according to table 3.2. - can carry forestry vegetation, 30 per cent is actually classified as forest land.

Northern savanna region

In this region nearly all areas outside the desert and subdesert region (50 per cent of land area) are at present classified as agricultural or forest land (45 per cent of land area). In certain countries even parts of the subdesert (and desert) are classified as agricultural (pasture) land.

West Africa

In the countries in this region, 45 per cent of land area is classified as agricultural land while one-fourth is classified as forest land. This is the region in Africa where the land area is most intensively utilized by man. It is known too that the forests in this region are being converted into agricultural land at a great pace.

Central Africa

As is shown in table 3.9., arable land and land under permanent crops counts for only a small part while forty per cent is classified as being "other area" (unused land?). In earlier inquiries parts of this area have been classified as grazing land.

East Africa

In this region, only a minor part is classified as being occupied by arable land and land under permanent crops. Permanent meadows and

pastures on the other hand occupy around one-third of the area. Overgrazing is said to occur in many areas.

Southern Africa

Some of the figures given for this region are very old. A comparison between the country figures for vegetation and land use indicates that considerable areas of subdesert are classified as agricultural land. In Rhodesia and Namibia it is evident that considerable areas of dry open woodlands have been classified as forest land.

Islands

For a number of the islands the information is very incomplete. It is impossible to make any generalization from available information.

3.3 Population

3.3.1 General

The population density reflects the human influence on the natural environment. Table 3.10. shows the population, projections of population, population density and population density ranges in the different regions discussed in this report (sources FAO Production Yearbook 1973, UN 1972 b, and Hance 1970):

Table 3.10. Total population and population density

Region	Population 1973	Population density	Population density ranges[2]			Projections[3]	
			Percentage of area			1985	2000
	1000 inh.	inh./km^2	5	10	20		
			% of population			million inh.	
North Africa	77,278	13(152)[1]	80	87	..	115	175
Northern Savanna Region	25,289	5(10)[1]				36	55
West Africa I	12,555	24	45	63	80	125	193
" " II	75,439	48					
Central Africa	34,425	6	25	45	60	52	80
East Africa	115,947	14(18)[1]	37	50	65	167	260
Southern Africa	30,176	10(13)[1]	53	67	90	41	62
Islands	2,050	167	..	..	..		
Total	373,327	12	53	67	82	530	818

1/ Within brackets the population density in non-desertic areas. The small population in non-desertic areas has been ignored.
2/ Crudely adopted from Hance 1970. Note: Sudan included in North Africa, Chad inlcuded in Central Africa, Rhodesia included in East Africa.
3/ Adopted from UN 1972 b. Medium variant estimate used. Country grouping as in 2/.

According to Grove (1970) the accuracy of the population figures in Africa is in the order of ± 15 per cent. The increase of the population is now often given as 2.6 per cent per year for Africa as a whole (e.g. Harrison-Church et al. 1971). There is a great variation from country-to-country. UN 1972 b estimates an annual increase of 2.9 per cent up to 2000 (medium variant estimate).

Africa is often said to be under-populated. In fact some parts are very densely populated. The patchiness of the population depends partly on the physical environment but also on social and historical factors. For example it is mentioned by several authors that over 30 million people were taken to slaves (or killed in slave raids). Mountainous areas which probably offered security are often densely populated.

3.3.2 Comments on regions

Country figures on population are given in summary-table S XIV. Here we shall comment on the conditions in different regions.

North Africa

North Africa is actually very densely populated in the inhabited parts. The Nile delta for example is one of the most densely populated agricultural areas in the world. The oases in the Sahara desert and parts of the mountains are also very densely populated.

Northern Savanna Region

The population density figures for this region is low even if one considers only the non-desertic parts. The population may anyhow be large considered in relation to the productivity of the land with present agricultural practices. Furthermore the population is unevenly distributed. The area east of Dakar, the Niger delta, central Upper Volta and parts of southern Chad are the most densely populated parts.

West Africa

In West Africa I the population is unevenly distributed within the countries. In Togo and Benin the population density is highest in the southern part while in Guinea the population is concentrated in Fouta Djalon, and to some extent, the southern highlands. The population density in West Africa is higher in the Sudan zone than in the Guinea zone. This is due in part to tsetse, poor soils and lack of surface water supply in the Guinea zone. Historical reasons like previous slave-raiding, or the lack of strong kingdoms in the Guinea zone may be another reason.

It is not known in detail how large a part of the population is presently found in the rainforest region. In Ghana and Nigeria in any event the population density in the rainforest region is known to be high for example in Ibo and Yoruba land in Nigeria and in Ashanti in Ghana. At some places in the northern part of Nigeria's savanna zone for example around Kano the population density is also very high. Northern Ghana has some densely populated areas too.

The high mean figure for West Africa II depends mainly on the very high figure for Nigeria (which may be on overestimate). The figures for Liberia and especially the Ivory Coast seem surprisingly low. It

is well known however that even the present population clears the forest to make land available for other uses.

Central Africa

This zone, largely within the rainforest region, is low-populated. Large areas within the densely-forested parts of these countries are nearly uninhabited. Parts of northern and western Cameroon are known to be densely populated.

East Africa

The population density in this region varies from 5 inh./km^2 in Somalia to around 140 inh./km^2 in Burundi and Rwanda. The great differences in population density between the countries in this region depends on historical reasons and on the productivity of the land under present agricultural practices. The most densely populated areas are the Nile area in the Sudan, the highland areas in Ethiopia, the Lake Victoria area, the mountain areas in Kenya and Tanzania, Rwanda and Burundi and part of east-central Madagascar.

Southern Africa

This region has a surprisingly low mean population density. Swaziland and Lesotho have the highest population density in the region. The mean figure for South Africa is naturally misleading as the population is concentrated in certain parts while the desert and steppe regions have a very low population. The so-called Bantu reserves have a very high population density as have the industrial regions in the east.

Islands

The islands are often very densely populated. This very dense population has caused a lot of erosion on some of the very mountainous islands.

3.4 General about production, trade and consumption of wood and wood products

3.4.1 Production of roundwood and major wood products

Table 3.11[1/] shows information concerning the estimated production of industrial wood and fuelwood. (Source FAO Yearbook of Forest Products 1973.)

West, Central, East and Southern Africa have the most important production of industrial wood. West and Eastern Africa produce and consume the largest quantities of fuelwood. The figures for the production of fuelwood are often only crude guesstimates.

Table 3.12. gives the present production of the most important wood products in the different regions. (Source FAO Yearbook of Forest Products 1973.)

1/ See at end of page 46

Table 3.12. Annual production of major wood products

Region	Round-wood products	Sawn-wood	Plywood and ve-neers	Fibre-board and par-ticle board	Paper and paper-board	Wood-pulp	Other pulp
	1000 m^3(r)	1000 m^3(s)			1000 m.t.		
North Africa	503	77	66	77	244	38	123
Northern Sa-vanna Region	1,615	14	-	-	-	-	-
West Africa I	693	129	2	-	-	-	-
" " II	2,338	1,358	248	5	10	-	-
Central Africa	2,670	773	333	4	19	32	2
East Africa	5,798	901	32	28	19	5	2
Southern Africa	3,122	1,579	66	227	888	1,279	80
Total	16,743	4,838	751	341	1,178	1,353	206

Roundwood (poles, posts, pitprops) is the most common commodity next to fuelwood. Information about the production of this type of wood i.e. mainly household wood is limited. The production of processed wood products is mainly confined to sawnwood and - to some extent - to plywood and veneer. The production of sawnwood is likely to be underestimated in many countries. The production of paper and pulp is mainly confined to Southern Africa.

3.4.2 Present trade

Table 3.13. shows the present export of wood and wood products in 1973. (Source FAO Yearbook of Forest Products 1973.) It should be noted that trade within regions are included in these figures. This trade is of minor importance in all regions.

This table shows clearly that Africa mainly exports logs. Of different wood products Africa has an export surplus of roundwood, plywood and veneers, and wood pulp (depending on South Africa). Africa as a whole shows a great deficit in sawnwood trade. This is because of the large import to North Africa.

The value of present exports and imports is shown in table 3.14. (Source FAO Yearbook of Forest Products 1973.)

Table 3.14. shows that only two regions - West and Central Africa - have a positive wood products trade balance. For Africa as a whole the trade balance for wood products is positive by 280 million US $. Only two years ago (1971) the trade balance was negative by 50 million US $. This quick change to a positive balance is a result of rapid rising export (and prices) during the 1972/73 boom. Due to a recent decrease in export the surplus has decreased (surplus 124 million US $ in 1974). In 1973 the trade balance was positive by 457 million US $ in the case of roundwood but negative by 178 million US $ in the case of processed products.

Table 3.13. Present (1973) trade with major forest products

Region	Roundwood	Sawnwood	Plywood and veneers	Fibre-board and particle board	Paper and paper-board	Wood-pulp
	1000 m^3(r)	1000 m^3(s)			1000 m.t.	
Import						
North Africa	398	1,608	62	32	117	64
Northern Savanna Region	(34)	27	2	1	13	-
West Africa I	(2)	69	3	2	(3)	-
" " II	(1)	1	-	15	134	6
Central Africa	-	-	3	2	42	-
East Africa	125	180	30	35	159	2
Southern Africa	78	570	80	10	151	105
Total[1/]	639	2,527	189	99	622	178
Export						
North Africa	-	-	3	-	23	44
Northern Savanna Region	-	-	-	-	-	-
West Africa I	-	54	-	-	-	-
" " II	5,201	520	140	5	-	-
Central Africa	3,009	222	195	-	1	31
East Africa	387	210	2	1	2	-
Southern Africa	169	127	19	113	100	510
Total[1/]	8,765	1,133	360	120	125	585
Balance	8,126	-1,394	171	+21	-497	407

1/ Islands included

Table 3.14. Value of export and import of forest products (1973)

Region	Import c.i.f.	Export f.o.b.	Surplus (+) or deficit (-)
	1000 US $		
North Africa	220,972	14,271	- 206,701
Northern Savanna Region	6,784	-	- 6,784
West Africa I	2,212	3,870	+ 1,658
" " II	42,041	423,263	+ 381,222
Central Africa	15,506	211,731	+ 196,225
East Africa	69,603	16,261	- 53,342
Southern Africa	136,143	110,688	- 25,455
Total[1/]	501,429	780,084	+ 278,655

1/ Islands are included

3.4.3 Present consumption of different wood products

The present consumption of wood products is shown in table 3.15. Table 3.16. shows the present consumption of these products per 1000 inhabitants.

Table 3.15. Present consumption of major wood products

Region	Sawnwood	Plywood and veneers	Fibreboard and particle board	Paper and paperboard	Roundwood products[1/]	Fuelwood and charcoal
	1000 m^3 (s)			1000 m.t.	1000 m^3(r)	
North Africa	1,685	125	109	338	639	5,780
Northern Savanna Region	41	2	1	13	1,615	14,871
West Africa I	144	5	2	(3)	693	8,594
" " II	839	108	15	144	2,339	71,500
Central Africa	551	141	6	60	2,670	30,390
East Africa	871	60	62	176	5,856	127,073
Southern Africa	2,022	127	124	939	3,066	14,000
Total	6,232	580	319	1,675	16,885	272,208

1/ The sum of pitprops and other industrial roundwood

Table 3.16. Consumption per 1000 inhabitants of different wood products

Region	Sawnwood	Plywood and veneers	Fibreboard and particle board	Paper and paperboard	Roundwood products	Fuelwood and charcoal
	m^3(s)/1000 inh.			mt./1000 inh.	m^3(r)/1000 inh.	
North Africa	22	1.6	1.4	4.4	8.2	75
Northern Savanna Region	1.6	0	0	0.5	64	588
West Africa I	11	0.4	0.2	(0.2)	55	685
" " II	11	1.4	0.2	1.9	31	948
Central Africa	16	4.0	0.2	1.7	78	883
East Africa	8	0.5	0 5	1.5	51	1,095
Southern Africa	67	4.2	4.1	31	102	464
Total Africa	17	1.6	0.9	4.5	45	731
Total World	115	12	13	38	53	298

Africa in comparison with the average for the world has a small consumption of all products except fuelwood and roundwood products. In the case of fuelwood it is somewhat surprising that the consumption in forest regions does not differ more from that in the savanna regions. Actually East Africa shows the highest consumption per capita. It is perhaps significant that several surveys of actual fuelwood consumption have been made in this region.

The consumption figures for different wood products have been crudely transformed to roundwood in table 3.17.

Table 3.17. Consumption of industrial wood

Region	Industrial wood	Industrial wood excl. roundwood products
	m^3 WRME/1000 inh.	
North Africa	68	60
Northern Savanna Region	69	5
West Africa I	77	22
" " II	59	29
Central Africa	121	43
East Africa	72	21
Southern Africa	340	238
Total Africa	95	50
Total World	430	377

Of the different regions Southern Africa shows by far the highest consumption per caput of industrial wood. It is hardly possible to draw any conclusions from the figures for the other regions but Central Africa seems to have somewhat higher consumption.

If the figures for roundwood products are excluded it can be seen that Southern and Northern Africa shows the highest figure. The consumption of manufactured wood products seems to be relatively low in all the other regions and especially in the Northern Savanna Region.

3.4.4. Past trends in production, trade and consumption of wood products

It may be of some interest to crudely compare the present conditions with the conditions described in for example "Timber Trends and Prospects in Africa 1967". Some basic figures from this report and from FAO Yearbook of Forest Products 1973 are summarized in table 3.18.

Naturally one must be rather careful in comparing these figures as there may be some differences in coverage of the figures. It is probably safe to conclude that the increase in consumption per capita has not been striking. The actual consumption is lower than was anticipated for 1975 in the African Timber Trends Study. This is especially the case concerning sawnwood, (7.1 million m^3 anticipated), and paper and paperboard (2.21 million m.t. anticipated). The consumption of fuelwood on the other hand is already higher than was anticipated (0.61 m^3/caput). The 1960 figure for fuelwood was probably underestimated.

Table 3.18. Past trends in production, export and consumption of wood products

Product	Production		Export		Consumption			
	1962	1973	1962	1973	1960[1]/	1973	1960[1]/	1973
	million of units						units/1000 capita	
Industrial wood $m^3(r)$	26	43	4.5	8.4	..	..	(91)[2]/	(95)
Sawlogs & veneer logs $m^3(r)$	12	22	4.5	8.3	..	..	..	..
Roundwood products $m^3(r)$	13	17	0.04	0.1	12	17	50	45
Fuelwood $m^3(r)$	214	272	0.2	0.4	177	272	680	731
Sawnwood $m^3(s)$	2.7	4.8	0.74	1.13	4.0	6.2	15.4	17
Plywood & veneers $m^3(s)$	0.24	0.75	0.16	0.36	0.18	0.58	0.7	1.6
Fibreboard & particle board $m^3(s)$	0.14	0.34	0.07	0.12	0.19	0.32	0.7	0.9
Paper & paper-board m.t.	0.40	1.18	0.04	0.13	0.83	1.68	3.4	4.5
Wood pulp m.t.	0.42	0.35	0.14	0.59	..	..	..	..

1/ Information from "Timber Trends and Prospects in Africa"(FAO/UN 1967)
2/ Based on the same conversion factors as for 1973. FAO/UN 1967 gave 89 m^3WRME.

Production seems to have increased considerably. In the case of sawlogs and veneer logs production has nearly doubled. The production of processed wood products has increased proportionally more (2 to 3 times) but the absolute increase is relatively small as production at the start of the period was small.

The export of sawlogs and veneer logs has increased by 4 million m^3. There are proportionally large increases for some of the processed products too but the total increase is naturally relatively small. The locally produced proportion of the consumption has, however, increased considerably.

In 1959/61 about 57 per cent of the value exported was in the form of logs. In 1973 this figure has actually increased to 62 per cent. The balance of trade in all wood products has improved considerably during the same period (from -77 to + 279 million dollars). In the case of Eastern and Northern the negative balances have become bigger.

3.4.5 Discussion of trends for future consumption of different wood products in Africa

Table 3.19. shows the consumption per capita in 1960 (from Timber Trends and Prospects in Africa) and corresponding values for 1962 and 1973 calculated from the FAO Yearbook of Forest Products 1973.

Table 3.19. Past changes in consumption per capita

Product	Consumption			Predicted consumption for 1975[2/]	Approx. annual change	
	1960[1/]	1962	1973		1960-73	1962-73
	units per 1000 capita				per cent	
Fuelwood (m^3)	680	759	731	610	+0.6	-0.4
Roundwood (m^3)	50	47	45	50	-0.94	-0.3
Sawnwood (m^3 s)	15.4	12	17	19.1	+0.75	+3.2
Plywood & veneer (m^3 s)	0.7	0.6	1.6	..	+6.5	+9.5
Fibre & particle board (m^3 s)	0.7	0.4	0.9	..	+2.0	+7.5
Wood-based panels (m^3 s)	1.4	1.0	2.5	2.6	+4.6	+8.5
Paper & paperboard (m.t.)	3.37	2.99	4.5	5.9	+2.3	+3.8

1/ FAO/UN 1967
2/ FAO/UN 1967. Medium alternative

As is seen in table 3.19 if the 1960 or 1962 figures are used as the base there is a difference. In cases where new findings indicate that the figures for previous years in the FAO Yearbook of Forest Products are wrong, the old figures are adjusted in new editions. Consequently the figures from the Yearbook of Forest Products ought to be most reliable. Even so, the figures in the Yearbook of Forest Products are not complete (certainly not for 1962).Part of the changes shown from the 1962 data may therefore be caused by improved statistics (which normally means a rise in the figures). Probably the figures in the Timber Trends and Prospects have been completed for missing data as far as possible. It is also clear that the population used for 1960 was underestimated (10-15 million) which means that the per capita figures should be lowered somewhat. As must be evident from these discussions it is difficult to conclude which changes in per capita consumption actually have taken place. Here it is assumed that the 1962-1973 figures are most reliable (although somewhat overestimated).

Table 3.20. gives crude projections for consumption per 1000 capita, and for total consumption in Africa as a whole for the years 1985 and 2000 respectively.

Table 3.20. Crude projections of requirements for wood products 1985 and 2000

Product	Annual est. change in per capita consumption	Consumption per 1000 capita		Total consumption		Roundwood consumption	
		1985	2000	1985	2000	1985	2000
	per cent	units		million units		mill m^3(WRME)	
Fuelwood (m^3)	-0.5	670	620	360	510	(360)	(510)
Roundwood (m^3)	-0.5	42	39	22	32	(22)	(32)
Sawnwood (m^3 s)	+2	21.5	29	11	24	20	43
Wood-based panels (m^3 s)	+4.5	4.3	8.1	2.2	6.7	(4)	(13)
Paper & paper-board (m.t.)	+4	7.2	13.1	3.8	11	13	36

Although one may expect a slight decrease in consumption per capita of fuelwood and roundwood products (e.g. due to lack of fuelwood in some regions) the total demand will increase. One can also expect a fast increase in the demand for wood-based panels and paper products. This increase may very well be faster than shown here.

3.4.6 Discussion about trends in the demand for tropical wood

The export of wood and wood products from Africa has risen fast over the last decades. In value the export of wood products rose by 125 per cent between 1962 and 1972 (and by 270 per cent by 1973). In quantity the export of sawlogs and veneer logs rose by 65 per cent and sawnwood by 40 per cent during the 1962-1972 period. In Asia exports have risen still faster. The export of sawlogs and veneer logs for example has risen four times from 1962 to 1972. For Latin America on the other hand development of wood export has been rather slow.

As tropical wood is still the most important wood product from Africa it is necessary to know something about the expected rise in demand for tropical wood in the world and especially in Europe. Pringle (1974) discussed trends and prospects in demand, supply and trade of tropical wood products in some detail. He shows that, at a world level, the removal of tropical broadleaved logs has increased by 4.9 per cent per year during the period 1954-1971. During the same period export has increased by 14 per cent a year. He estimates that, at the worldlevel the total import of tropical broadleaved wood will rise from 52 million m^3 WRME in 1971 to 75 million m^3 WRME in 1980 and to 100 million m3WRME in 1990. Export from Africa is expected to change from 8.7 million m^3 WRME in 1971 to 8.6 million m^3 WRME in 1980 and 11 million m^3 WRME in 1990. The export of logs is expected to go down from 7 million m^3 (r) in 1971 to 5 million m^3 (r) in 1980 and 4 million m^3 (r) in 1990. Asia-Pacific he estimates will double its export of tropical wood in the same period (from 35 million m^3 WRME to 69 million m^3 WRME). The domestic consumption of tropical logs in exporting regions is estimated to rise from 48 million m^3 WRME in 1971 to 60 million m^3 WRME in 1980 and 75 million m^3 WRME by 1990.

Europe is and will probably remain the main market for the export of forest products from Africa. Pringle assumes a rather slow increase in

the import of tropical wood to Europe; from 10.7 million m^3 WRME in 1971 to 13.5 million m^3 WRME in 1980 and 13.8 million m^3 WRME in 1990. In recent Timber Trends and Prospects in Europe (draft) it is estimated that the import of tropical hardwoods in the year 2000 will be 25-35 million m^3 WRME as compared with 10.5 million m^3 WRME in 1969-71 and a temporary peak of about 16 million m^3 WRME in 1973 (present import is lower). The rate of growth during this period is estimated to be 3-4 per cent per year, compared with a yearly mean of 5.5 per cent in the sixties.

It is concluded that Europe, during the coming 25 years, could probably absorb even higher quantities than estimated if the wood is readily available and prices competitive. But this is not judged to be likely. It is expected that the volumes of tropical woods imported as logs will decrease.

Pringle (1974) and FAO/ECE (1975) have evidently different opinions about how much tropical wood can be imported to Europe. These different opinions depend more on different assumptions about existing resources than on different assumptions about the future demand for tropical wood. Pringle (1974) concludes about Africa: "It is felt that exports of West and Central Africa must grow fairly modestly because of the growth of domestic demand and the exploited nature of much of its forest, especially the readily accessible portions." FAO/ECE (1975) is evidently much more optimistic about the possibilities of the tropical forest to supply wood.

How much wood really could be exported from Africa in the future at the present or at increased relative prices cannot be said with any certainty. It can be assumed however that there is a great potential for increased export of tropical wood from Africa.

3.4.7 Discussion about trends in the world demand for wood products

At present Africa exports only minor quantities of processed wood-products. Of the world export of pulp 3 per cent, of wood-based panels 3 per cent and of sawnwood (non-coniferous) 8 per cent at present (1973) comes from African countries. Of sawnwood, paper and paperboard Africa as a whole has a net import. What possibilities exist for an expansion of this export of processed wood products?

The main importing region in coming decennia will be Europe, Japan and USA. From the African point of view, Europe is the region of major interest. The recent Timber Trends and Prospects in Europe (draft) shows an increasing need for wood import. From a net import in 1971-73 of 48 million m^3WRME the net import is estimated to raise to 60, 75 and 90 million m^3 WRME in 1980, 1990 and 2000 respectively. Of the present (1973) gross import 24 million m^3 WRME comes from USSR, 23.5 million m^3 WRME from North America and 18.5 million m^3 WRME from Other regions. In 2000 the possible import from USSR is estimated to be 30-35 million m^3 WRME, from North America 40-50 million m^3 WRME and from Tropical regions 25-35 million m^3 WRME. From plantations in tropical and subtropical regions an additional supply of 5-10 million m^3 WRME may eventually be possible. In 2000 the export from Europe to non-European regions has been estimated as 20-30 million m^3 million m^3 WRME.

It should be mentioned here that the import figures given above show the expected possible import. The difference between consumption and import would - in one way or another - be produced by the European forests. But it is questionable whether the European forests really will be able to produce these quantities.

From the projections for the consumption of different products it is seen that the consumption of sawnwood can rise by 10-40 million m^3 (s) (10-40 per cent) during the 30 year period 1970 to 2000. During the same period the consumption of wood-based panels is projected to increase by 120-130 million m^3 (s) (six times) and paper and paperboard by 80-110 million m.t. (3-4 times).

No effort has been made in the FAO/ECE study to calculate what quantities of these different products will be imported. In 1971-73 the net imports of sawnwood, wood-based panels and wood pulp were 9.3 million m^3 (s), approx. 1.4 million m^3(s) and 2.28 million m.t. respectively. For paper and paperboard there was a net export of 0.25 million m.t.

It is expected that most of the sawnwood can be produced from European resources. It is likely then, that the greatest need for increased import will be in pulp and wood-based panels.

It may be risky to draw any conclusions from the European Timber Trend Study in its present preliminary form. One can conclude however that the European need for wood imports will increase. How much of this increase can be met from traditional sources cannot be said. It is most likely that large quantities of processed wood from Africa could be sold on the European market (there would be an enormous demand for logs). How hard the competition from the traditional producers (mainly USSR and Canada) and new producers (like e.g. Brazil) really will become cannot be said.

The Swedish forest industries expert A Sundelin has recently estimated that the increase in paper and board consumption in Western Europe will not be as fast as expected by FAO/ECE (Bayliss 1976). If European consumption trends would flatten out then the prospects for African exports would decrease.

3.4.8 Concluding comments

The present consumption of processed wood products in Africa is relatively low. Most countries are also net importers of wood. The few countries that show an export surplus do this due to export of logs.

The demand for processed wood products is likely to increase fast in Africa. The African forest industry will therefore have to develop fast to satisfy the domestic demand. It is also likely that the demand on the world market will increase considerably. Many African countries have therefore the possibility of building up an export-oriented forest industry.

The following table shows the rate of increase in production that has occurred in the last years and the approximate rate of increase that would be needed if Africa as a whole should satisfy its own demand in the year 2000. The table also shows the balance of export and import for different products.

Product	Balance export-import 1973[1]	Annual increase in production 1962-73	Increase needed to meet the demand in 2000
	1000 units	per cent	
Sawnwood $m^3(s)$	-1394	5.4	6
Wood-based panels $m^3(s)$	+ 190	10	7
Paper & Paperboard m.t.	- 497	10	9
Wood pulp m.t.	+ 407[2]	10+	7

1/ Net import (-). Net export (+)
2/ Mainly from South Africa

As is seen in the table the saw mill industry may have to expand faster than during the last decade to cover the estimated demand in the year 2000. For the other products the rate of increase would be more than sufficient and give room for a net export. But it is not certain that these industries can continue to increase the production by 10 per cent a year. The total increase in million of units during the period 1962-1973 has been rather modest.

The calculations made here are, naturally, very crude and, in addition, are only of limited interest for Africa as a whole. It is, however, not meaningful to expand the discussions further. The crude calculations indicate that the wood processing industry in Africa must develop very rapidly to keep ahead of the domestic African demand. Without a firm concentration on the forest industries sector a large net export would be unlikely.

The export of processed wood products may naturally become of great importance in some countries. It is also possible that a large export from some countries will be directed more towards Europe than to other African countries with an insufficient domestic production. This would mean that these countries cannot afford to meet the domestic demand.

Table 3.11. Production of roundwood 1973

Region	Industrial roundwood	Fuelwood[2]	Total
	1000 m^3 (r)		
North Africa	812	5,751	6,563
Northern Savanna Region	1,662	14,870	16,532
West Africa I	962	8,594	9,556
West Africa II	11,058	71,500	82,558
Central Africa	8,501	30,390	38,891
East Africa	8,824	127,375	136,199
Southern Africa	11,397	(14,000)[1]	(25,400)
Total	43,235	272,500	315,700

1/ Grut 1975
2/ Including charcoal

4 REGIONAL DESCRIPTIONS OF FOREST RESOURCES

4.1 General

In the country notes in chapter 3 of Part I information concerning forest resources are summarized country-by-country. For the discussions in this report, but also as an aim in itself, it has been considered necessary to make a short summary of certain basic background facts about the forests. Otherwise the ordinary reader might find it difficult to take in all the information in the country notes.

The regional summaries briefly discuss the present forest resources - natural and man-made - and the amount of wood available in different types of forest and other wooded areas. This information aims at outlining the prospects for forestry in each region.

The wood volume has been calculated for different types of wooded areas. It has nearly always been necessary to do a considerable amount of guesswork. The result must therefore be treated with great care. See Appendix I for approximate definitions of gross volume, commercial volume, potentially commercial volume and so on.

To some extent these regional summaries are provocative. The normal way of doing a regional description is simply to give regional totals. This hides the guesswork. Here instead guesses have been clearly shown. Many of the per ha figures used for the calculations of standing timber will prove to be wrong. It is my hope that people with local experience will inform me about major mistakes.

Using this summary-method means that a lot of source information is not shown. Detailed information given in a country note will sometimes loose its accuracy in the transformation to a form more comparable at the regional level.

The regional descriptions use available information to try to give the best description of each region. This means that the classifications are not the same for all regions.

Only a few items are discussed in detail in the regional summaries. A full discussion of "all" items of interest would have made too voluminous a report and meant still more repetition of facts already given in the country notes. Some other aspects are briefly discussed in chapters 5 and 6.

4.2 North Africa

4.2.1 General

In Morocco, Tunisia and Algeria the relief is dominated by the Atlas mountains which become lower from Morocco eastward to Tunisia. There are two main chains. The southern one runs continuously along the edge of the desert. The northern roughly parallells the sea but without real continuity. Between the two, high plateaus are found in Algeria and Morocco.

In Libya the high plateau of Cyrenaica attains an altitude of nearly 900 m and is bounded on the north by narrow coastal plains. Sandy

plains spread out to the south. Tripolitana in western Libya consists of a coastal strip of dunes and sandy plains.

4.2.2. Natural forest land

The areas nowadays classified as forest are nearly all situated in the two chains of the Atlas mountains. In Libya the few remnants of forest (or wooded areas) are found on the Cyrenaica plateau. Egypt and the Western Sahara are almost completely covered by desert as is the southern part of all the other countries.

The extent of forest land is indicated in summary-table S I (information from FAO Production Yearbook 1973). These areas can, in any case, not be called closed forest and give little indication as to the amount of wood available. The wooded areas have been reduced by fire, overgrazing, temporary cultivation, and unregulated fellings, so that their present stocking is generally much below the potential. Coppice or maquis with a low timber production is the most common wooded cover in the areas of forest land. These are important sources of firewood, small poles and other wood for domestic consumption.

The species distribution of the remaining wooded areas for the four "forest countries" in North Africa are given in table 4.1.

Table 4.1. Species distribution of forest land[1/]

Species	Morocco	Algeria	Tunisia	Libya
	1000 ha			
Hardwoods				
Quercus ilex	1,413	.. (676)	.. (83)	.. ..
Q. suber	425	60 (429)	80 (127)	.. ..
Q. faginea, Q. afares, Q. spp.	25	.. (67)	20 (25)	.. ..
Argania spinosa	740	.. ..	.. ..	.. ..
Acacia spp.	75	.. ..	.. ..	.. ..
Coniferous				
Cedrus atlantica	140	20 (30)	.. ..	.. ..
Tetraclinis articulata	950	.. (161)	.. (30)	.. ..
Juniperus spp.	240	.. ..	.. ..	.. ..
Cupréssus-Juniperus spp.	6[2/]	.. (322)	.. (8)	70 (230)
Pinus spp.	80	410 (855)	80 (349)	.. ..
Abies numidica	6	.. ..	.. ..	.. ..
Other spp.	25	.. ..	.. ..	.. ..
Sub-total	4,142	490 (2,540)	253 (622)	70 (230)
Maquis etc.	858	2,500 (519)	323 (169)	390 (217)
Grand-total	5,000	2-3,000 (3,059)	576 (791)	460 (447)

1/ Within brackets species distribution of "forest land" in a ten year old FAO draft
2/ Only Cupréssus

The information from the FAO draft has been included as it indicates the species distribution of maquis. It also shows how the forest area can change from report to report depending on the definitions.

To evaluate the potential of existing forest resources it is necessary to have a breakdown of the wooded areas at least into closed forest and maquis. To some extent this information is given in table 4.1. but it is evident from other information available that there exist certain degraded types which have not been shown as maquis.

The short summaries of the forest conditions in different countries that follow indicate the basis for a more meaningful breakdown of the wooded areas.

Morocco

Around 5 million ha is given as forest land of which 4.4 million ha seems to be considered as closed forest. Most of these forests are situated in the mountains.

The so-called forest area includes considerable areas of very poor forest. According to a recent estimate 434,000 ha of the natural forests is of strong interest for exploitation - 1,906,000 ha of medium interest and - 2,541,000 ha of low interest.

In the area of strong interest for exploitation Cedrus atlantica, pines and Quercus ilex are the main species. Quercus suber (cork oak) is an important species in the next interest group.

The description in the country note indicates that about 400,000 ha of valuable natural forests exists in Morocco. Of this area around 200,000 ha are covered by cork oak. The remaining "forest" or wooded areas is valuable for producing fuelwood, poles and for protection. From the different descriptions found it is not possible to say how much should be classified as closed forest. It is certainly more than the 400,000 ha mentioned above (in WFI 1963 2.4 million ha e.g. given as coppice) but this area may be the one of main commercial interest.

Algeria [1/]

Forest remnants are found in the two ranges of the Atlas mountains. It is estimated that the total area of productive forests, scrub and brushland covers 2-3 million ha. The climax vegetation is mainly formed by Quercus ilex, Cedrus atlantica, Abies numidica, Juniperus spp. and Tetraclinis articulata. A large part of the area shown on different maps as forest and forest land is degraded. A recent approximation of the potential commercial forest land gave following figures:

Species	Area, 1000 ha
Pinus halepensis	400
Pinus pinaster	10
Cedrus atlantica	20
Quercus suber	60
Total	490

1/ See page 218

It is unknown how much of this forest is covered by exploitable forest at present.

Tunisia

Tunisia is reported to have 253,000 ha of natural forest. These forests are found in the two parallell chains running from south-west to north-east. Another area of 323,000 ha is classified as scrub and brushlands.

The forest of the northern massif is dominated by cork oak (Quercus suber) either pure or in mixture with Q. faginea or Pinus pinaster. This type of forest has been well-managed for a long time.

The forest of the southern massif consists mostly of Pinus halepensis or Quercus ilex. The pines are slow growing and of poor form and have never been properly managed.

One estimate says that 180,000 ha of the total forest area are dense enough for utilization of which 80,000 ha are covered by Pinus halepensis and the rest by Quercus suber and Q. faginea.

Libya

It is estimated that 460,000 ha of mixed coniferous-hardwood scrub forest exists. The wooded vegetation is degraded to a large extent. The indigenous wooded areas are almost exclusively located on the two plateaus of the Cyrenaica. Tripolitana has no natural forest.

In the higher, sub-humid zones (rainfall 450-600 mm) there are some fair stands of Cupressus sempervirens. var. horizontalis, Quercus coccifera and Juniperus phoenicea. This type of wooded area is estimated to cover around 70,000 ha.

In the semi-arid parts of the two plateaus (rainfall 300-400 mm) an open type composed of Juniperus phoenicea, Olea oleaster, Pistacia lentiscus, Arbutus pavarii, and Ceratonia siliqua is found. The area is estimated at around 230,000 ha. Pinus halepensis grows in isolated clumps in this type of woodland.

Towards the south of the plateau the climate turns still more dry (150-300 mm rainfall) and the vegetation changes into very open scrub with Juniperus phoenicea, Zizyphus lotus and Thymelaea hirsuta. The area covered may be 160,000 ha.

Outside the plateaus in Cyrenaica the natural tree vegetation is very sparse and consists of occasional Tamarix articulata, Pistacia atlantica, Rhus tripartita, Acacia tortilis, Zizyphus lotus and so on.

Western Sahara and Egypt

These two countries are devoid of natural forest.

Summary

These country descriptions give most of the basic background information about areas for the summary about existing wooded areas in table 4.4.

4.2.3. Man-made forest

Available information about the area of plantations is summarized in table 4.2. below.

Table 4.2. Man-made forests

Country	Year	Total area planted	Pines	Other coni-ferous	Total coni-ferous	Euca-lyptus	Other broad-leaved	Total broad-leaved
		1000 ha						
Western Sahara (Sp.S.)	..	..	..	..	..	..	..	..
Morocco	1971	294	71	33	104	169	22	190
Algeria	1972	(100-200) 1/	37 2/	6	42	28	2	30
Tunisia	1969	114	31 2/	8	40	29	12	41
Libya	1972	75 3/	4 2/	-	4	26	26	52
Egypt	1969	10 4/	..	..	..	..	..	10

1/ Very uncertain figure. A large number of existing plantations are mainly for protection purposes.
2/ No recent breakdown in species is available. As an example information from the 1965 estimate found in Unasylva Volume 21 (3-4), Numbers 86-87, 1967, has been included here.
3/ In addition there should be at least 22,000 ha of private plantations.
4/ Mainly linear plantations.

Existing plantations are already considerable and all countries show a keen interest in expanding these areas. The last known plans for plantations are as follows:

Table 4.3. Plans for plantation

Country	Area to plant	Coni-ferous	Broad-leaved	Period	Actual planting rate	Period
	1000 ha				1000 ha	
Morocco	660	540	115	1968-2000	130	1968-1972
Algeria	(45)	..	..	1972-1973	25	Yearly
Tunisia	18	..	..	Yearly	11-14	Yearly
Libya	15 1/	..	..	1972-1975	4	Yearly

1/ State forests

4.2.4 Wood resources

A discussion of the wood resources in the north African countries requires that the man-made forests are included as these forests are quite extensive and are of basic importance for wood production. Available information also gives the standing volume in both natural and man-made forests.

Some sort of management plan inventories are reported to cover the whole forest area in Tunisia. Only small selected areas have been inventoried in Morocco but it seems as if the Forest Service has a rather good picture of the country's forest resource. In Algeria an inventory of around 100,000 ha has been undertaken while in Libya no inventory is known.

Table 4.4. summarizes the estimates about areas covered by natural wooded areas and plantations. The total gross volume given and the volume of different species are, in the case of Morocco and Tunisia, based on national estimates. The information utilized for these countries gives the volume in natural forests (in Morocco even maquis) and plantations together. When national estimates are missing crude estimates of volume per ha in different types of forest have been utilized.

Ideally this calculation ought to have been made for different vegetation types but, for the time being, the background information is too limited.

Table 4.4. Wooded areas and standing timber

Type of wooded area	Morocco	Algeria	Tunisia	Libya
A. Areas (1000 ha)				
Natural				
Timber forest	400[1/]	490	180	70[2/]
Other forest and maquis	4,500	2,000	400	400
Man-made	294	(200)	114	97
B. Average standing timber (total gross volume m^3/ha)				
Timber forest	60	40	40	25
Other forest and maquis	25	15	10	10
Man-made	50	50	15	30
C. Standing timber (million m^3)				
Natural closed forest				
Total gross volume	25	20	6.6	2
Of which timber	15	5	2	0.3
Quercus	17[3/]	3	4.8[4/]	..
Pinus	4[3/]	16	2.5[4/]	..
Cedrus	11[3/]	1	..	..
Man-made[5/]	15	10	2	3
Of which Eucalyptus	8	..	0.45	..
Maquis[5/]	115	30	4	4

1/ Of which 200,000 ha valuable cork oak forest
2/ Probably an overestimate
3/ Figures for all natural woodlands and plantations
4/ Figures from plantations included
5/ Total gross volume

4.2.5 Conclusions

The present production of the North African forests is discussed in 3.4. The figures in that chapter can be taken only as an indication of the present production and say nothing about the actual productivity. The production of industrial wood is far less than the present consumption. Fuelwood is exploited in relatively large quantities but covers only a part of the present need. The remaining need is covered by crop residues, dung, kerosene etc.

The need for wood in these countries can hardly ever be met by existing natural resources even if they become better managed. New plantations are necessary if the basic domestic needs are to be met from internal forest resources.

Extensive areas (several million ha) are also in need of anti-erosion measures. Considerable areas are stripped of soil annually, walking dunes are a problem in certain areas and the remaining areas of natural wooded areas are being degraded. Plantations are often more important in this context than for wood production.

It is likely that the present wood resources are over-exploited, especially for the production of fuelwood. Some of these countries have considerable oil-resources but fuelwood plantations are probably the best way to supply the demand for fuel. In this dry region plantations have many important environmental benefits quite apart from wood production.

4.3 Northern Savanna Region

4.3.1 General

On the southern range of the Sahara desert there are countries where the natural wooded vegetation is different steppe and open woodland types. The terrain in this region is relatively flat without any dominating mountain ranges.

As forestry is of very little importance in these countries the information available about wooded areas is really scarce. No inventories have been made except in Casamance in Senegal. As the country notes contain very little information certain special studies have been made here for this region in order to at least have an indicative picture of conditions.

4.3.2 Natural forest land

The areas shown as forest land in table 3.9. cover 11 per cent of the region. These areas shall not be thought of as closed forest but as "open woodland, scrub and brushland". It is probable that in the countries concerned, areas that have a tree cover that fulfill the definition of forest land in the FAO Production Yearbook are actually often shown as pasture. In reality it is impossible to give a few figures to explain the "forestry" situation in these countries. Only a breakdown of the whole land area into classes of trees per ha, crown-density or still better volume per ha would approach the truth. Such information definitively does not exist now. The scarce information given about forest and other wooded areas in the country notes can - country-by-country - be summarized as follows:

Mauritania

This is more or less a desert country. Only in the southern part is thorn and dry savanna (Sahel) to be found. These areas can give fuelwood.

Senegal

The natural vegetation in Senegal is open woodland, grasslands and steppes. The main part of the country is in the Sahel and Sudan zone. These areas are mainly suppliers of fuelwood. In the southern part, especially in the Casamance region, there are areas of "dry dense forest" (Guinea). In the Casamance region it is estimated that there are 210,000 ha of "valuable woodlands" (which have sawtimber in "acceptable" quantities?). Along the coast there are said to be 200,000 ha of mangrove of which 80,000 ha are exploitable. In the interior there are reported to be around 20,000 ha of bamboo.

Gambia

The natural vegetation of lower and middle Gambia is Guinea savanna which changes to Sudan savanna in the upper basin. The wooded vegetation is used for fuelwood and charcoal. Scattered timber trees occur where there is more water. Along the coast and the Gambia river there is 25,000 ha of mangrove. Shifting cultivation is the normal agricultural pattern. The area under bush fallow has been estimated to be 200,000-360,000 ha. The fallow period though becomes shorter and shorter.

Mali

The northern and central part of the country is covered by desert, subdesert, Sahel and Sudan savanna. The latter two types give fuelwood. In the far south there are areas of poor Guinea savanna (sometimes called "dry dense forest") which perhaps could be utilized for timber. These areas are thought to be of a very limited extent.

Upper Volta

Upper Volta is mainly covered by Sudan savanna. The present forest products are mainly fuelwood and poles. In the south-western corner there is estimated to be 1 million ha of Guinea savanna.

Niger

The northern half is covered by desert and tropical subdesert steppe. The remaining part of the country is mainly covered with wooded steppe (Sahel). On the southern frontier with Nigeria some wooded areas of Sudan type are found. Niger is, in some sources, considered to be practically devoid of sawtimber trees.

Chad

The northern half of the country is covered with desert and subdesert. The southern half 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 in the southern corner of the country is covered with Guinea savanna.

Wooded areas are exploited for fuelwood, building poles and canoe logs. Some sources maintain that it is unlikely that Chad will meet any demands for sawnwood.

Summary

These country summaries do not allow of an evaluation of the wooded areas in this region. As has been mentioned the existing wooded areas give fuelwood and, in better types, some timber.

It is of interest to at least indicate the different types of wooded areas that exist. The statistics available are very weak or almost non-existent. In the land use table (S I) certain areas have been classified as forest land. It is probable that large areas classified as pasture and agriculture at present also have some wood resources. In the following guesswork all these difficulties must carefully be kept in mind.

Table 4.6. is an attempt to combine the information in the land use table (S I) and the table with the area of different vegetation types (table 3.4.). Certain basic assumptions have been made.

a) "Other land" is if possible placed in desert and subdesert types
b) "Agriculture" is placed mainly in the best types, Sudan and Guinea
c) "Forest land" is if possible placed in Sudan and Guinea savanna
d) "Pasture" placed, if possible, in Sudan and Sahel (tsetse should make the main part of Guinea unsuitable for cattle)

In this guesswork all other information which could be of any use like population density has been used. It is also quite certain that grazing occurs also in most areas classified as forest land. All details and assumptions behind these guesstimates cannot be given.

This guesswork has given table 4.6. (page 56) which shows guesstimates of the areas of different vegetation types with different type of utilization.

4.3.3 Man-made forests

In spite of the small forest resources only very small areas of plantations have been established up to now. Available information is summarized in the table 4.5.:

Table 4.5. Man-made forests

Country	Total area planted	Main species
	1000 ha	
Mauritania	-	-
Senegal	13.7	Casuarina spp., Anacardium, Tectona grandis, Gmelina
Gambia	0.8	Gmelina arborea, Tectona grandis, Eucalyptus citriodora
Mali	1.2	Tectona grandis
Upper Volta	2	Tectona grandis, Anacardium
Niger	Trials	"
Chad	Small areas	Khaya senegalensis

Table 4.6. Land use in vegetation types and countries

Vegetation type and land use	Mauri-tania	Senegal	Gambia	Mali	Upper Volta	Niger	Chad
	million ha						
Sahel							
Forest land	15	-	-	-	-	8.0	-
Pasture	12.5	5.4	-	14.3	-	3.0	11.4
Agriculture	0.3	-	-	-	-	7.6	-
Other	-	3.0	-	27.0	3.0	27.0	-
Sudan							
Forest land	-	3.1	-	-	0.7	4.0	13.5
Pasture	-	-	0.08	14.2	13.8	-	22.3
Agriculture	-	2.8	-	6.5	5.0	7.4	6.2
Other	-	-	0.02	-	1.1	-	-
Guinea							
Forest land	-	2.0	0.3	4.5	3.4	-	3.0
Pasture	-	-	0.3	1.5	-	-	-
Agriculture	-	2.8	0.2	5.0	0.4	-	0.8
Other	-	-	0.05	-	-	-	-
Mangrove	-	0.2	0.025	-	-	-	-

It is known that Senegal plans to plant another 7,500 ha. Most other countries also plan to establish plantations. In the dry zones where the erosion problem is most serious, and fuelwood often scarce, it is rather difficult to find species with an acceptable rate of growth.

4.3.4. Wood resources

The crude mean-values about volume per ha in different types, shown in table 4.7. have been estimated taking into account the scarce information available about the volume in different vegetation types, population density, density of cattle stock etc.

These figures are based on the assumption that areas shown as forest land in the land use table have some form of wooded cover (which they perhaps do not always have). It is also thought that areas used as pasture have partial wooded cover. To a much lesser extent the same may be true for agricultural land and other land outside the desert zone.

If the area figures in table 4.6 are used together with the per ha figures in table 4.7. a table showing the total amount of wood available can be calculated (table 4.8.). The guesstimated volumes of sawtimber are naturally much more unreliable than the volumes calculated for fuelwood. They indicate merely that the resources, if any, are very small.

Table 4.7. Average standing timber

Vegetation type and land use	Mauri-tania	Sene-gal	Gambia	Mali	Upper Volta	Niger	Chad
	m^3/ha						
Sahel							
Forest land	10	-	-	-	-	10	-
Pasture	5	5	-	5	-	5	5
Other[1/]	2.5	2.5	-	2.5	2.5	2.5	-
Sudan							
Forest land	-	20	-	-	20	20	20
Pasture	-	-	10	10	10	-	10
Other[1/]	-	2.5	2.5	2.5	2.5	2.5	2.5
Guinea							
Forest land	-	40	30	25	30	-	25
Pasture	-	-	10	10	-	-	-
Other[1/]	-	5	10	5	5	-	5
Forest	-	40	40	-	-	-	-

1/ Includes agricultural land and other land

Table 4.8. Standing timber

Country	Total gross volume[1/]	Estimate of possible max. and min. values	Sawtimber volume
	million m^3		
Mauritania	215	100-250	0
Senegal	210	100-300	(10)[3/]
Gambia	20	10-30	0
Mali	450	150-550	(5)[2/]
Upper Volta	280	150-400	(5)[2/]
Niger	280	150-400	0
Chad	650	300-800	0

1/ Usable for fuelwood
2/ Optimistic assumptions. Scattered trees in forest land (difficult to utilize).
3/ Total volume may be higher (see country note).

4.3.5 Conclusions

The crude calculations made in this chapter only allow of very general and uncertain conclusions.

The discussions concerning this region are very detailed because it is sometimes said that there is no lack of fuelwood in this region. The total amount of wood available is also surprisingly high - perhaps 40-110 m^3 per caput according to the guesstimates. This means that the amount of wood per caput may be of the same order as in Europe or

Asia - or perhaps even higher. This is because of the vast area and the small population.

Fuelwood is probably available in adequate quantities over extensive areas with a low population density. Around population centra it is known that there is a lack of fuelwood and that over-exploitation of available resources causes serious erosion. This makes it impossible to judge from available information whether existing wood resources are adequate or not. For this reason it is necessary to study how much wood is available in areas with different population densities. There are reasons to fear that the available volume may decrease very fast in densely populated parts.

For the time being only Senegal have sawtimber resources of any importance. Small resources are also reported to exist in Mali and Upper Volta. Mauritania, Niger and Chad have negligible resources of trees capable of yielding sawlogs.

In this region available wood resources must be used for fuelwood production (and protection). It is however unlikely that they can yield enough to meet the demand for fuelwood. The risks for over-utilization are therefore grave. It is quite certain that fuelwood plantations are needed at least around all towns and large villages. There is naturally also a need for establishing sawtimber plantations in suitable locations.

4.4 West Africa

4.4.1 General

This region is mainly characterized by rather low land which is penetrated by several important rivers. There are some important highlands like Fouta Djalon in the western centre of Guinea, the Nimba mountains in southern Guinea and northern Liberia, low highlands on the border between Ghana and Togo, the Jos plateau in central Nigeria and the highlands in eastern Nigeria where some peaks rise above 2,000 m.

4.4.2 West Africa I

4.4.2.1 Natural forest land

The relatively high population pressure in these countries has meant that the naturally wooded areas have largely been transformed into other uses than forestry. At present 10 per cent of the area is classified as forest land (summary-table S I). Country-by-country the present wooded areas can be described as follows:

Guinea Bissau

There exists very little information about forest resources. The WFI 1963 gave forest land as 1 million ha and in WFI 1970 forest and other wooded areas were stated to be 2.3 million ha. The great discrepancy certainly depends on different definitions and a lack of surveys. According to a detailed vegetation map, roughly 10 year old, the vegetation cover is (or was) as in table 4.9.:

Table 4.9. Vegetation types

Vegetation type	Area, 1000 ha
"Forest disturbed by agriculture"	1,291
Rice fields	213
"Forest"	294
Palms	182
Mangrove	465
Grass savanna	162
Tree savanna	126
Sandbanks	67
Total	2,800

These figures have been used in this report. It should be noted that "forest" seems to mean "dry dense forest" or "dry open forest" (both normally called Guinea savanna). Part of it is probably also riverine forest.

Guinea

Guinea has tropical rainforest in the south-eastern corner. The montane forest in Fouta Djalon seems to have been cleared completely. A recent estimate gave the total forest area as 1.2 million ha, of which 600,000 - 700,000 ha should be exploitable. Of the latter area dense forest should cover 200,000 ha, open forest 400,000 ha and an intermediate category 100,000 ha. A somewhat older estimate gave the area of dense forest as only 80,000 ha of which 50,000 ha was in degradation. According to the same source 6 million ha were covered by disturbed savanna, and 10 million ha by savanna where degradation was in progress. A more recent source stated that some 14 million ha of savanna should have some form of woodcover.

Sierra Leone

Sierra Leone is, to a large extent, situated within the rainforest zone. Only a small area normally given as 290,000 ha remains as closed forest. The forests are reported to be rather poor.

Mangrove, which earlier covered the whole coastal region, has now more or less disappeared. Of the 290,000 ha remaining as closed forest only 110,000 ha is classified as productive. When cleared, the rainforest gives place to a fallow bush. As shifting cultivation is the normal agricultural system, a large part of the area classified as agriculture is actually under a wooded cover. Harrison Church (1969) gives forest (excl. mangrove) 3-5 per cent, high bush 20-25 per cent, low bush 20-25 per cent, savanna and grasslands 35-40 per cent, and swamps 10-20 per cent.

Benin (Dahomey)

Altogether around 60 per cent of the land area is wooded in some form. At most 250,000 ha is covered with islands of "sub-equatorial forest". riverine forest or "dry tropical forests". Altogether an area of 2,144,000 ha is classified as "forest" in Benin.

Togo

There are some scattered stands of closed forests in the southern part, but most of the country is covered with grass savannas and open woodlands. A recent inventory in the south (2,555,000 ha) gave 380,000 ha with closed forests, 70,000 ha with "dry dense forests" (Guinea savanna), 116,000 ha with secondary growth and 1,292,000 ha with wooded savanna. The forest land situated in the northern part of the country is open woodlands.

Summary

Summarized, the forest land in the region could be described as in table 4.10.

Table 4.10. Natural forest land

Country	Closed forest	of which			Other forests	Open woodlands
		Dense forest	Productive	Mangrove		
	1000 ha					
Guinea Bissau	760	294[6]	..	465	182[1]	126
Guinea	700[2]	200	700	(400)	500[3]	14,000[4]
Sierra Leone	290	290	110	+	..	66
Benin	200	..	..	..	(50)	6,500
Togo	380	..	..	..	70[5]	3,000

1/ Palms
2/ Mangrove probably not included. Part of this area may in fact be open woodlands.
3/ Mangrove may be included in this area
4/ Of this area 10 million ha may be "disturbed" savanna
5/ In addition there is at least 115,000 ha with secondary vegetation
6/ May, in fact, be Guinea savanna

4.4.2.2 Wood resources

In this region some inventories of selected areas have been made but to complete the picture a lot of guesswork is still necessary. The estimates of the standing timber per ha in different types of wooded areas and the total of standing timber is given in table 4.11.

In Sierra Leone the forest resources of any interest are situated within the forest reserves. The considerable volumes thought to exist in agricultural land are of local interest for fuelwood.

In Guinea considerable volumes are thought to exist in the open woodland areas. Again, these resources are only of local interest. The sawtimber production will probably come from the 0.7 mill ha considered as "productive forest". In Togo and Benin the quite considerable volumes available are difficult to utilize for industrial use as they are so scattered.

Table 4.11. Standing timber

Country	Closed forest		Other forest[1/7/]	Open woodlands[7/]	Other land[7/]
	Gross volume	Commercial volume			
A. Average standing timber (m^3/ha)					
Guinea Bissau	50	10	40	20	10
Guinea	75[2/]	15	40	20	10
Sierra Leone	200	40[3/]	-	10	20
Benin	140	20	50	15	5
Togo	140	35	50	15	5
B. Standing timber (mill. m^3)					
Guinea Bissau	15	4	25	3	10
Guinea	50	10[4/]	20	250	50
Sierra Leone	55	10[5/]	-	1	75[6/]
Benin	25	4	(3)	90	10
Togo	50	13	4	45	10

1/ Includes mangrove
2/ Productive forest area
3/ In productive forest area
4/ Recent national estimates
5/ Based on national estimate. Part of this volume non-accessible
6/ National estimate
7/ Total gross volume

4.4.2.3 Man-made forests

Available information about plantations have been summarized in table 4.12.

Table 4.12. Man-made forests

Country	Area	Main species
	1000 ha	
Guinea Bissau 1970	0.3	..
Guinea 1971	2.0	Tectona grandis, pines, Terminalia superba, T. ivorensis, bamboo
Sierra Leone 1970	6.5	Cordia alliodora, Terminalia ivorensis, T. superba, Entandophragma spp., Tectona grandis, Gmelina arborea, Triplochiton scleroxylon, Nauclea diderichii, Tarrietia utilis
Benin 1972	18.4	Tectona grandis, Casuarina sp(p), Cassia sp(p), Hymenea, Anacardium
Togo 1972	3-6	Tectona grandis

These plantations include both small village plantations created to supply the need of the local population and larger plantations established to give veneer or other high-quality timber.

4.4.3 West Africa II

4.4.3.1 Natural forest land

Even in this region the words "forest" and "forest land" have a different meaning from country-to-country. For the following discussions the existing forest resources are therefore briefly described for each country.

Liberia

Closed forest was the natural vegetation in practically the whole of Liberia but a large part of this has disappeared. At present about 2.5 million ha (sometimes given as 3.5 million) ha is still classified as closed forest. Of this area 1.6 million ha is designated as forest reserves. Existing forest resources are quite inaccessible. An area of 1.2 million ha is classified as exploitable.

The forest area may be larger if another definition is chosen. Extensive areas of young forest have not been included in the forest area as they are mainly used for shifting cultivation. The rotation period for shifting cultivation is now 15-25 years and this makes it impossible to consider these young forests of any forestry importance at least as timber producers.

Ivory Coast

The southern part, roughly 16 million ha, is covered by the closed (high) forest zone. At present an area of 8-9 million ha is still classified as forest. The table below may indicate how difficult it is to decide the present forest area. It gives the result from the 15.7 million ha inventoried in 1966 (the whole closed forest zone):

Land type	Area, 1000 ha
Forest area (blocks > 500 ha)	8,357
Small forest blocks (blocks 10-500 ha)	626
Degraded forests (blocks 5-10 ha)	5,701
Unforested areas	988

In the 13.1 million ha covered by a CTFT inventory in 1966, the forest area had decreased by 3 million ha from 1956 to 1966[1]/ This degradation probably continues at about the same rate. The vast areas covered by blocks of 5 to 10 ha certainly contain considerable volumes of valuable species. It is probable that these "forest areas" will more or less disappear within a few years. The wood will mainly be used as a fertilizer in agriculture.

The savanna areas in the north also contain a large amount of wood but this is only of importance to cover the need of the local population.

Ghana

The closed forest zone covers about 10 million ha. Of this area roughly 1.8 million ha have been formally constituted as forest reserves (of which around 1.5 million ha considered as productive). Some years ago

1/ Note: Decrease of forest blocks larger than 10 ha.

Table 4.9. Vegetation types

Vegetation type	Area, 1000 ha
"Forest disturbed by agriculture"	1,291
Rice fields	213
"Forest"	294
Palms	182
Mangrove	465
Grass savanna	162
Tree savanna	126
Sandbanks	67
Total	2,800

These figures have been used in this report. It should be noted that "forest" seems to mean "dry dense forest" or "dry open forest" (both normally called Guinea savanna). Part of it is probably also riverine forest.

Guinea

Guinea has tropical rainforest in the south-eastern corner. The montane forest in Fouta Djalon seems to have been cleared completely. A recent estimate gave the total forest area as 1.2 million ha, of which 600,000 - 700,000 ha should be exploitable. Of the latter area dense forest should cover 200,000 ha, open forest 400,000 ha and an intermediate category 100,000 ha. A somewhat older estimate gave the area of dense forest as only 80,000 ha of which 50,000 ha was in degradation. According to the same source 6 million ha were covered by disturbed savanna, and 10 million ha by savanna where degradation was in progress. A more recent source stated that some 14 million ha of savanna should have some form of woodcover.

Sierra Leone

Sierra Leone is, to a large extent, situated within the rainforest zone. Only a small area normally given as 290,000 ha remains as closed forest. The forests are reported to be rather poor.

Mangrove, which earlier covered the whole coastal region, has now more or less disappeared. Of the 290,000 ha remaining as closed forest only 110,000 ha is classified as productive. When cleared, the rainforest gives place to a fallow bush. As shifting cultivation is the normal agricultural system, a large part of the area classified as agriculture is actually under a wooded cover. Harrison Church (1969) gives forest (excl. mangrove) 3-5 per cent, high bush 20-25 per cent, low bush 20-25 per cent, savanna and grasslands 35-40 per cent, and swamps 10-20 per cent.

Benin (Dahomey)

Altogether around 60 per cent of the land area is wooded in some form. At most 250,000 ha is covered with islands of "sub-equatorial forest". riverine forest or "dry tropical forests". Altogether an area of 2,144,000 ha is classified as "forest" in Benin.

Togo

There are some scattered stands of closed forests in the southern part, but most of the country is covered with grass savannas and open woodlands. A recent inventory in the south (2,555,000 ha) gave 380,000 ha with closed forests, 70,000 ha with "dry dense forests" (Guinea savanna), 116,000 ha with secondary growth and 1,292,000 ha with wooded savanna. The forest land situated in the northern part of the country is open woodlands.

Summary

Summarized, the forest land in the region could be described as in table 4.10.

Table 4.10. Natural forest land

Country	Closed forest	of which			Other forests	Open woodlands
		Dense forest	Productive	Mangrove		
	1000 ha					
Guinea Bissau	760	294[6]	..	465	182[1]	126
Guinea	700[2]	200	700	(400)	500[3]	14,000[4]
Sierra Leone	290	290	110	+	..	66
Benin	200	..	..	..	(50)	6,500
Togo	380	..	..	..	70[5]	3,000

1/ Palms
2/ Mangrove probably not included. Part of this area may in fact be open woodlands.
3/ Mangrove may be included in this area
4/ Of this area 10 million ha may be "disturbed" savanna
5/ In addition there is at least 115,000 ha with secondary vegetation
6/ May, in fact, be Guinea savanna

4.4.2.2 Wood resources

In this region some inventories of selected areas have been made but to complete the picture a lot of guesswork is still necessary. The estimates of the standing timber per ha in different types of wooded areas and the total of standing timber is given in table 4.11.

In Sierra Leone the forest resources of any interest are situated within the forest reserves. The considerable volumes thought to exist in agricultural land are of local interest for fuelwood.

In Guinea considerable volumes are thought to exist in the open woodland areas. Again, these resources are only of local interest. The sawtimber production will probably come from the 0.7 mill ha considered as "productive forest". In Togo and Benin the quite considerable volumes available are difficult to utilize for industrial use as they are so scattered.

Table 4.11. Standing timber

Country	Closed forest		Other forest[1/7/]	Open woodlands[7/]	Other land[7/]
	Gross volume	Commercial volume			
A. Average standing timber (m^3/ha)					
Guinea Bissau	50	10	40	20	10
Guinea	75[2/]	15	40	20	10
Sierra Leone	200	40[3/]	-	10	20
Benin	140	20	50	15	5
Togo	140	35	50	15	5
B. Standing timber (mill. m^3)					
Guinea Bissau	15	4	25	3	10
Guinea	50	10[4/]	20	250	50
Sierra Leone	55	10[5/]	-	1	75[6/]
Benin	25	4	(3)	90	10
Togo	50	13	4	45	10

1/ Includes mangrove
2/ Productive forest area
3/ In productive forest area
4/ Recent national estimates
5/ Based on national estimate. Part of this volume non-accessible
6/ National estimate
7/ Total gross volume

4.4.2.3 Man-made forests

Available information about plantations have been summarized in table 4.12.

Table 4.12. Man-made forests

Country	Area	Main species
	1000 ha	
Guinea Bissau 1970	0.3	..
Guinea 1971	2.0	Tectona grandis, pines, Terminalia superba, T. ivorensis, bamboo
Sierra Leone 1970	6.5	Cordia alliodora, Terminalia ivorensis, T. superba, Entandophragma spp., Tectona grandis, Gmelina arborea, Triplochiton scleroxylon, Nauclea diderichii, Tarrietia utilis
Benin 1972	18.4	Tectona grandis, Casuarina sp(p), Cassia sp(p), Hymenea, Anacardium
Togo 1972	3-6	Tectona grandis

These plantations include both small village plantations created to supply the need of the local population and larger plantations established to give veneer or other high-quality timber.

4.4.3 West Africa II

4.4.3.1 Natural forest land

Even in this region the words "forest" and "forest land" have a different meaning from country-to-country. For the following discussions the existing forest resources are therefore briefly described for each country.

Liberia

Closed forest was the natural vegetation in practically the whole of Liberia but a large part of this has disappeared. At present about 2.5 million ha (sometimes given as 3.5 million) ha is still classified as closed forest. Of this area 1.6 million ha is designated as forest reserves. Existing forest resources are quite inaccessible. An area of 1.2 million ha is classified as exploitable.

The forest area may be larger if another definition is chosen. Extensive areas of young forest have not been included in the forest area as they are mainly used for shifting cultivation. The rotation period for shifting cultivation is now 15-25 years and this makes it impossible to consider these young forests of any forestry importance at least as timber producers.

Ivory Coast

The southern part, roughly 16 million ha, is covered by the closed (high) forest zone. At present an area of 8-9 million ha is still classified as forest. The table below may indicate how difficult it is to decide the present forest area. It gives the result from the 15.7 million ha inventoried in 1966 (the whole closed forest zone):

Land type	Area, 1000 ha
Forest area (blocks > 500 ha)	8,357
Small forest blocks (blocks 10-500 ha)	626
Degraded forests (blocks 5-10 ha)	5,701
Unforested areas	988

In the 13.1 million ha covered by a CTFT inventory in 1966, the forest area had decreased by 3 million ha from 1956 to 1966[1]/ This degradation probably continues at about the same rate. The vast areas covered by blocks of 5 to 10 ha certainly contain considerable volumes of valuable species. It is probable that these "forest areas" will more or less disappear within a few years. The wood will mainly be used as a fertilizer in agriculture.

The savanna areas in the north also contain a large amount of wood but this is only of importance to cover the need of the local population.

Ghana

The closed forest zone covers about 10 million ha. Of this area roughly 1.8 million ha have been formally constituted as forest reserves (of which around 1.5 million ha considered as productive). Some years ago

1/ Note: Decrease of forest blocks larger than 10 ha.

types are: dense forest on solid soils, forest on marshy soils, degraded and second-growth forest. Dense forest on solid soil is of main interest for forest exploitation. It is not known how much of the total forest area really is covered with forest of this type (probably the main part).

Approximately 100,000 ha of mangrove is to be found. About 8.5 million ha of the closed forest area is said to have been exploited. At least 6 million ha of forest have been opened up to concessions in recent years.

Equatorial Guinea

This country is completely situated within the rainforest zone. No detailed information is available about its forest resources. It has been estimated that 1.0 million ha is covered with closed forest. Of this area 0.7 million ha should be undegraded and unexploited. It is not known exactly how much is worth exploiting. The country is relatively mountainous and 15-20 per cent of it is sometimes considered to be inaccessible. On Fernando Poo an area of 120,000 ha is reported to be covered by closed forest.

For the time being secondary forests and bush are estimated to cover about 1.1 million ha. The non-forested parts of the land area are agricultural land of some kind. Along the coast there are some areas of savanna.

Gabon

Gabon is a very lowly populated country and the forest resources are therefore quite undisturbed by agricultural activities. Roughly 20.5 million ha is covered with rainforest. Of this area around 6 million ha in the eastern part of the country is described as an intermediate type between evergreen forest and semi-deciduous forest. The basic difference between this type and the evergreen forest found in the remaining part of the country is that okoumé, which is the principal species in Gabon, is lacking in the eastern part. Existing vegetation maps show relatively large areas in the southern part of the country as savanna. These areas are normally a forest-savanna mosaic with the savanna (grassland) predominating. Scattered areas of savanna are also found in areas marked as closed forest on the map. Around 1 million ha is covered by swamp forest or mangrove.

Central African Republic

In the southern part of the country there are 3 million ha of closed forest. Some parts of this forest appear to be exceptionally rich. The forests are almost untouched and still rich with exploitable species. North of the closed forest zone there is a belt of "derived Guinea-savanna" with gallery forests containing Khaya senegalensis and Chlorophora excelsa. One-quarter of the country (the more densely populated areas) is covered by this type of association, and about one-quarter has woodlands of Isoberlinia and Anogeissus (Guinea savanna). In the northern part there is Sudan savanna.

The savanna areas supply fuelwood, poles and so on for local consumption. Parts are evidently rather rich.

Congo

All the forests of any importance are classified as dense tropical moist forest. The remaining part of the country is classified as forest-savanna mosaic. For the time being, the area of closed forest is given as 17 million ha. Of this area 5 million ha is reported to be non-productive (inundated and non-exploitable).

The most extensive closed forests are in the north. Access is difficult. A considerable part of this region is covered with swamp forest considered impossible to exploit. The areas which have hitherto been of main interest for exploitation are situated in the Mayombe region along the coast and in the region around Mossendjo and Zanaga. The Mayombe region is almost completely exhausted of valuable species (limba). Export from the Congo has decreased in recent years.

Zaire

Zaire has about 50 per cent of the closed forest area of Africa. Available information about these forests is rather unreliable. Estimates of the area of closed forest range from 90-110 million ha. According to an old estimate open woodlands covered 90 million ha.

Angola

About two-thirds of the country is under tree cover. An area of 250,000 ha of tropical rainforest is said to be found in the Cabinda enclave. (Some other sources give more: Hance (1965) 950,000 ha in Cabinda.) Another 750,000 ha of riparian and mangrove forests are reported to occur. According to some sources an area of 2,760,000 ha is covered with moist semi-deciduous forest. "The Vegetation map of Africa" classified these areas as woodlands of relatively moist type (Miombo). Miombo is the dominating vegetation type and covers close to 60 million ha. Mopane and Adansonia woodlands cover over 10 million ha.

Summary

The forestry situation in these countries is summarized in table 4.16. Naturally, we have used some guesstimates, especially in the case of unexploited areas and open woodlands.

Table 4.16. Natural forest land

Country	Closed forest	of which			Open wood-lands	Bush fallow
		Mangrove	Unex-ploited	Concessions		
	million ha					
Cameroon	17.5	0.1	9.0	6.0	12	4.5
Equatorial Guinea	1.1	..	0.8	-	..	1
Gabon	21.5	1.1[1/]	15.0	6.0	3	..
CAR	3.0	-	2.5	(0.5)	40	..
Congo	17.0[2/]	..	10.0	(2.5)	10	..
Zaire	90.0	0.3[1/]	(50.0)	..	90	(10)
Angola	1.0	0.8	..	0.1	70	..

1/ Includes swamp forest 2/ Of which 5.0 mill ha is"unexploitable"

The forest area destroyed by shifting cultivation is thought to be small compared to West Africa except in the case of certain areas in Cameroon and, probably, parts of Zaire.

4.5.3 Wood resources

Inventories have been undertaken in certain parts of the region. They do not allow of a reliable estimate of the total amount of wood available. Inventory figures and guesstimates together give table 4.17. showing volume per ha and the total volume. As many as possible of the figures have been calculated from the volume figures given in the country notes.

Table 4.17. Standing timber

Country	Closed forest				Other forest[1/]	Open-wood-land[5/]	Bush fallow[5/]
	Gross volume			Exploitable volume[2/]			
	d.b.h. >10 cm[4/] all species	d.b.h.>60 cm commercial species	d.b.h.>60 cm pot.commercial species				
A. Average standing timber (m^3/ha)							
Cameroon	250	45	30	15	250	15	20
Equatorial Guinea	250	50	20	25[3/]	..	..	50
Gabon	275	15	20	10	150	10	..
CAR	275	50	25	15	-	20	..
Congo	250	25	30	10	150	10	..
Zaire	250	25	25	6-10	200	15	20
Angola	250	25	25	10	200	20	..
B. Standing timber (million m^3)							
Cameroon	4 300	800	500	130	25	180	90
Equatorial Guinea	300	50	20	20	..	..	50
Gabon	5 600	300	400	150	150	30	..
CAR	800	150	70	35	-	800	..
Congo	4 200	400	500	100	..	100	..
Zaire	22 000	2 200	2 200	500	60	1 300	(200)
Angola	60	5	5	..	150	1 400	..

1/ Includes mangrove and swamp forest
2/ Volume that is considered exploitable considering present demand and present exploitation methods. The per ha figures and the total volumes do not always agree with each other as they are taken from different estimates.
3/ This figure is some years old and probably high because of demand from the Spanish market.
4/ These mean-values may be on the high side. They can be seen as an attempt to show the volume usable for fuelwood (or perhaps pulp if all species were used).
5/ Total gross volume of all trees above d.b.h. 10 cm.

Of the figures given in this table the ones showing total gross volume are probably nearest to the truth. The crude figures about total volume indicate the enormous amount of wood to be found in these countries. Uncertainty about the actual area of closed forest in Zaire means that figures for this country are very unreliable.

The volume that can be made available on the market and the volumes of the most important species would be figures of basic interest. At the present time it is impossible to estimate this. The figures showing commercial and potentially commercial volume are difficult to interpret. As far as possible they have been calculated with existing inventories and national estimates as the base but the differences from country-to-country indicate that "commercial" has been interpreted quite differently. Equatorial Guinea earlier had to supply the Spanish market which explains the very high figure for this small country. The values for the Central African Republic and the Cameroon also seem to be high. In the case of CAR, which certainly has valuable forest, exploitation of many commercial species will probably not pay when one takes into account the enormous distance to the export market. The values for Gabon seem very low as compared to other countries. It is probable that the mean-values for commercial and potentially commercial species in the region as a whole (25 m^3/ha of each) does not fall too far short of the actual value.

Figures for "exploitable volume" are roughly based on present exploitation and national estimates. It is probable that these figures in one way give a better picture of the potential woodsupply in the countries than do the figures for commercial and potentially commercial volume.

The figures for volume in open woodlands and bush fallow are naturally very unreliable. They have been included only to show the magnitude of this resource.

4.5.4 Man-made forests

In spite of the large areas of natural forests existing in the region, considerable areas of man-made forests have been established. This is quite natural as the Governments want forestry to remain important. In table 4.18. the area of existing plantations is shown.

Table 4.18. Man-made forests

Country	Year	Total area planted	Coniferous	Broad-leaved	Main species
		1000 ha			
Cameroon	1970	9	..	9	Okoumé, Eucalyptus
Equatorial Guinea	-	-	-	-	
Gabon	1971	25	0	25	Okoumé, some Eucalyptus and pines
CAR	1971	1	-	1	Terminalia superba, Cassia, Eucalyptus
Congo	1972	12	2	10	Terminalia superba, Eucalyptus spp., Pine spp.
Zaire	..	50-60	2	..	Mainly Terminalia superba
Angola	1970	120	18	..	Eucalyptus, pines

In Congo Brazzaville there are plans to create plantations of Eucalyptus and pines sufficient to establish a pulp mill. Angola already produces pulp from existing plantations. In Congo and Zaire plantations of Terminalia superba have been established to ensure the future need of the industries in Mayombe region where the forests are nearly exhausted of this species. The plantations in Zaire may have suffered from inadequate management during the sixties.

4.5.5 Conclusions

It is most probable that the importance of the forest resource in this region will increase in coming years. Poor accessibility is the basic disadvantage of the forest resource.

These countries with large unexploited resources can now utilize these resources in a proper way, if they learn from the mistakes that have been made in other forest-rich countries in the tropics.

4.6 East Africa

4.6.1 General

In the main, this region is characterized by vast open woodland areas with relatively small areas of closed forest situated in the mountains. Ethiopia, a mountainous country with quite large areas of closed forest in inaccessible mountain areas, is an exception. Madagascar too has quite large areas of closed forest in the eastern mountainous part of the country.

The region as a whole is characterized by vast plateaus, some of them at high altitudes. These high plateaus are crossed from north to south by important mountain ranges along the Rift Valleys. These mountain ranges are most extensive in Ethiopia, western Uganda, Rwanda, Burundi and western Kenya.

4.6.2 Natural forest land

Country-by-country the different types of forest and other wooded areas are briefly described below:

Sudan

Roughly half of the land area - the northern part - is covered by desert and subdesert types. In the central part of the country there are extensive areas of wooded steppe and in the southern part one-fifth of the land area is covered with open woodlands. In mountains in the south and west there are 300,000-600,000 ha of closed forest. Around the Nile as much as 25 million ha is covered by inundated areas.

In 1962 the "productive" area of different vegetation types were given as follows:

Zone	Area, 1000 ha
Wooded steppe	16,600
Savanna - low rainfall	5,400
Savanna - high rainfall	16,400
Flood region	1,200
Montane vegetation	300[1/]
Total productive	45,500

1/ Montane forest often given as 600,000 ha.

In the total above certain subdesert types and special areas which have been classified as productive but which are not shown separately are also included.

A recent estimate gives the area of forest and other wooded areas as 40 million ha (crown-cover above 5 per cent).

Ethiopia

Estimates of the area covered by closed forests vary considerably. The currently accepted figure is 4 million ha. Another 1 million ha thought to be covered with bamboo. One estimate gives 850,000 ha with coniferous and 3,150,000 ha with broadleaved forests (including 630,000 ha with an admixture of coniferous).

"Open forests"(woodlands) in the lowlands cover perhaps 3 million ha while 25 million ha of "open woodland" (wooded grasslands, scrub, thickets) is estimated to remain.

French Territory of Afars and Issas

This is a desert and subdesert country. A few remnants of forests totalling about 6,000 ha are said to exist in a mountain area. There is also an area of 100,000 ha of poor tree vegetation good only for fuelwood and low-quality poles. The tree vegetation is dominated by Acacia species.

Somalia

The dominant vegetation is of subdesert type. It is a country covered by low bushes, of which Acacias are the main species. About 10 million ha may have some form of tree cover.

There are said to be some stands of African pencil cedar (Juniperus procera) in the high altitude areas of the Golis range in the north. The area is estimated to be 120,000 ha.

There are thought to be some potentially productive forests in the southern part of Somalia, along the rivers Juba and Scebelli and south-west of Chisimaio. The area of this forest is estimated to be 40,000 ha. The mangrove on the coast between the river Juba and the Kenya border has been heavily over-cut.

Uganda

Uganda has rainforest of both montane and lowland type. Within the forest reserves are 720,000 ha of closed forests. It was once estimated that there is 150,000 ha of closed forest outside the reserves. Of the reserved closed forest area only around 400,000 ha are of immediate interest for exploitation.

About 800,000 ha of open woodlands has been declared as forest reserves. Open woodlands situated outside these reserves have quite often been strongly influenced by man. If one accepts the often quoted figure of 9.2 million ha for forest land the unreserved open woodlands should cover around 7.5 million ha. Of this area 6.4 ha have recently been designated for agricultural development. It is clear that a large amount of wood is to be found also outside the areas classified as forest land.

Kenya

Around 1.7 million ha is covered by forest reserves. Roughly 620,000 ha of these are closed natural forests. In addition there is 290,000 ha of bamboo. The principal forest areas are concentrated on Mount Kenya, and on the Aberdare mountains east of the Rift Valley, and on the Mau Range, Kaptagat-Elgeyo and Mount Elgon to the west. Few large blocks remain below 1,800 m. Podocarpus is an important genera in these forests. There is estimated to be 45,000 ha of mangrove forests. It is probable that practically no closed forests are to be found outside the forest reserves.

There also exist areas of open woodlands but no information as to the extent of these areas have been found. Any valuable areas are thought to be relatively small.

Rwanda

The natural forests that remain are found in the more remote areas in the northern and southern part of the Congo-Nile divide. They are estimated to cover 180,000 ha in the north and 120,000 ha in the south. They are diminishing quite rapidly.

There are open woodland areas in the eastern part of the country. The areas of tree and bush savanna, and gallery forest which are still partially wooded have been estimated as roughly 1 million ha.

Burundi

The major part of the country is an undulating plateau between 1,500 and 2,000 m. The mountainous Congo-Nile divide crosses the country from north to south. This region was once forested but nearly all of the forest has now disappeared reaching as a maximum, 100,000 ha or perhaps as little as 10,000 ha. Most of these forests are at high altitudes, rather inaccessible, and mainly needed for protection purposes. There are open woodlands in the eastern and southern part of the country.

Tanzania

Up to 50 per cent of Tanzania is estimated to be covered by forest and other wooded areas. Of this, closed forest covers 940,000 ha, mangrove 80,000 ha and open woodlands about 32.6 mill ha. Remaining areas classified as forest land (10.8 million ha) are scrub and brushlands (intermediate woodlands) and open areas. Seventy-five per cent of the closed forest is reserved and 30 per cent of the open woodlands. Many people expect that a large part of these unreserved wooded areas will disappear. These unreserved forests and open woodlands supply a lot of sawtimber. In 1968 45 per cent of the sawlog-production was estimated to come from these areas.

Zambia

According to the Vegetation map of Africa the whole country is covered with different open woodland types, with Miombo dominating. The woodland types vary very much in density. There are wooded areas of a more open and drier type (mainly Mopane). It is thought that about 50 per cent of the land area is still covered with different open woodland types.

The Rhodesian teak forests are said to cover 650,000 ha (or 230,000 ha) in Barotseland north of the Zambezi river. It is reported that most of the productive areas have been exploited.

Malawi

Relicts of closed forests are found in the high mountains. Very small areas are thought to remain. The dominating vegetation type is the Miombo which covers approximately 60 per cent of the land area. This type has a very poor sawlog content.

Two other open woodland types (Pterocarpus-Oxytenanthera and Combretum-Afrormosia-Acacia woodlands) cover about 30-40 per cent of the land area. They are of little economic significance. Around 7 million ha is reported to be covered by open woodland at present.

Mozambique

Of the land area in Mozambique four-fifth is under tree cover. Rain forest is said to be more or less negligible but 1.5 million ha of riparian and mangrove forests exists.

The dominating vegetation type is the Miombo which has been estimated to cover 60 million ha. This type is reported to be very luxurious in certain areas. Another 5 million ha is covered by Mopane and Adansonia woodlands. Hance (1965) says that 10 per cent of the land area is exploitable "forest" (mainly in Beira).

Madagascar

Several estimates as to the extensions of the forest area have been made. Estimates are difficult because large areas have been more or less degraded. Thus the 12 million ha figure normally given may be correct but gives little indication of the potential for wood production.

An estimate based on old photographs reported 12 million ha to be undegraded and 4 million ha to be degraded. It is probable that larger areas must be classified as degraded nowadays. In the eastern rainforest for instance, which should cover 6-7 million ha, only the most inaccessible areas are untouched. A recent estimate gives 4-5 million ha of untouched forest in the east.

The dry deciduous forest in the west - said to cover 2.7 million ha - is easily destroyed by fire. Much of this type of forest has disappeared completely and only a few major blocks are left. The survival of this type is due to the sparse population. The so-called bush forest in the south should cover 2 million ha. It is degraded to a large extent.

Summary

Table 4.19. gives the present area of different types of forest and other wooded areas in the region. In its preparation all available information has been utilized.

Table 4.19. Natural forest land

Country	Closed natural forest	of which				Open woodlands	Bush fallow, degraded forests, scrub etc.
		Exploitable - Productive	Mangrove	Bamboo	Coniferous		
	million ha						
Sudan	0.3	0.3	-	..	..1/	39	..
Ethiopia	5.0	(0.3)5/	-	1.0	0.92/	3	253/
Fr. Terr. Afars, Issas	0.006	-	-	..	..	-	0.14/
Somalia	0.2	..	..	..	0.1	-	10
Uganda	0.7	0.4	-	0.04	..	8.5	..
Kenya	0.9	..	0.04	0.3	..1/	1.06/	..
Rwanda	0.3	..	-	..	..	1.0	..
Burundi	0.1	..	-	..	..	0.26/	..
Tanzania	1.0	0.4	0.08	..	..1/	32.6	10.78/
Zambia	0.77/	..	-	-	-	37.5	..
Malawi	0	0	-	..	..	7	..
Mozambique	1.5	..	1.5	-	-	65	..
Madagascar	6.0	(1.5)	0.2	..	..	2	8

1/ Mixed forest
2/ In addition 630,000 ha with mixed forest
3/ Wooded grasslands, thickets etc.
4/ Scrub
5/ Exploitable or accessible
6/ Unreliable guesstimate (E)
7/ Dry deciduous forest
8/ Intermediate woodlands

4.6.3 Wood resources

No accurate figures as to the amount of wood of different qualities can be given. Certain inventories have been undertaken in some of these countries but they by no means give a complete picture. Table 4.20. shows the per ha figures that have been used when calculating the total volumes available. The figures are inventory information, official estimates or my own estimates. Some of the per ha figures have been reached by calculating backwards from national estimates giving the total volumes.

Table 4.20. Standing timber

Country	Closed natural forests[1]			Other forests[2]	Open woodlands[17]	Other wood resources[3]	Commercial volume outside closed forests
	Gross volume[4]	Commercial volume	Gross volume coniferous				
A. Average standing timber (m^3/ha)							
Sudan	150	30	..	..	40	..	(1)
Ethiopia	175	40	..	..	20	5	..
Fr.Terr.of Afars,Issas	30	-	..	..	..	5	..
Somalia	125	..	..	..	..	5-10	..
Uganda	200	(20)	..	..	30	..	..
Kenya	(90)	(40)	..	100[8]	(10)	..	..
Rwanda	150	..	..	..	5	..	..
Burundi	150	..	..	..	5	..	..
Tanzania	150	50	..	100[8]	45	15	5
Zambia	..	..	-	50	40	..	2
Malawi	..	..	..	..	25	..	..
Mozambique	..	..	..	150[10]	30	..	..
Madagascar	90	25	..	40	15	15	..
B. Standing timber (million m^3)							
Sudan	50	10	..	..	1,500	..	(15)
Ethiopia	700	150	150	..	60	120	..
Fr.Terr.of Afars,Issas	0.2	..	..	..	..	0.5	..
Somalia	20	..	10	..	..	50	..
Uganda	150	(15)[16]	..	..	200	..	3[5]
Kenya	110[6]	40[7]	30	4[8]	10	..	..
Rwanda	40	..	..	..	5	..	..
Burundi	15	..	..	..	..	..	..
Tanzania	140[13]	30	30	10[8]	1,200[15]	120[15]	150
Zambia	..	3	-	30[9]	1,500	..	70
Malawi	..	..	..	..	200	..	10
Mozambique	..	..	..	200[8]	2,000	..	100
Madagascar	540[11]	(150)	..	10[8]	30[14]	120[12]	2

1/ Bamboo and mangrove not included
2/ Volume in mangrove, exploited forests etc. Total gross volume.
3/ Total gross volume in degraded forests, scrub forests, dry open woodlands etc.

4/ Volume of all species above d.b.h. 10 cm.
5/ In unreserved forest
6/ All species above d.b.h. 15 cm. This volume is from an area of 1,263,000 ha.
7/ Commercial species above d.b.h. 33 cm.
8/ Mangrove
9/ Dry deciduous forest
10/ Mangrove and riparian forest
11/ Volume above 30 cm d.b.h. Area covered 6 million ha (non-exploited and rather dense forest). National estimate.
12/ Including exploited forest (4 mill ha) and degraded forest (4 mill ha).
13/ Volume in productive forest area is 66 million m^3.
14/ Dry deciduous forest and southern scrub forest.
15/ Volume in productive areas. In addition wooded areas in National parks, protection reserves etc.
16/ Estimated from inventory information. In certain regions more or less all species utilized for sawnwood. Rukuba (1969) gives 17 million m^3 in all forest.
17/ Total gross volume

On the whole, the volume in closed forest is relatively small compared to the volume in open woodland. Of the volume in closed forest a large part is in mountainous terrain where logging may be difficult and, furthermore, forests may be needed more for protection than for production. In Tanzania for example only 35 per cent of the montane forest area is considered productive.

4.6.4 Man-made forests

Over a long period of years there has been an intensive planting activity in this region. For the time being existing plantations can be summarized as in table 4.21.

The plantations are mainly scattered in relatively small blocks. In Malawi and Madagascar concentrated pulpwood plantations have been started. Part of the plantations in Kenya have been used for a pulpwood project. Plans exist for the establishment of pulpwood plantations in Tanzania. Of the planted area in Ethiopia 15,000 ha are found around Addis Ababa. These plantations are mainly for fuelwood and protection.

The very intensive plantation activity in this region seems to continue. In table 4.22 the present plans for plantations are shown. For comparison, areas that have been planted during the last years, are also given.

4.6.5 Conclusions

The forest resources in the countries in this region vary from relatively rich to very poor. Within the countries there are important regional differences. The areas of closed forests are often situated in rather inaccessible regions. In many cases the unreliable information available allows only a few conclusions to be made.

Somalia cannot supply its own need for sawnwood. There are probably considerable volumes of fuelwood still but increased degradation can easily occur if the natural wooded areas are exploited for fuelwood. No doubt there is a need for fuelwood plantations.

Table 4.21. Man-made forest

Country	Year	Total area planted	Broad-leaved	of which Eucalyptus	Coni-ferous	of which pines	"Private" plantations[1/]	Pulp-wood plantations	Timber plantations	Fuelwood plantations[2/]
		1000 ha								
Sudan	1969	81	79	7.6	2	0.2	..	-	..	..
Ethiopia	1970	40	40	40	..	..	..	-	..	40
Fr. Terr. of Afars, Issas	..	..	..	..	..	..	..	-	..	..
Somalia	..	(15)	(15)	..	..	..	..	-	..	..
Uganda	1971	20	11	7.5	9	D	7	..	(11)	8
Kenya	1970	160[4/]	15	..	123	55	140	15[3/]	125	..
Rwanda	1970	29	27	22	2	0.6	..	-	..	D
Burundi	1970	25	21	17	4	..	..	-	..	D
Tanzania	1975	65	17	..	48	..	..	..	D	..
Zambia	1974	24	8	8	16	16	..	..	..	..
Malawi	1971	37	3	2.5	34	34	4	23	14	..
Mozambique	1971	21	6	2	15	15	1	-	..	..
Madagascar	1975	280	200	200	80	80	..	..	..	200

1/ Here certain small private fuelwood and pole plantations are included. These for one reason or another are not included in the total area planted. Normally, private plantations are included in the total area planted. That these are not may be due to the fact that they are less well known.
2/ Fuel and pole plantations.
3/ Only part of the pine plantations will be used for pulp-production.
4/ Information from 1975.

Table 4.22. Plans for plantations

Country	Area to plant	Coni-ferous	Broad-leaved	Period	Actual planting-rate	Period
	1000 ha/year				1000 ha/year	
Sudan	22.5	..	22.5	1970-74	4.6	1971
Ethiopia	..	..	..	..	..	..
Fr.Terr.of Afars,Issas	..	..	..	..	..	..
Somalia	..	..	..	..	..	..
Uganda	..	2	..	Yearly	..	..
Kenya	6.5[1/]	6	..	Yearly	(6)	Yearly
Rwanda	0.25	..	..	Yearly	0.25	Yearly
Burundi	(0.25)[2/]	..	..	..	0.25	Yearly
Tanzania	(5)	..	..	Yearly	(6)	(Yearly)
Zambia	2.4[3/]	1.6	0.8	Yearly	2.6	1972
Malawi	(3.0)	..	..	Yearly	(3)	1969-71
Mozambique	..	..	..	..	..	..
Madagascar	(10)	(7)	..	Yearly	10-20	Yearly

1/ Annual clear fellings of plantations will be 1,300 ha
2/ 3,000 to 4,000 ha per year should be needed
3/ In 1975 2,900

Ethiopia has relatively large forest resources. The impressive gross volumes could make it seem likely that the domestic need for fuelwood could be easily satisfied. But a large proportion of this volume is in inaccessible regions and there is actually a serious lack of fuelwood over large areas of the country. Existing accessible resources are under continuous degradation. Certainly therefore there is a need for fuelwood plantations in large parts of Ethiopia.

The closed forest could give a considerable production of sawtimber. There are great difficulties in transporting it to existing local markets. If these forests were accessible they could probably meet the main part of the demand for sawnwood. The management of these forests is however, difficult and they should probably be replaced by plantations.

The forests of Uganda are relatively rich and will certainly continue to yield timber in coming years although probably in decreasing quantities. The future of the closed forests in Kenya and Tanzania is more difficult to judge. The difficult terrain and the unclear regeneration conditions makes the management of these forests very difficult. It is probable that the future requirements of wood in Kenya (at least industrial wood) must be met from plantations. Tanzania has large quantities of wood in the Miombo. These areas are - according to some sources - very low-productive in the case of industrial wood and it is most uncertain what will happen to these areas in the future. It is probable that most of the local needs for timber will have to be met from plantations. Valuable species in the closed natural forests will certainly be exploited in coming years too although in small and decreasing quantities.

In Rwanda and Burundi there is not even enough fuelwood available. The future need for wood must be met from plantations.

The extensive areas of Miombo in Zambia are nowadays mainly used for local consumption of fuelwood and poles. They supply only small limited quantities of industrial wood. It is probable that the future needs of industrial wood will be met from plantations. The same is true for Malawi.

Mozambique has considerable areas of open woodlands. It is probable that this resource will have to supply the main part of the local needs in coming years. In the future, industrial wood may, even in this country, have to come from plantations.

The natural forest resources on Madagascar are still quite considerable but it is unclear how much of the wood can reach the market. A large part of the population lives in areas where there is a lack of wood. The inadequate transport system causes difficulties in transporting the wood to the market. The rough terrain in forested areas often makes logging difficult.

It is probable that plantations will cover most of the needs of the population. The natural forest may mainly be used for exploitation of more valuable species.

In summary the natural closed forests in the region will in the future supply relatively small quantities of industrial wood. Most of the industrial wood will have to come from plantations. In large areas there is also a great need for the establishment of fuelwood plantations.

4.7 Southern Africa

4.7.1 General

This region is covered by quite variable vegetation but there are several similarities which make it quite natural to treat the region separately.

The region is characterized by vast plateaus. In the main part of Namibia and Rhodesia and in the western part of South Africa these plateaus reach over 1,000 m. Along the eastern coast of South Africa there is an important mountain range (Drakensberg).

4.7.2 Natural forest land

The natural vegetation in this region is of importance for fuelwood production but not for the production of industrial wood. The descriptions of forest land in the different countries can therefore be simple and brief.

Rhodesia

There are a few negligible relicts of montane forest along the eastern border. The characteristic woody vegetation comprises several types of deciduous open wooded areas with occasional fringes of riverine forest along the major water courses. Around two-thirds of the land area is covered by such open woodland types. The most important of these wooded

areas is the dry deciduous forest which occurs in over 800,000 ha in the western corner of the country. This type is rich in Baikiaea plurijuga (Rhodesian teak).

The other wooded areas are mainly of the Miombo type and, to some extent, of the Mopane type. These wooded areas are of very low productivity.

Botswana

A crude land classification some years ago gave 24 million ha in the central and western part of the country as shrub or bush savanna (wooded steppe with abundant Acacia and Commiphora). Roughly 32 million should be covered by dry open woodland (partly Acacia and Mopane shrub). Around 1 million ha in the northern corner is covered by dry deciduous forest which is a continuation of the same formation in Rhodesia and Zambia. An area of 40 million ha (of dry open woodland) is said to be used for grazing.

Namibia

At least 80 per cent of the land area is covered by desert, subdesert and steppe. In the absolute northern part of the country there are perhaps 10 million ha of Mopane.

Swaziland

There are about 40,000 ha of dry open woodlands in the eastern part of the country.

Lesotho

In this country there is reported to be a complete absence of naturally occurring tree growth. With the present grazing pressure only unedible shrubs can survive.

South Africa

The closed forest is estimated to cover about 255,000 ha while open woodland and scrub covers around 2,686,000 ha.

Summary

Table 4.23. summarizes the information about the natural vegetation of some forestry importance in the whole region.

Table 4.23. Natural forest land

Country	Closed forest	Dry deciduous forest	Moist savanna	Dry savanna
	million ha			
Rhodesia	0	0.8	15	8
Botswana	-	1.0	-	30
Namibia	-	-	-	10
Swaziland	-	-	-	0.04
Lesotho	-	-	-	-
South Africa	0.26	-	-	2.7

4.7.3 Wood resources in natural forest land

No large inventories have been undertaken in this region. Guesstimates of total volume have been necessary to complete the picture. The per ha figures used for the calculation of total volume are shown in table 4.24. This table also shows the corresponding figures for total volume.

Table 4.24. Standing timber

Country	Total gross volume				Commercial volume in dry deciduous forest
	Closed forest	Dry deciduous forest	Moist savanna	Dry savanna	
A. Average standing timber (m^3/ha)					
Rhodesia	-	50	30	20	..
Botswana	-	30	-	20	..
Namibia	-	-	-	20	-
Swaziland	-	-	-	15	-
Lesotho	-	-	-	-	-
South Africa	150	-	-	20	-
B. Standing timber (million m^3)					
Rhodesia	-	40	450	160	0.5
Botswana	-	30	-	600	0.3
Namibia	-	-	-	200	-
Swaziland	-	-	-	0	-
Lesotho	-	-	-	-	-
South Africa	35	-	-	50	-

4.7.4 Man-made forests

There is a rather intense planting activity in some of the countries in this region. Latest available information is summarized in table 4.25.

Table 4.25. Man-made forests

Country	Year	Total area planted	Broad-leaved	Of which Eucalyptus	Coniferous	Of which pine
		1000 ha				
Rhodesia	1975	100	40	..	60	..
Botswana	..	0	..	..	..	..
Namibia	..	0	..	..	..	..
Swaziland	1973	96	28	22	68	D
Lesotho	..	0	..	..	..	..
South Africa	1974	1099	522	322	544	D

4.7.5 Conclusions

A large part of this region is wooded and the total amount of wood available is quite considerable. It is not probable that more than a very small part of this amount will be exploited for industrial wood. The need for industrial wood will be met by plantations or by import.

In considerable areas there is, even today, a need to create fuelwood plantations to satisfy the basic needs of the local population.

4.8 Islands

The African region has a considerable number of small islands which are independent states or colonies. These islands often have a serious lack of wood. On the whole, these islands make little difference to the wood balance in the whole of Africa or in subregions. Each island must be studied separately. Certain basic figures about the forests are summarized in table 4.26.

Table 4.26. Forest land

Country	Year	Closed natural forest	Degraded forests, scrub	Plantations
		1000 ha		
British Indian Ocean Terr.	..	..	..	..
Cap Verde Islands	..	..	..	2
Comoro Islands	1964	42	9	0
Mauritius	1970	2	25[1/]	7
Réunion	..	..	100	9
St. Helena, Ascension, Tristan da Cunha	1966	..	..	1
Sao Tomé and Principe	..	-	-	-
Seychelles	1970	..	4	1

1/ To the WFI 1970 an area of 7,100 ha was given as open woodland. In addition there were 48,000 ha of scrub and brushland.

5 DESCRIPTION OF THE PRESENT FORESTRY SITUATION IN AFRICA

5.1 General

The country notes from Part I have been summarized in the regional descriptions in chapter 4 and parts of chapter 3. This has been done in certain natural regions. Where basic information was missing in the country notes these regional descriptions have been completed with guesstimates. As the regions are not similar the type of information given varies.

In this chapter the regional descriptions in chapter 4 have been summarized into a description of the forestry situation in the whole of Africa. This chapter also briefly discusses some items which were not dealt with in the regional descriptions.

5.2 Forest resources

5.2.1 Forest and other wooded areas (natural)

Table 5.1. summarizes information about the wooded areas that remain today. The basic data for this table has been taken from country notes and regional descriptions. To make it complete pages of footnotes would have been necessary.

Most of the information given in this table has been discussed in chapter 4 but some further remarks are necessary.

In table 5.1. the present area of closed natural forest is given as 189 million ha. This is probably a maximum figure as overestimates of the forest area are more common than underestimates. Considering, for example, the accuracy classification, (summary-table S II) the forest area could be as low as 130-160 million ha. The figure 130 million ha is probably too low: it is unlikely that all areas of natural forest would be overestimated to that extent.

In some parts of this report - for example table 7.1 - closed forest has been given as 180 million ha. This is the figure I personally favour for closed forest. (Conservative estimate).

It is clear that considerable areas of the closed forest are covered by swamps, mangroves, bamboo or are situated in terrain with difficult access. Mangrove may cover 6 million ha while swamp forest may cover 20-30*million ha. Of the closed forest area perhaps 2-3 million ha is covered by coniferous forest.

In addition to closed forest given in table 5.1. there are other areas of forestry importance which are often called "forest". About 3 million ha in Botswana, Rhodesia and Zambia is covered by so-called dry deciduous forest which, in certain stands, still contains some valuable Baikiaea plurijuga (Rhodesian teak). In all 10 million ha in tropical Africa are covered by "forest" of intermediate types. These types are easily degraded by fire.

Around 7 million ha in North Africa is covered by typical Mediterranean vegetation types. A large part of this area has been degraded to maquis or scrub good only for fuelwood and perhaps poles. Certain parts however

Table 5.1. Forest and other wooded areas (natural)

Region	Closed forest	of which		Other "forest"[1/]	Degraded closed forest[8/]	Moist savanna	Dry savanna	Dry scrub[2/]
		Coniferous	Swamps[12/]					
	million ha							
North Africa	1.1[10/]	0.8	-	(4.0)	..	-	-	3
Northern Savanna R.	0.2	-	0.2	0.2	-	10	47	..
West Africa I	2.4[3/]	-	0.9	0.8	..	21	2	..
" " II	17.7	-	(0.9)[4/]	..	20	35	15	..
Central Africa	151.1	-	(7.2)[5/]	2.8	15	205	20	..
East Africa	16.0[7/]	1.4[6/]	2.1	0.7	4	185	25	37[9/]
Southern Africa	0.3	..	..	1.8	-	15	50	..
Total	189	(2)[6/]	(11)[11/]	10.0	40	470	160	(40)
% of land	6	..	..	0.3	1.4	16	5	..

1/ Dry deciduous forest, "open forest", "dry forest" and so on.
2/ The figures given here shows areas that are not forest or open woodland (mainly scrub and brushland) but considered to be of some forestry importance and often included in national statistics as forest and other wooded areas. Information about areas of this type in other regions is missing.
3/ Part of it probably "dry dense forest" (Guinea). 1 million ha certainly closed forest.
4/ Probably covers considerable areas.
5/ Includes 5 million ha of swamp in the Congo.
6/ Incomplete figure. In addition large areas with mixed forest.
7/ Of which at least 1.3 million ha with bamboo and thickets.
8/ Including bush fallow and so on.
9/ Dry woodland areas in Ethiopia and Somalia; scrub forest on Madagascar.
10/ In addition about 4 million ha with Mediterranean forest types (dry forest, maquis, and so on).
11/ Neither the information concerning mangrove nor concerning swamp forests is complete. There may be considerably more.
12/ Including mangrove, riparian

may still be capable of producing low-quality timber. The 1.1 million ha given as closed forest in North Africa is most likely an underestimate.

Open woodland areas in tropical Africa are of great importance. According to table 5.1. these areas should cover more than 600 million ha. Included here are woodland, savanna woodland, tree savanna, and tree and or shrub steppe. It is doubtful whether all these areas really are still covered by such wood. The open woodlands can produce fuelwood and poles and, in better areas, even a certain amount of timber. In addition, there are also large areas of very dry savannas or scrub. These areas are not always included in the table as dry scrub. The drought that has hit parts of Africa these last years may have seriously damaged these areas.

There are also, especially in West and Central Africa, large areas covered by degraded forest or bush fallow. These sometimes produce a considerable amount of valuable timber. This production will gradually be reduced to zero.

A comparison between regions clearly shows that Central Africa has most of the remaining closed forest. Western Africa, now the main exporter of tropical wood, has only quite small resources left. The other regions often have large areas of open woodland but small areas of closed forest.

Africa is often said to be rich in forest resources. This is false. Actually Africa's resources are modest and very unevenly distributed.

In table 5.2. certain relative figures concerning the importance of the actual forest resources are shown.

Table 5.2. The forest resources in relation to land area and population

Region	Percentage closed forest of land area	Percentage open woodland[1/] of land area	Closed natural forest per caput	Open woodland per caput
	per cent		ha	
North Africa	0.12	1	0.01	0.11
Northern Savanna R.	0	6	0.01	1.5
West Africa I	4	45	0.2	2.0
" " II	11	31	0.2	0.6
Central Africa	28	44	4.4	7.0
East Africa	2	24	0.1	2.3
Southern Africa	0	22	0.01	2.3
Total	6	21	0.5	1.8

1/ Open woodland, maquis, dry deciduous forest etc.

5.2.2 Man-made forests

As has been briefly discussed earlier, natural forest resources in many areas are inadequate to meet the demand for wood of the local people. This makes it necessary to study to what extent the natural resources have been complemented by plantations.

Table 5.3. which shows the total area of planted forests is relatively complete. Where no country information was available the complete breakdown in species groups included was based on crude estimates. It must be kept in mind too that estimates of the total area planted in a country have often a tendency of being overestimated and that the figures often vary from report to report.

Table 5.3. Man-made forests

Region	Total area of planted forests	Pines	Other coniferous	Total coniferous	Eucalyptus	Other broadleaved	Total broadleaved
	1000 ha						
North Africa	700	(220)	(50)	(270)	(340)	(90)	(430)
Northern Savanna R.	18	..	1	1	..	17	17
West Africa I	30	1	..	1	1	28	29
" " II	160	..	..	..	(2)	(158)	(160)
Central Africa	220	20	..	20	110	90	200
East Africa	800[1/]	260	115	375	315	110	425
Southern Africa[2/]	1,300	(670)	..	670	(405)	(185)	590
Total	3,200	1,170	170	1,340	1,170	680	1,850

1/ In addition reported to exist about 180,000 ha of private fuelwood plantations etc. about which information is scarce.
2/ 30,000 ha temporarily unplanted area not included in species breakdown.

According to present information, the area of man-made forests in Africa is about 3 million ha. Mostly, the information is from between 1970 and 1972. What are often called fast-growing species - Eucalyptus and pines - according to this breakdown cover about 1 million ha each. Other coniferous species include, for instance, Cupressus spp. Other broadleaved species include wattle, indigenous timber species, teak, Casuarina, Cassia and so on.

The main planted areas are found in North, East and Southern Africa. All these regions have only comparatively small natural resources of closed forest. The region with no closed forest at all - the Northern Savanna region - has very small plantations - nearly all in Senegal. A considerable area of plantations is also found in the forest-rich regions - West and Central Africa. The high figure for Central Africa is mainly due to Angola which has large-scale plantations.

It must be pointed out that many of the plantations in Africa are in small blocks here and there which makes them difficult to utilize for

industry. Information concerning the size of plantations is not available and information concerning the planned (or possible use) of the plantations is inadequate. Table 5.4. summarizes existing knowledge on the last point. This table is a personal judgement based on the scattered information available. In fact clear-cut boundaries do not exist. Protection plantations can produce fuelwood for example, and pulpwood is normally produced together with timber.

Table 5.4. Main purpose of plantations (or main yield)

Region	Pulpwood	Timber	Protection, windbreaks	Fuelwood, poles	Other main uses[1/]
	1000 ha				
North Africa	(40)	(220)	(300)	(150)	..
Northern Savanna R.	-	6	12	..	..
West Africa I	-	19	..	3	8
" " II	-	(150)	..	10	..
Central Africa	35	95	..	90	..
East Africa[2/]	(110)	330	20	460	30
Southern Africa	290	880[3/]	..	100	30
Total	475	1,700	330	810	70

1/ Fruits, bark etc.
2/ Includes 150,000 ha with private fuelwood plantations.
3/ Including 300,000 ha with mining timber (partly also used for tannin-wattle).

Pulpwood includes plantation areas thought to be utilized for the production of pulpwood and plantations which have been established with pulpwood production in mind. This includes existing production in Morocco, Angola, Kenya, Swaziland and South Africa. The most advanced plans to utilize part of existing plantations for pulpwood are found in Algeria, Congo, Madagascar and Malawi. The greatest share of existing plantations will probably be used for timber production.

Plans for plantations are normally too optimistic. This should be kept in mind when studying table 5.5. which gives a summary of existing information on present plans and recent achievements in the field of forest plantations. The information given is partially based on crude judgements.

According to Timber Trends and Prospects in Africa (FAO/UN 1967) 1,980,000 ha had been planted in 1961-1962. In the sixties therefore roughly 100,000 ha a year was planted.

The figures for total area planted often date some years back. According to table 5.5. the total area planted ought to have increased considerably. The figures for actual annual planting rate in table 5.5. often date from 1970-1972 whereas the planned planting rate often starts with 1971-1972.

A study of the year of information for the total area planted, plans for plantations and so on has provided the basis for the estimated planted area at the end of 1975. According to this estimate the present total area of planted forests could now be somewhere around 3.5 million ha.

Table 5.5. Plans for plantations

Region	Actual planting rate[4/]	Planned planting rate[4/]	Estimated planted area at end of 1975[3/]
	1000 ha		
North Africa	65	85	850
Northern Savanna R.	(2)	(2)	25
West Africa I	(2)	..	35
" " II	15	25	180
Central Africa	..	25[2/]	275
East Africa	35	35	830
Southern Africa	30[1/]	(30)	1,300
Total	(150)	(200)	3,500

1/ Annual increase
2/ Large planting project (100,000 ha) in Zaire not included
3/ According to table S IV and S V
4/ Annual

5.2.3 Wood resources

In chapter 4 the scattered information about standing timber has been used to estimate figures for total volume and commercial volume in all countries. Naturally this information has many limitations. To give a meaningful description of the wood resources a far more detailed breakdown of the volume is e.g. necessary. In table 5.6. a summary of the results for different regions is given.

Table 5.6. Standing timber

Region	Closed forest		Gross volume in other forest	Open woodlands		Gross volume outside forest land	Gross volume in all land
	Gross volume	Commercial volume		Gross volume	Commercial volume		
	million m^3						
North Africa	80[3/]	40	..	160[1/]	..	..	240
Northern Savanna R.	-	-	8[2/]	2,100	(20)	..	2,100
West Africa I	200	40	50	380	..	150	800
" " II	3,000	650	..	750	..	900	4,700
Central Africa	37,000	3,900	400	3,800	..	(300)	42,000
Zaire	22,000	2,200	60	1,300	..	(200)	24.000
East Africa	1,800	450	300	6,700	170	(400)	9,200
Southern Africa	200[3/]	(150)	70	1,450	..	..	1,600
Total	42,300	5,000	800	15,000	(300)	(2,000)	60,000

1/ Maquis
2/ Mangrove
3/ Gross volume for man-made forests included

This table indicates the importance of the forest resource in different parts of Africa. The enormous volume in Central Africa is striking. According to table 5.6. nearly 90 per cent of the volume in closed forest is found in this region. Of this volume about 60 per cent is in Zaire. The closed forest resources in West Africa are not impressive. Other regions have quite small volumes in closed forest.

Outside Central Africa there is perhaps twice as much wood in open woodland areas as in closed forests. The commercial volume in open woodlands on the other hand is certainly small.

With the present demand for tropical wood a volume of 3,000 million m^3 could probably be sold if it reached the market (the 5,000 million m^3 given as commercial volume in the table is the gross volume). It is likely that only 1,000-2,000 million m^3 of this volume will actually reach the market with present demand and exploitation techniques. The volume that actually could be utilized if all species with technically acceptable qualities (for sawnwood etc.) were used could be in the order of 15,000 million m^3 (100 m^3/ha according to optimistic inventory results). The volume that could be used for pulp, particle or fibreboard is not included in this figure.

The importance of the wood resource in different regions can be judged from table 5.7. which gives the wood volume per caput in different regions.

Table 5.7. Volume per caput

Region	Gross volume	
	Closed natural forest	All land
	m^3/caput	
North Africa	0.7 (1.1)[1/]	2.8
Northern Savanna R.	-	83
West Africa I	16	64
" " II	40	62
Central Africa	1,075	1,220
East Africa	16	77
Southern Africa	1.2 (5.5)[1/]	53
Total	113	174

1/Including volume in man-made forests

This table shows that only Central Africa has important resources of closed forest in relation to the population. The volume per caput on all land shows that Central Africa has still the most important resource. East Africa and, surprisingly enough, the Northern Savanna region show higher values than West Africa.

5.2.4 Accessibility

Naturally, exploited wood reaching the world market mainly comes from forest areas situated close to the coast. Until now more remote areas have supplied only small quantities. Little is known about the

order in which hitherto unexploited forests can be made available. The opening up of a railway for example can quickly make new areas accessible. If e.g. the capacity of the railway Brazzaville - Pointe Noire was increased the utilization of the forests in northern Congo, Central African Republic and, possibly, also certain areas in south-eastern Cameroon would be facilitated. From these areas the wood can be tranported on rivers to Brazzaville. (Below Brazzaville rapids prevent river transport.)

Except for certain parts of East Africa few regions are so mountainous that exploitation and transport is really difficult. Swamps are probably a greater obstacle to the utilization of many areas. Transport during the rainy season is difficult in many regions.

Naturally all areas can be made accessible in one way or another. It is mainly a question of cost. The forests in remote areas or in extremely difficult terrain are only rarely so valuable that large investments in infrastructure become profitable. The opening up of forests for exploitation is often a rather slow process. It is a step-by-step infiltration into hitherto inaccessible areas. The forest exploiters have a certain economic and technical capacity to open up new areas. Increasing prices of wood and increasing exploitable volume per ha will increase this capacity. Under certain conditions it can increase very rapidly. Exploitation in Indonesia for example has increased extremely rapidly these last years. This is mainly due to increased exploitation by foreign companies.

Here accessibility for the export to overseas market has been discussed. Naturally the internal market faces quite different conditions. The forests in Central African Republic for example are relatively well-situated in relation to the market in Chad but badly situated in relation to the European market. It is still possible that the forests in CAR will be opened up for overseas export earlier than areas of comparable access in e.g. Zaire. What is of importance here is the accessibility within countries (and naturally whether they export roundwood or not).

It is evident that a better knowledge about the economic accessibility in different countries in Africa is required. During this study a crude attempt has been made to identify the areas that can be incorporated in timber production without the need for major infrastructural work. (See summary-table S XII and table 7.1.) Different maps have been the basic tool in doing these estimates. A lot of simple roads must naturally be constructed. It has here been considered from the viewpoint of internal demand. Some areas in eastern Zaire are e.g. accessible from the viewpoint of local sawmills but would hardly be considered if we discussed the present export-potential.

It can be assumed that the Central African forests will become most costly to exploit due to the fact that they are often situated in sparsely populated regions with lack of infrastructure. The distance to the export harbours are also long. Table 7.1. indicates that less than 20* per cent or so of the unexploited forest is accessible at present.

The forests in East Africa are often situated in mountainous regions where logging can be difficult and costly (perhaps two-thirds). West Africa´s forests are easier to utilize. Even in this region however, parts of the remaining forests are situated in areas with hitherto bad access.

5.3 Forest policy

5.3.1 Ownership and tenureship

In Africa it is important to distinguish between ownership and tenureship in forest land. Tenureship shows in the first instance those who make the decision concerning forestry activities as opposed to ownership which shows the legal owner of the land.

The country notes contain rather limited information concerning the ownership of the forests. Summary-table S X gives existing information country-by-country. The information in the country notes has been completed with the questionnaire answers to the WFI 1970 and information in WFI 1963. Table 5.8. shows this information summarized for regions.

Table 5.8. Ownership

Region	Natural closed forest		Man-made forest	
	Public	Private	Public	Private
	1000 ha			
North Africa	1,100	..	640	70[1/]
Northern Savanna R.	220	..	17	..
West Africa I	2,400	40	26	4
" " II	17,700	..	160	..
Central Africa	151,000	..	110	110
East Africa	16,000	-	660	290[1/]
Southern Africa	250	..	360	940
Total	189,000	(40)	1,970	1,410

1/ Private fuelwood plantations included

The above table is incomplete and contain many guesstimates but some conclusions can still be drawn.

Practically all natural closed forests are publicly owned. Only minor areas are - for one reason or another - considered as privately owned. Individual ownership is rare in traditional Africa.

In Africa "publicly owned" often means that the forests are owned by communities or local chiefdoms. In this case they are still often managed by the Forest Service. It must be mentioned that certain areas are said to have no designated owner. There are probably even in these cases people who have right of usage.

Plantations are often privately owned. In most regions these private plantations are small village plantations for fuelwood and poles, fuelwood plantations in tobacco farms and so on. Important private industrial plantations only exist in Southern Africa.

The tenureship conditions are from many points of view of greater importance to know than the ownership conditions. Tenureship can be derived from ownership, lease contracts, cutting licences or traditional right of usage. (It can also be illegal.)

Complete information concerning the actual tenureship in forest land has not been possible to trace while preparing this report. It is known, however, that at present the exploitation of industrial wood in the natural forests is often undertaken by concessionaires or holders of short-time licences. In many of the forest-rich countries the Forest Services do almost no exploitation themselves.

Concessions and licences are given in closed forest, open woodland and even in agricultural land when this contains valuable timber trees. The area of closed forest under concessions in some regions is crudely shown in table 5.9. Nothing is known about the area exploited by the Forest Service directly, area of concessions in open woodlands, or the areas exploited under some form of short-time licence. Exploitation of fuelwood and other household wood is often done under traditional rights of usage.

Table 5.9. Concessions

Regions	Concessions in closed forest
	1000 ha
North Africa	..
Northern Savanna R.	..
West Africa I	..
" " II	11,250
Central Africa	15,000
East Africa	300
Southern Africa	..
Total	..

This table shows that concessions are very important in West and Central Africa at least. Exploitation of industrial wood is concentrated here too.

5.3.2 Forest reserves

So-called "forest reserves" have been established in many of the African countries (mainly in Anglophone countries). They have been established (often long ago) to ensure a long-term supply of wood or for protection. In WFI 1970 forest reserve (or permanent forest) is defined as follows:

"Forest effectively protected against destruction and in which provisions (such as obligatory regeneration often clear-cut) are established to ensure maintenance of the forestry vegetation. 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."

In some countries without demarcated forest reserves all forest are protected by law. Such a general protection often has a limited effect and the forests are sometimes not actually "protected" at all. In relatively recent times reserves have also been established in some countries.

Where shifting cultivation is general these recent "reservations" do not seem to have been especially effective. These reserves (or "forêt classé" in French speaking countries) have, however, been included in table 5.10. which tries to reflect the present situation. This table therefore shows the situation as being "better" than it actually is.

There are, naturally, forests in National parks, protection forests and so on which should not be exploited at all. Rather little information exists concerning these areas. Information about National parks in summary-table S XI comes from the "UN list of National parks". It is probably rather complete. Some preliminary figures for protection reserves are given in table 5.10. and S XI. Protection reserves are often included in the forest area (as forest reserves). Forests in National parks on the other hand are seldom included in the forest area unless they are administered by the Forest Service in which case they may be. Further details are given in summary-table SXI which give existing information country-by-country. To what extent forest reserves are excluded from production is, however, not fully known.

Table 5.10. is incomplete and partly based on old figures. The breakdown between closed forest and open woodland is not fully known. Man-made forests are probably not always included in the figures but these forests can normally be considered as 'reserved' in the correct meaning of the word. In some regions - for example North Africa - a large proportion of them could also be classified as protection reserves.

Table 5.10. Reserved areas of forest and other wooded areas (natural forests mainly)

Region	Reserved closed forest	Percentage of closed forest reserved	Reserved open woodland areas	Protection reserves	
				Closed forest	Open woodlands
	1000 ha	%	1000 ha		
North Africa	(367)	(33)	..	..	..
Northern Savanna R.	..	..	9,600	..	..
West Africa I	(750)	(31)	3,100	200	1,000
" " II	10,500	(59)	8,400	(2,040)	1,250
Central Africa	(5,200)	3	400	60	2,700
East Africa	(9,500)	60)	21,000	(2,000)	(5,000)
Southern Africa	..	..	900	..	..
Total	(26,000)	(14)	(44,000)	(5,000)	(10,000)

Table 5.10. indicates in a crude way the magnitude of the reservation work that has been done so far. Although the figures are on the high side only 14 per cent of the closed forest area is shown as reserved. The most important efforts have been made in West and East Africa. These figures decrease quickly if some subjective judgements are made as to the effectiveness of the reservation.

The value of the forest reservation can be discussed. In countries with a high land hunger it is evident that the area which by tradition is demarcated as forest is much better protected against agricultural

clearings than unreserved forests. At least in theory the reservation can also have negative effects. All forests not designated 'reserved' are often considered as waste land. The Forest Services normally have very little interest in their management or protection. Forest reserves set aside long ago on the other hand are defended by tradition even if the land could be better used for agriculture.

5.3.3 Management status

The forests in North Africa can be managed with the same silvicultural methods as those applied in other Mediterranean countries i.e. thinnings, clear-fellings, plantings. How intensively the natural forests are managed at present I do not know.

The forests in some countries in tropical Africa for example Ghana and Uganda are managed under rather intensive silvicultural systems[1/]. The working plans prepared for these forests aim at an increased yield of valuable species. It is not known at present if the goals set will be reached.

These countries report rather considerable areas of forest to be under management plans:

Country	Area, 1000 ha
Ghana	1,600
Kenya	1,050
Nigeria	1,900
Uganda	500
Sierra Leone	92

Most other countries either have no real planned management or planned management only of relatively small areas. (Note that the table above is not complete.) In these countries exploitation takes place with very few measures to ensure the regeneration of valuable species. It must be admitted here that methods suitable for the management of tropical forests seems very difficult finding.

Large scale plantations established for timber or pulp wood production are normally under some form of planned management.

1/ It has lately been reported that the management system in Ghana has been abandoned.

6 DISCUSSION OF CHANGES IN THE NATURAL WOODED AREAS AND ITS EFFECTS

6.1 General

It is a rather well known fact that in the tropical and subtropical zones, the forest area is decreasing, sometimes rapidly. Erosion is evidently a problem in many areas. In dry areas overgrazing is sometimes a serious problem. It is also said that many sources of permanent water known since long have dried out in recent time.

A very important question then, what is actually happening in Africa today? In which sense do environmental changes influence forestry and what can forestry do about them? Obviously there is a lack of information about present changes but it may still be possible to see in which direction the different trends lead.

6.2 The environmental benefits of forests

Forest is often considered as a rival for available space to agriculture and grazing. Food-production is naturally the most essential utilization of the land. In many densely populated areas forest may only be justified on poor soils and in watersheds, on steep slopes and so on. Forestry is therefore often the loosing side.

Foresters often maintain that trees have many positive effects in addition to supplying industrial wood, fuelwood and poles. Foresters may say, "they protect the soil from erosion and protect the water supply in the ground". Some points in favour of tree vegetation are mentioned below (partly from Dana 1956). These points are mainly relevant for African conditions.

a) Trees reduce the strength of the wind. Shelterbelts and windbreaks are planted of this reason. In dry areas cleared of trees wind erosion can become a serious problem.

b) The heavy rains of the tropics wash the topsoil away if the ground is not well covered with vegetation. This is most serious on slopes of mountains but also occurs on flat ground. Trees reduce the power of the rain and leaves and branches on the ground reduce the run-off water by keeping the soil open so that the water can infiltrate.

c) Water is infiltrated in forest soil, and is stored in the ground for long periods. Forested areas have a smaller annual run-off than non-forested areas. The annual run-off is more evenly spread out than in non-forested areas. Non-forested mountainous regions can produce floods in low-lying areas.

d) In tree-covered areas the maximum temperatures are lower and the minimum temperatures higher than in open areas. The air in the forest is somewhat moister than in non-forested areas. Forests normally improve both the chemical and physical characteristics of the soil. They tend to make light soils heavier and heavy soils lighter. Forest increases minimum temperatures and decreases maximum temperatures of the soil. Forests both reduce and increase the moisture in the soil. The net effect varies with the character of the soil, the climate and the forest. On land without vegetation the surface often becomes hard and inpenetrable.

The negative effect of changes in the tree-cover discussed above can show up when a forest area is cleared e.g. for agriculture. Tree crops and even shrubs have many of the positive effect of forest.

Agricultural development projects aim at increased agricultural production, increasing livestock, more concentrated dwellings and so on. Especially in dry areas these projects often increase the destruction of forests and trees, which as we have seen can have negative consequences for the grasscover, soil quality, water supply and so on. When discussing changes in the natural environment it is necessary to keep these points in mind.

At the same time it must be admitted here that the points mentioned in favour of trees are often but not always of advantage for society. For example it is not always an advantage that forests reduce the run-off. In certain dry areas all rainfall may be needed for irrigation. The popular statement that forest is of importance as a rain-maker is probably exaggerated. The effect is probably negligible except under special circumstances. (Verdcourt 1968.)

In parenthesis it might be mentioned that one can find examples where degradation of environment in one area can be beneficial in another. Water erosion in the Ethiopian highlands and wind erosion in North Africa were evidently of benefit to Egypt. Building the Assuan dam certainly changed this.

6.3 Main causes of change in the environment

Here the main present causes of change in the natural environment and the effects these changes have will be discussed in some detail. These changes are in the main to do with present land use. We will mainly deal with those aspects which concern the wood resources in different areas.

6.3.1 Moist areas

Agriculture (main source FAO/SIDA 1974)

The main reason for the decrease in forest area is agriculture mainly the so-called shifting cultivation. Briefly, shifting cultivation means the felling and burning of natural forest, secondary forest or open woodlands. The area cleared is cultivated for a few years (one to three years normally) after which the land is abandoned and returns to forest or bush fallow. After a period of time the process can be repeated.

Agronomists often distinguish between several different types of shifting cultivation. Shifting cultivation may mean the clearing of virgin forest or old secondary forest. This often implies moving of the population. Rotational types of shifting cultivation are perhaps more common. Here each farmer or family or group clears land in a more or less systematic pattern. The bush fallow period is not longer than the soil needs to recover. In this case the bush fallow is not forest but agricultural land.

Foresters often call both these types shifting cultivation although the first form concerns them most. In statistical surveys these types are often mixed which makes interpretation very difficult.

The practice of shifting cultivation in the tropics is normally explained as being necessary because of the low content of nutrients in many tropical soils. Most of the nutrients are in living plants and these nutrients are made available when an area is cleared and burned. The soils are quickly exhausted of nutrients if continuously cropped. Weeds are often cited as making the abandoning of fields necessary (e.g. Nye & Greenland 1960). Other reasons have also been given. In any case except under specific circumstances (vulcanic soils, certain alluvial soils etc.) yields do go down after a short period of cropping.

Shifting cultivation has always horrified foresters. From their point of view shifting cultivation means that valuable trees are cut without being properly made use of. Foresters have long argued that shifting cultivation must be abandoned and replaced by some permanent system.

But in fact a well-balanced shifting cultivation does not mean disastrous and irreparable destruction of the environment. If the rotation periods are long enough, shifting cultivation can maintain the fertility of the soil. (Nye & Greenland 1960.) Traditional forms of shifting cultivation may to some extent protect soils from erosion too since some trees are usually left. Lal (1974) says that soil erosion under shifting cultivation is not serious if forest clearing is done on gentle slopes and no extensive damage is done to forest litter by uncontrolled burning. A short cropping period must be followed by a long forest fallow.

In recent time and in many regions the bush fallow period has decreased due to heavy population pressure. A too intensive utilization can damage the soil for a long time. This is claimed to be the case in certain grassland areas in the rainforest region in Gabon where slavetraders are thought to have utilized the same area of land for too many years. (Gloriod 1971.) Under "normal" conditions trees should have reinvaded these areas. There must be some very specific reason why this has not happened (e.g. annual fires, invasion of Imperata cylindrica).

Shifting cultivation naturally takes up more land than the growing of crops under permanent agriculture. In due time it must be expected that some systems of permanent agriculture will be introduced, but it is probable that in many areas shifting cultivation will remain the predominant agricultural form for a long time. The increase of the rural population will certainly mean that the area under shifting cultivation will continue to grow. The possibility of profits in agriculture may lead to extension of cropping areas and cropping periods too.

At present agricultural production in Africa is increased largely by increasing the area under crops and not by increased productivity. Much of this increase in agricultural area comes from forest and open woodland. Much of the good soils, at least in dense populated regions, are already being utilized. The new areas opened up for agriculture have therefore often rather poor soils.

The population increase means that the often well-balanced types of shifting cultivation cannot continue in many areas. To be useful, shifting cultivation requires that the area of land in proportion to people is high. If this is not the case shorter fallows and longer cropping periods become necessary. A serious destruction of an area can start in this way which means that the system has outlived its usefulness and will have to be replaced gradually by other systems.

Agronomists argue though that no better agricultural system than a well-balanced form of shifting cultivation has been found for many areas of the tropics. Nye & Greenland (1960) say e.g.: ". . we have failed to introduce to the forest regions any method of staple food production superiour to the system of natural fallowing used in shifting cultivation."

In permanent agriculture the soil lies e.g. often bare for a longer period than in shifting cultivation (more erosion). All trees are also removed. On certain soils (mainly in savanna areas) cultivation for a long time can produce a lateritic crust on the surface. This is due to a continuous erosion of the thin layer of topsoil which sometimes rests upon a layer of laterit. The physical properties of the soil can also change if the soil lies bare for a long time. It should be mentioned here that fertilizers cannot always be used with success in tropical soils. Sometimes they do not become available to the plants. (Dasman et al. 1973.)

What has been discussed so far is mainly subsistence farming. There are however also schemes for large-scale plantations of perennial commercial crops like cocoa and coffee (often Government schemes). Such plantations of shrubs do not exhaust the soil in the same way as the annuals often used in subsistence farming. Large investments in soil management and so on are also possible.

Grazing is rare in the humid tropical area of Africa. This is due in the main to the occurrence of tsetse. According to ecologists (e.g. Dasman et al. 1973) permanent pasture in the humid tropics is nearly impossible as the grasses in cleared areas is of very low value for grazing after a while (weed species invade). The lack of cattle in the rainforest region is the main reason for the little use of manure in these areas.

Forestry

At least in the humid tropics of Africa, forestry should not mean any reduction of the forest area. This is due to the fact that only a few species have economic value at present (selective cutting). Even clear-felling of a forest - which happens rarely - should not be disastrous as a cleared area regenerates fast. All forest operations - especially intensive - increase however the erosion. Fire can also be a problem.

Forestry can mean an increased destruction of the forests if it opens up hitherto inaccessible areas. Where there is great land-hunger these areas are normally invaded by landless people.

With present exploitation the botanical composition of the forests change, at least in the short run. If left undisturbed they may in the long run change to forest resembling virgin forests. On the effect of selective cutting Synnott (1975) writes: "The continued removal of the most valuable individuals from a forest must change the specific and genetic constitution of the forest, and, with end-uses in mind, result in economic and genetic deterioration."

Some ecologists are seriously worried about the future of tropical forests (see e.g. Gómez-Pompa et al. 1972, Richards 1973). As many countries in the rainforest zone have a low population, these forests will hardly disappear altogether as is often said although large parts will, before

the turn of the century, be still more influenced by human activities (e.g. forestry). It is the virgin type of rainforest which is threatened. Even now so-called virgin forests are said to be very rare in tropical Africa (at least in West Africa). Most forests are probably secondary (Richards 1966). From the forestry point of view, mature secondary forest is often more valuable than virgin forest as it contains most of the valuable species.

Exploitation of the forests in mountainous regions can mean increased erosion at the time of exploitation. Mountains in the tropics are very fragile. There are certainly many other instances when it is necessary to be careful when considering exploitation of tropical forests. It may for ecological reasons be unwise to exploit certain areas. Land use studies must identify these areas.

Synnott (1975) has discussed the impact of forestry in tropical moist forest. His conclusions are quoted below:

"The operations regularly carried out in tropical high-forest change the environment and affect, to a large or small extent, many aspects of hydrology, soil processes, and the growth, regeneration and interaction of plants and animals.

In many regions almost nothing is known of the effects of interference except the approximate species-composition of the trees in the secondary regrowth.

It is most important to improve our knowledge of the quantitative changes, and the reasons for the changes, in species composition and growth rates after different forest operations, and of the magnitude and long-term importance of changes in soil processes...Until such information is obtained, and its importance appreciated, major mistakes will continue to be made both in forest management and in conversion of forests to other forms of land use."

The best way to make sure that an area - for example a watershed - is kept under forest is probably to utilize it for some type of long-term commercial forestry (?). It is otherwise often difficult to defend an unutilized forest area against agriculture. One must then naturally ascertain that forestry causes no serious damages to the environment.

6.3.2 Dry areas

The discussion here mainly concerns problems that can reduce these areas' capacity to produce the necessary timber, fuelwood and poles and, briefly, the environmental problems caused by destruction of the wooded vegetation. This can reduce the potential of an area for agriculture and grazing. The effects of overgrazing are discussed at some length.

Agriculture

Shifting cultivation (or fallowing) also occurs in savanna areas. Even here it can have a serious deteriorating effect if it is too intensive. The damages of over-utilization and misuse can, from many points of view, be more serious in a dry environment than in a moist. One reason for this is that vegetation in dry areas recovers more slowly than vegetation in moist areas. Agriculture often keeps the ground barren. Wind erosion is then often a serious problem. Water erosion can also be a

very serious problem. It is sometimes claimed that traditional agriculture in dry areas is not always well fitted to the environment (e.g. by Allan 1965).

Grazing

The dry savanna (and steppe) zones in Africa are very important pastures. Grazing also occurs in forest areas in North Africa which often makes forestry a difficult undertaking. Regeneration for example can be prevented.

Overgrazing of the "natural" pastures seems to be more or less a rule in all parts of the world. Dasman et al. (1973) write: "There are few sectors of the environment that have been more badly damaged by man's activities than the grazing lands of the world". To utilize the natural pastures in the best way the herds should only utilize a relatively small share of the available grasscover each year (Odum 1971). It is perhaps natural that this rarely happens among pastoralists.

Rapp in 1974 published a report ("A review of Desertization in Africa-Water, Vegetation and Man") which summarizes some effects of overgrazing in dry areas. Much of what is said here about grazing in general comes from this report and from discussions with experts who have worked with grazing in Africa.

Many dry grassland areas can be transformed into dense scrub if they are overgrazed. It is sometimes said that bush encroachment can increase soil erosion as the grasscover below the bushes is too sparse to hold the topsoil together. Overgrazing in an area can result in these gradual changes (according to Zumer-Linder 1972):

- Selective impoverishment of species
- Perennial grasses and herbs are grazed out
- Only unpalatable species are left, eventually bush encroachment
- Only bara ground is left.

As in other parts of Africa there is a fast population increase in the dry zones. Parts of the population migrate into marginal areas with their herds during favourable years. This has happened during the last decennia in the Sahel zone for example. Nowadays a drought becomes more serious than earlier when marginal areas had a smaller population. Future droughts may give still more serious effects than the recent drought period.

Overgrazing is one of the main reasons why deserts are spreading. Edible species are replaced by annuals or edible perennials. The range is usually destroyed for kilometers around the villages and wells. Artificial wells make the situation worse. Marginal areas may not recover if subjected to continued attempts at intense use in dry years. The natural vegetation in the marginal areas is very sensitive to any kind of disturbance. When the rain comes it causes a rapid erosion of unprotected soils.

Traditional nomadic grazing was based on mobile grazing patterns utilizing complementary ecological zones during the different seasons of the year. Pressure for land has forced the herdsmen gradually to adopt a more permanent and concentrated use of pastures. Due to increase in

agricultural area the areas that can be used for pastures have also decreased. The marginal areas with a dry season of 9 months or more during an exceptionally dry year are not able to support livestock with fodder the year round. Consequently trees and woody vegetation are used for browsing. This saves millions of livestock each year. Trees are also important under normal conditions. They affect microclimate and provide shade for livestock and people (Zumer-Linder 1975 b).

Burning of vegetation

Traditionally savannas are burnt each year. Deschler (1974) has studied satellite pictures and found that 40 to 60 per cent of all land in the zone 5-12° N latitude from Nigeria to the Red Sea were burnt during the dry season 1972/73. In moist savannas the fires are commonly said to improve the grazing by promoting the growth of the new grass and preventing bush encroachment. Fires at "wrong" times of the dry season or frequent fires are said to be harmful. However, there seems to be some disagreement about the right and wrong time. Burning late in the dry season seems however to favour grasses at the expense of trees (Dasman et al. 1973).

Fires are not so common in very dry areas. There are also said to be many negative effects of fires in these areas. The vegetation recovers much more slowly and this can for example lead to increased erosion.

Wood cutting

Cutting of trees and bushes for fuelwood occurs in all dry areas. In savanna areas with a low population this has, naturally, no negative effect as long as natural regeneration is possible.

In many areas the present population is so large that the existing wood-resources are over-exploited. In many areas natural regeneration is also prevented due to fires, heavy grazing and so on. In semi-arid zones bushes are sometimes uprooted.

The over-exploitation and misuse of bushes in many areas leads to a complete disappearance of the wooded vegetation. A man-made desert can then easily develop.

This point will be further discussed in chapter 8.

6.4 Regionwise description of present changes in the natural environment

Here we shall describe region-by-region the changes in the natural vegetation that occur today and the different environmental problems that these changes cause. The summaries are compiled from a large number of articles and reports (mainly UN 1972 a) and from interviews with people with local experience.

6.4.1 North Africa

The southern part of this region is occupied by the wide Sahara desert while the northernmost part of the region is occupied mainly by a steppe-like vegetation. Part of this northern region was once called the wheat treasury of Rome.

According to the Bioclimatic map of the Mediterranean zone (UNESCO/FAO 1963) an area of 30-35 million ha should have a climate where tree vegetation is possible. Today an area of 8-9 million ha may be occupied by irregular tree vegetation. Most of this is degraded to maquis vegetation. The forest remnants are found mainly in the mountainous areas.

Forests and other vegetation in the mountains help to prevent serious erosion. Some areas are now said to be completely depleted of vegetation cover. In such cases there is a serious erosion of fertile soils. Water regulation is affected and irrigation channels and roads are damaged. The erosion is reported to be especially serious in the Rif and in Kabylien. For Algeria a yearly loss of soil corresponding to 40,000 - 50,000 ha has been mentioned e.g. by UN (1972 a).

In many places forests are exploited through common rights. Regeneration of the forests is poor due to heavy grazing. It has been estimated that 50,000 ha of forests and shrublands are damaged by fires each year in the non-arid zones of North-Africa (quoted in Rapp 1974). The wooded vegetation cannot by far provide sufficient fuelwoods. Dung and vegetable waste are often used instead.

Rapp (1974) has discussed some studies of the "arid zones" of the Magrebh countries and Libya (45 million ha). (Note. Arid as used by Rapp seems to correspond closely with semi-arid in this report.) In this area 12 million people and 30 million heads of domestic animals should live. This is said to be 2.5 times the population the region can support.

Degradation of the vegetation occurs. In the driest parts (100-200 mm/year) the degradation is said to be more or less irreversible. Perennial natural species cannot re-establish themselves once they have been removed. It is said that vegetation could recover earlier but that this is impossible nowadays due to the influence of man and animals. The Sahara desert is therefore advancing northwards. Le Houérou has estimated that for the whole of North Africa over 100,000 ha per year becomes desert.

Fries (1970) gives an example from Egypt where an area long considered desert actually recovered when it had been completely protected for a time.

The size of the different problems discussed here is not known in any detail. No information has been found of the area with serious erosion, changes in wooded areas, the area needing protection plantations and so on.

It is evident that many measures are necessary to prevent further damages. Reforestation, contouring, protection of water, shelterbelts, better cultivation techniques and control of the grazing are some of the measures that will be necessary. Much is being done at present to improve the situation.

6.4.2 Northern Savanna Region

Hance (1970) writes that parts of Senegal suffer from soil exhaustion, which has led to a shift in the peanut production zone. Upper Volta (mainly the central part) has poor and fragile soils which have been

badly eroded and cannot support its population. The north of the country has too many animals like most of the tsetse-free grazing lands in West Africa.

This is the region where the advance of the Sahara desert seems to be most serious. The main reasons for this should be (Grove 1973):

a) Burning of vegetation
b) Overgrazing
c) Wood cutting
d) Cultivation of marginal lands.

The advance of the desert in this region has been discussed for a long time but has become better known during the last years due to the heavy drought that has hit this region. It has been concluded clearly (e.g. Rapp 1974) that the advance of the desert does not take place in the form of a moving desert limit as once claimed but in the creation of scattered areas with desert conditions in the whole semi-arid zone. These deserts are man-made and they are gradually encroaching into the non-deserts. Quite naturally they are more widespread the drier the climate and the higher the population density.

Rapp (1974) discusses this desertization and concludes that the drought during the last years does not depend on a long-term change in climate but is a rather normal drought period which occurs now and then. Due to the heavy population increase during the last years this drought may have caused more damages than earlier droughts.

Burning, looping of branches, overgrazing and overcultivation have caused increased erosion by wind and water in the Sahelian zone between 1968 and 1973. During this period the pressure on the trees increased from year to year. Trees were not only browsed on the spot but the branches were pruned and transported over long distances (Zumer-Linder 1975 b).

The goat has learnt to climb the trees and has specialized on the last remnants. Five to six years after a Sahelian drought the pastures are recovering due to better rainfall and decreased livestock numbers. The trees on the other hand are dying due to mistreatment, changed environmental conditions due to heavy trampling, reduced water holding capacity and fertility. Degradation of wooded areas due to burning and charcoal burning occurs also (Zumer-Linder 1975 b).

The increased desertization does not only depend on increased population. Plantations of industrial crops have also accelerated which have led to increased deforestation. More farming decreases the areas under pastures which in their turn increases the overgrazing.

Shifting cultivation (or fallowing) and extensive burning occurs frequently in the moister savanna zones. Frequent burning can lead to soil depletion and erosion. Denuded ground suffers increased maximum temperatures. This can disturb or stop biological activity and contribute to soil degradation.

Shifting cultivation also occurs in the Sahel zone. The fallow period is often said to be too short for the scrub cover to be built up again.

6.4.3 West Africa

The savannas in many areas have the problems with fires, soil degradation and short fallows which has already been described in 6.4.2.

The main problem to be discussed here is the decrease of the rainforest. Originally West Africa had perhaps 70 million ha with dense tropical forest (after Anon. 1959). At present an area of 20 million ha may remain. It is shifting cultivation which has caused this change. Of the 50 million ha of closed forest cleared, large areas are now covered with bush and grasslands.

As shifting cultivation is spreading into the dense forest at a fast rate it must be expected that, in some years time, only the areas reserved in one way or another will remain. As some countries do not have any clearly defined forest reserves, estimates of the future forest area are difficult but it would be surprising if in 20 years time there remained more than 10 million ha of natural forests.

The main effects of shifting cultivation have already been discussed. Soil depletion and erosion is e.g. said to be widespread in West Africa due to shifting cultivation, shortening of fallow periods, leaching of soils and so on.

Hance (1970) discusses the areas with main population pressure and mentions that in Sierra Leone the soils are deteriorating due to short fallows. In some of the densely populated parts of northern Ghana there are signs of soil exhaustion and topsoil erosion. The same seems to the case in parts of northern and southern Togo and Dahomey. In some of the densely populated parts of Nigeria (e.g. in Eastern States and Tivland in the Middlebelt) soil erosion, soil deterioration and degradation is also reported to occur. In the densely populated parts of Yorubaland and around Kano signs of over-utilization of the resources are not as evident as in the other densely populated parts. For Guinea Harrison Church (1969) mentions an estimate that 60 per cent of the country ought not be cultivated but could be used for pasture and that only 10 per cent can be cultivated without proper anti-erosion methods.

6.4.4 Central Africa

In the less populated countries the clearing of the forests does not seem to be as large a problem as in West Africa. In western Cameroon however shifting cultivation is reported to be extensive. Little is known about what is happening in Zaire in this respect but UN (1972 a) states that forests in accessible areas are being extensively cleared. Destruction of vegetation in suburban areas has also been extensive due to charcoal burning and agriculture.

Exploitation of the forests is increasing rapidly and this will naturally effect the composition of the forests. The valuable species are becoming more rare in accessible areas. The savanna areas are frequently burnt. This sometimes leads to erosion and soil depletion.

For this region Hance (1970) mentions that the Bamiléké country in the highlands of south-western Cameroon is "overgrazed, overcropped and subject to serious erosion". Other critical regions would be the Mandara Mountains in northern Cameroon and some of the densely populated parts of the highlands in eastern Zaire. In the last region erosion has long been reported to be a problem.

6.4.5 Eastern Africa

The semi-arid regions in Sudan, Ethiopia, Somalia, Kenya and Tanzania suffer from the same problems as earlier described for the Sahel zone. Deserts spread because trees are cut down, there is overgrazing and fires occur. Erosion is caused by water and wind - especially in overgrazed areas. Sedimentation is a problem in some rivers. Boreholes for cattle have lead to overstocking in many areas. In large areas of East Africa overgrazing may be as serious a problem as in Sahel. In large areas the grazing areas are now deteriorating. It can be mentioned here that it has been estimated that the cattle stock (in Kenya, Tanzania and Uganda) increased 6 times from 1900 to 1964 (Morgan 1969).

In many areas open woodlands are decreasing due to fires, increasing agriculture and so on. In Malawi for example a dense population strongly influences the environment. In many low-populated regions on the other hand present damage is relatively small. Large parts of the Miombo for example seems to be rather little influenced by destructive human influences.

The closed forests have mainly been situated in the mountains. The mountains are often densely populated. The forests have been reduced in area. In Ethiopia for example it is said that 45 million ha originally should have been covered by closed forests (SFODA 1974).Today perhaps 4 million ha remains.

In the forests in many parts of East Africa there is still a lot of uncontrolled burning, grazing of forests and production of charcoal. In several areas destruction of the forests has been the main reason for erosion, depletion of topsoils, run-off problems, loss of fertility and so on. In some areas the silting up of rivers causes inundation and a resulting decrease in agricultural production. Some of the highland areas are very intensively cultivated and here the problems are connected with over-utilization.

In many areas there are limited areas with fertile soils and adequate humidity. In some of these areas decline of fertility and yields is accelerated due to reduction of fallow periods.

Rwanda and Burundi are the most densely populated countries in Africa. The cattle population is also very high. It is estimated to have increased 10 times during Belgian´s administration (Grove 1970). Erosior is very serious in this mountainous country. The forests have nearly disappeared.

Certain areas around Lake Victoria and in Uganda (e.g. Kigezi) are also very densely populated and are reported to show signs of land degradation.

Madagascar is a very particular part of east Africa. The environmental problems seem to be serious. It is said that nine-tenth of the natural vegetation has disappeared as a result of fires, overgrazing, shifting cultivation and so on. After cultivation the degraded soils are colonized by stunted primitive vegetation types or are exposed to erosion. A large part of the rainforests in the eastern highlands have been transformed into this type of vegetation. The dry forests that originally should have covered the central high plateau have, to a large extent, been

transformed into grasslands. The dry deciduous forest on the west coast is very susceptible to fire and is now quickly changing into grass savanna.

6.4.6 Southern Africa

Southern Africa has some forest remnants in certain mountains but in the main these have disappeared. Southern Africa has large areas where grazing and dry farming is common. Overgrazing, grassfires and cultivation on hilly slopes are said to occur and the result is soil erosion. Some areas are said to be in danger of becoming permanently denuded of grasscover. Good grazing and trees disappear around boreholes and villages in many areas. The erosion in some highland areas is said to be tremendous (e.g. Lesotho and Swaziland). The so-called Bantu-reserves in South Africa (and some similar areas in Rhodesia) are also reported to be overgrazed and damaged by erosion (Hance 1970). Botswana, which has a low population density, is still reported to be overgrazed with the accompanying problems.

In open woodland areas regeneration is said to occur during particularly good years. Trees of the same age should be found over large areas and they seem to die off in groups after droughts. In deteriorated areas the chances of regeneration are reduced (Zumer-Linder 1972).

6.5 Decrease of wooded areas

The natural forests in the moist tropical areas are decreasing in area. The rate of decrease depends mainly on the population density (or population increase). The denser the population the less "forest" there is left. Dr K. D. Singh from the Preinvestment Survey of Forest Resources in India has studied this and found a clear relationship between the percentage forest cover and the population density in districts (Singh 1976). It is however true, that land use in densely populated areas is relatively more intense per area unit than in low-populated areas. The forest area decreases proportionally faster the more forest is left.

Several authors have said that the original area of closed forest south of the Sahara has shrunk by at least 100 million ha (FAO 1967 c). The Vegetation Map of Africa shows 280 million ha in the closed forest zone and 130 million ha in the forest-savanna mosaic zone at present. Originally this may have been the area of closed forest (with reduction for lakes, swamps, mountains etc.). These figures indicate that the closed forest may have decreased by at least 200 million ha.

Studies of the actual decrease of the forest area are rare. In the Timber Trends Study for Asia 1961 (FAO/UN 1961) a crude evaluation of the decrease of forest area was made. The forest area cleared annually was then estimated as 8.5 million ha (nearly 2 per cent of forest area). Twenty per cent of forest area was "under shifting cultivation". A recent Timber Trends Study for Asia (FAO 1976 a) has estimated an annual decrease of "operable forest" area of 3 million ha (2 per cent) in the developing Asian market economies. For Latin America the area cleared annually for agriculture has been estimated (FAO 1967 c) to 5-10 million ha. In the draft to the resource chapter of the new Timber Trends Study for Latin America (FAO/RLAT 1976) the annual decrease of the closed forest area during the period 1958-1973 has been estimated to be 6.5 million ha (0.8-0.9 per cent per year).

The country notes in Part I of this report do not give many details of the decrease of the forests in Africa. A few points are summarized below.

Cameroon:	4.5 million ha are under bush fallow.
Equatorial Guinea:	Secondary forest or bush cover 1.1 million ha.
Ethiopia:	200,000 ha of wooded area (closed forest) cleared annually. Same figure given by Vernede 1955.
Ghana:	50,000 ha of closed forest cleared annually (?)
Ivory Coast:	The years 1956-1966 the forest area decreased by 2.8 million ha. At the end (1966) the annual decrease was 0.5 million ha per year. (See comments to this on page 109.)
Madagascar:	3.6 million ha should be under bush fallow. The decrease of closed forest area may be 0.1-0.2 million ha/year.
Senegal:	According to one source the volume destroyed annually should be 4 million m^3 (?). The "forest" area under shifting cultivation should be 2,422,000 ha.
Sudan:	The annual decrease of the wooded areas should be 1.5 million ha.

This information obviously does not allow of any accurate estimate of the decrease of the wood resources. It is however rather certain that all countries in tropical Africa have a decreasing closed forest area. The intensive planting activities in North Africa means that there may be no net decrease of the total area of closed valuable forest in the countries of this region. In many areas in this region there is however a continuous thinning out and clearing of the existing natural vegetation.

The studies that have been undertaken have normally been carried out in the countries where the forest clearing is most alarming. In the countries mentioned above for example, the decrease is 2-5 per cent per year. Information from, say, the Ivory Coast cannot therefore be transformed to areas where there are other conditions. There is certainly no drastic change in most parts of Gabon, CAR, northern Congo and south-eastern Cameroon. In Sierra Leone, Liberia, Ghana and Nigeria a large part of the remaining closed forests are reserved and most of the decrease occurs in areas outside the forest reserves which are now of relatively limited area.

Utilizing the information mentioned above and other information like population density, present land use and so on the decrease in forest area has been estimated for all countries. According to these estimates at least 2 million ha of closed forest are cleared annually in Africa. The actual figure may be higher. It is for instance lower than the figure given for Asia. But the Asian figure may include bush fallow. In Africa 2-4 million ha of bush fallow in the rainforest zone may be cleared each year (40 million ha with a rotation period of 10-20 years).

Estimates of the decrease in forest area may also be worked out using information about population increase. The present population increase (2.6 -2.9 per cent) could indicate an increase in the total cultivated area (outside Northern och Southern Africa) of 4-5 mill. ha (of which perhaps less than half would be in the rainforest zone). If we also assume that each new person (in all around 8 million) need 0.5 ha of cultivated land (Allan 1965 says that 0.25 ha is needed in rainforest) the increase would be 4 million ha.

A crude estimate of the area of cultivated land in the rainforest zone would be 40 million ha. A 2 million ha decrease in the forest area then would indicate a 5 per cent increase in the agricultural area. Obviously decreases occur for other reasons than agriculture (e.g. roads, dams).

These crude examples indicate that the annual decrease in the forest area may well be about 2 million ha. A much higher figure is not likely according to these examples but in reality it can well be.

What has happened in Ivory Coast (Lanly 1969) contradicts some of these assumptions. In Ivory Coast the population density is not especially high and the population increase was below 100,000 per year in the sixties. This would indicate an annually cleared area of over 3 ha per person (Allan 1965 says that a "good" man could clear 0.5 ha of rainforest a year). There may however, have been some migration into the forest zone and what is more important the decrease of 2.8 million ha in 10 years refers to forest with an area of more than 10 ha. What happened in large areas of the Ivory Coast was a fragmentation of the forests into small blocks of 5-10 ha. The area actually cleared (of forest blocks larger than 10 ha) was therefore, not 2.8 million ha. Most of these small blocks remaining are likely to disappear in time. Degraded forests had almost the same volume per ha for some enumerated species as other forests. This volume is, however, difficult to utilize.

The area of "commercial forest" in Ivory Coast is therefore decreasing faster than the wooded cover. It is the valuable forests which has decreased by 2.8 million ha. The commercial forest area influenced by shifting cultivation is to a large extent transformed into secondary vegetation and small scattered remnants of closed forest.

It is not possible to estimate how much of the open woodland areas is cleared annually. In this context it would first of all be necessary to consider the decrease in different types of open woodlands (e.g. savanna woodland, tree savanna, bush savanna). It would also be necessary to describe the continuous lowering of the density and the degradation (which is likely) in some open woodland areas. From the discussion about increase in population one could dare to guess that the cultivated area in the savanna areas is increasing by 2-4 million ha a year (not all of this necessarily in open woodlands).

Somewhat contradictory to the above discussions is the repeated statements (e.g. Schantz & Turner 1958) that the woody vegetation is increasing - at least in East Africa. This is said to be mainly caused by increased grazing by animals. Bush encroachment of cource increases the fuelwood supply but makes the areas unsuitable for grazing. The population therefore leaves the area.

It must be said here that today´s trends do not necessarily continue

into the future. Physical conditions (e.g. difficult access), new policies or whatever can change the trends which have been shown so far either for better of for worse. A fast destruction of the forests can start even with a relatively low population density (as in Ivory Coast for example) when there are plenty of forests to clear. It is not unlikely that a fast destruction of forests can start in the now well-forested parts of Central Africa.

6.6 Concluding remarks

To a large extent this chapter has dealt with changes of the natural environment and of land use. These changes are of major concern for forestry. As has been evident from the descriptions the changes do not only give a reduction of the productive area of forests but also produce many environmental problems which in turn cause problems for other sectors of the society.

Environmental problems in industrial countries are mainly connected with urbanization and industrialization (e.g. pollution). In developing countries the environmental problems (at least the ones which concern forestry) are very much connected with changes in land use and over-utilization of existing resources (e.g. the soil, grasses, wooded cover). This is because agriculture is the basic business. Over-utilization of the resources is caused by an increased population and - sometimes - "modern" methods (e.g. some of the commercial crops introduced). The combination of the changes in traditional agricultural systems and illsuited new techniques can produce many negative effects.

A piece of land has different carrying capacity for an agricultural population depending on the agricultural systems used. Allan (1965) has studied the carrying capacity in different environments under traditional forms of agriculture. For any given area he calculated the percentage of cultivatable land, the relation between cultivated area and fallow and the area planted per capita per year. Here are some examples of critical carrying capacities for different parts of Africa (from Allan 1965):

1) Citemene system (ashfields on poor soils in open woodland areas in Zambia): 2-3 persons/km^2

2) Banana culture on Kilimanjaro (Tanzania): 150 persons/km^2

3) Best parts of Mount Elgon (Uganda): Perhaps 300-400 persons/km^2

4) Kikuyu land (Kenya): Perhaps 100 persons/km^2

5) Gogoland in semi-arid central part of Tanzania: 7 persons/km^2

6) Rainforest area in Zaire: 20 persons/km^2

7) Rainforest area in Ghana: 30-50 persons/km^2 could sometimes be possible

8) Example of good system (Dagomba) in Ghana's Guinea zone: 20-25 persons/km^2

9) Nomades (ex Masai): Around 1 person/km^2 (5-20 livestock units per person needed)

10) Grazing (ex from Rhodesia and South Africa): 2.5 ha per animal in best areas to 10 ha per animal in dry areas.

These carrying capacities (which sounds high compared to some other estimates) can be raised if some sort of investment is made but they can also be reduced quickly if the resources are over-utilized which happens when the population per area is more than the carrying capacity. Allan mentions examples of a complete breakdown of the traditional systems when the critical carrying capacity has been passed.

Outside the grazing areas many of the traditional systems have surprisingly high carrying capacities (according to Allan). Even if only the traditional systems were used it is not unlikely that the total population of Africa could be considerably higher than now if the population was evenly distributed (but below critical carrying capacities).In 3.3.1 we discussed the uneven population distribution. Hance (1970) says that 31 per cent of population lives in 1 per cent of the area and 80 per cent in 20 per cent of the area. The absolute size of the population density is however of limited importance. What is of basic importance is the population density in relation to existing natural resources and the utilization of these resources.

Hance (1970) describes the signs of high population pressure in an area. The ones mentioned here are of main interest in rural areas:

1) Soil deterioration, degradation, or outright destruction

2) Use of excessively steep slopes and other marginal lands

3) Declining crop yields

4) Changing crop emphasis (more soil-tolerant species)

5) Reduction of the fallow period and lengthening of the cropping period

6) Breakdown of the indigenous farming system

7) Land fragmentation

8) Unemployment and underemployment

9) Certain types of out-migration

A number of these signs have been noted in the regional descriptions.

Hance has also prepared a map which should show the areas that are now under population pressure. It includes North Africa; the Northern Savanna Zone; certain scattered parts in West Africa (mainly in Ghana and Nigeria); the dry north-eastern part of East Africa as well as some mountainous areas (e.g. Rwanda and Burundi); Botswana and some other scattered areas in Southern Africa. It can be seen that a large part of the dry areas, which have a very low carrying capacity are under pressure.The whole of Central Africa (which means the main part of the

rainforest zone) is considered as being under no pressure. From the map it was estimated that 47 per cent of the area and 50 per cent of the population was experiencing population pressure.

It can be concluded that the traditional forms of agriculture and shifting cultivation in the African society were often well adopted to the environment. Often grazing seems to have caused a deteriorating of the natural environment even in the traditional society. Increase in population and the introduction of methods more suitable to temperate regions have often started a serious deterioration of the natural environment, a breakdown of the traditional systems and resulting decrease in the potential.

The repeated message of this chapter is that man often causes a degradation of the natural environment. Of course I do not mean that the environment (or trees) is more important than man but only that a degradation of natural environment due to over-utilization often means a decrease in the potential. This is the reason why this chapter has been written.

It is certain that changes are necessary and will occur. That forest areas are decreasing is not necessarily a disaster. It must be admitted however that man-made systems are often unstable. Changes which may seem development or improvements in the short-term, introduced without adequate knowledge of ecology can actually cause serious negative effects.

In a discussion of how to relieve population pressure Hance (1970) mentions:

1) The extension of the agricultural areas
2) Intensification of agriculture
3) Development of non-agricultural sectors.

The first one of these possibilities is already utilized to a high extent. Available land however is often rare where the need is greatest. Wooded areas will largely disappear in areas with a high population pressure until intensification of agriculture leads to a reduction of the pressure.

With regard to point 3 it is evident that forestry can play an important role in creating a non-agricultural sector. At first this may not relieve pressure to any great extent as food will mostly have to be produced locally. In the long run the introduction of a non-agricultural sector and a strengthening of the monetary economy will facilitate an intensification of agriculture.

Foresters (and forestry) cannot oppose all change. They must however be aware of the negative effects of many changes and the often beneficial effects of trees. In many areas foresters could fulfill their task best by supporting agricultural development. A proper land use planning seems to be necessary if the present negative trends are to be changed.

This chapter has in the main catalogued the environmental problems forestry has to consider. This list of problems may seem very depressing. But as a matter of fact we rarely know in detail the extent of all these problems. How large an area for example really suffers serious erosion, how much land is overgrazed or over-utilized in some other way?

Even if these problems only occur locally they are serious enough and action ought to be taken to control them. Existing knowledge indicates too that the resources are increasingly over-utilized.

Even if the environmental problems discussed here often are connected with a high population pressure the problems cannot be solved - in the first hand - by trying to reduce the increase in population. Instead a better land use is required as a first step. Many of the environmental problems discussed here can be solved if the production per area unit of agricultural land is increased. In this way the necessary protection measures can be concentrated better and areas unsuitable for agricultural production (e.g. steep slopes) need not be utilized.

7 POTENTIALS FOR FORESTRY

7.1 General

Basic to a discussion of the prospects for forestry in a region or country is knowledge of the potential yield. In Sweden for example detailed investigations are made about future forest yield assuming different management and investment strategies. Adequate knowledge about the management of tropical forests is however not available at present so detailed studies of this kind cannot in the same way be made for countries with large resources of natural tropical forests.

In this chapter existing knowledge and theories about potential yield in African forests (mainly tropical forests) will be briefly discussed. We shall also discuss areas that will be available for future production.

7.2 Forest areas for future production

Table 7.1 indicates the area that is unexploited at present; the area of which is potentially exploitable and accessible; the area exploited at present; and changes in the forest area up to the year 2000. Some crude country figures about the present exploitation pattern are shown in summary-table SXII. These figures are only rarely based on any national estimates. They are mainly based on my own judgements after studying exploitation during the last decade, population density, mean yield per ha, road net and so on.

In this table the area of closed forest is lower than the one given in table 5.1. This is because table 5.1, which is based on the country notes, contains information which is some years old. In some cases it probably overestimates the area of remaining forest too. Here I have given the closed forest area I personally believe remain at present in different countries. It is a conservative estimate. It should be said that there probably are some closed forest resources in addition to this e.g. part of the so-called "degraded forests" in Ivory Coast.

To estimate the extent to which natural forest will supply wood in the future it is important to know the areas that have been cut over and the areas that are exploited each year. A future exploitation in these often selectively cut areas will, at least within the next 20-30 years, produce smaller quantities of commercial wood than will exploitation of virgin or mature secondary forests.

As can be seen in table 7.1 an area of about 140* million ha may be relatively unexploited. Of this area it has been estimated that around 110* million ha are of interest for exploitation in coming years. Areas deducted include inundated areas, swamps, areas with an extremely difficult terrain, forests with poor sawlog content, protection forest, bamboo, etc. It must be said that the figures given are crude guesstimates. The area exploited each year in the closed forest has been estimated to be in the order of 1* million ha.

The areas classified as accessible indicate crudely the areas that can be incorporated in timber production without the need for major infrastructural work. Naturally simple access roads must be built. It has here been considered from the viewpoint of internal demand.

Table 7.1. Present status and changes of the forest resources

Region	Present status of the forest resources						Natural closed forest the year 2000
	Total closed forest	Unexploited	of which: Accessible	of which: Potentially exploitable	Exploited	Annually exploited area	
	million ha						
North Africa	1	..	(1)	1	1	..	1
Northern Savanna R.	0.2	..	(0.2)	(0.2)	..	..	..
West Africa I	1.9	(1-1.4)	0.6-1	0.6-1.1	0.5-0.9	(0.02)	1.4
" " II	15	6-9	4-6	4-6	6-9	(0.3)[1/]	8
Central Africa	148	120-130	20-25	(100)	18-28[4/]	(0.6)[2/]	126
Zaire	90	(85)	10-20	(70)	(5)	(0.1)	80
East Africa	15	7-9	2-4	3-6	6-8	(0.1)[3/]	10
Southern Africa	0.2	..	0.2	..	..	..	0.2
Total	180	140	30	110	40	1	145

1/ Part of the production comes from areas not classified as forest
2/ Yield per ha is lower than in West Africa. Most production comes from areas classified as forest.
3/ Most of the production comes from open woodland.
4/ The suspiciously high figure for Cameroon has been accepted.

We have tried to estimate how large the remaining forest area will be in the year 2000. This is the background for the regional figures about the forest area in the year 2000. A basic assumption has been that the present clearing of the forests in West and East Africa will and cannot continue at the present rate. We have assumed that most of the forest reserves will remain in the year 2000. In the case of Central Africa it is thought that the clearing rate will increase in coming years, especially in Cameroon and Zaire which, in some areas, already have a large population. It has been estimated that, of the total closed forest area, at least 35 million ha will be cleared, mostly for subsistence agriculture, during the coming 25 years period. Large schemes for commercial crops, dams etc. can increase this figure.

Table 7.1. shows that Central Africa has by far the most important forest resources while West Africa now has actually relatively limited forest resources at least in relation to the present exploitation rate.

7.3 Discussion about the productivity of the tropical rainforest

Ninety per cent of the closed forest in Africa is "rainforest" using this term in its widest sense. To know the potential for forestry the rainforest must be studied.

Although there are great variations in species composition in tropical rainforests in different parts of the world there are also many similarities (see e.g. Dawkins 1959). In most reports tropical rainforest is discussed as one concept and information (e.g. in the case of increment) is summarized from different parts of the world. This may be an oversimplification but it is inavoidable as insufficient information is available about different types of rainforest. What is mainly discussed here is conditions in tropical lowland rainforest in Africa.

It is not possible to give an increment figure to indicate the present productivity of rainforests. First the forests must be exploited. In unexploited forests the net increment is by definition zero (WFI 1963). In exploited but unmanaged forests (that is those where selective cutting is employed) it is difficult to say how much of the net increment occuring will be in valuable species. Utilization of some secondary species will also make todays calculations out of date.

Increment conditions in the tropical forests are not well known. To date it has mainly been studied (and discussed) by ecologists who are very much concerned with the production of biomass (e.g. Bazilevich, Drozdov & Rodin 1971, Kira & Ogawa 1971, Bray & Gorham 1964). Their estimates vary from 30 to more than 100 m.t./ha. Earl (1975) has studied a number of sources and concludes that the maximum primary productivity varies between 55 - 123 m.t./ha gross and that the net production above ground is in the order of 8-40 m.t./ha.

The above figures are only of theoretical interest in this context but it is significant that most reports which compare the biomass increment in different vegetation types of the world indicate that the biomass production in the tropical rainforest is higher (sometimes considerably higher) than in temperate forests. Becking (1962) has made some theoretic calculations and gives 2 to 3 times higher stem-wood production for tropical rainforest than for West European forest. He estimated that 21 per cent of the total potential dry-matter production in tropical rainforests was stem-wood whereas the figure for European forests was 32 per cent.

Most productivity studies that have been done by foresters in the natural forests are about the possible production of wood from forests under different management. We will here discuss three different types of "management" namely:

1/ Clear-felling with natural regeneration
2/ Selective cutting with natural regeneration and
3/ Silvicultural systems for improvement of the yield in natural forests.

Clear-felling - natural regeneration. No study has been found which clearly shows the productivity of natural regeneration after clear-felling. This was only of remote academic interest but now pulping from mixed tropical forests is being considered. Mr G. Gloriod, previous FAO Project Manager in Gabon, told me that CTFT made some studies in the Kango area in Gabon. These indicated that natural regeneration could yield 100 m^3 of "pulpwood" after 30 years. This would be a net increment of 3 m^3/ha/year of wood utilizable for pulpwood. According to CTFT 80 - 90 per cent of the species in mature forests can be used for pulpwood. In the inventory of the mature forest all stems and branches down to a diameter of 7 cm were measured.

A mature rainforest in Africa is said to have 275 - 425 m^3/ha of stems and branches with a diameter above 5 - 7 cm (Catinot 1974). The same author gives figures of 250 - 300 m^3 for the bolevolume (stemvolume up to the first branch). These figures are based on different CTFT inventories. Considering that these volumes may be reached after 70 - 100 years one may perhaps assume a production of 3 - 5 m^3/ha. Wadsworth (1957) recorded a gross increment of 2.5 - 5 m^3/ha/year in plots in natural forests in Puerto Rico. Some sources (e.g. Catinot 1974) have mentioned that Madoux has estimated the annual increment to be 3 m^3/ha (or 1 per cent).

These different calculations indicate that the production of wood in the rainforest is not by any means striking if compared with forests in e.g. the temperate zone. This is somewhat contradictory to the biomass studies mentioned earlier. Thinning could possibly be used to increase the net production of wood. The extreme light-demanders which start the succession after a clear-felling are very shortlived (Baur 1964) though no doubt fast-growing. Baur (1964) refers e.g. to Taylor (1960) who found that Musanga (parasoll tree) reaches a height of 1.8 - 2.5 m in one year and has found a tree of this species which reached a height of 9 m and a d.b.h. of 44 cm after 9 years. Any thinning in this inpenetrable secondary thicket will certainly be extremely costly but a later thinning may be possible and this would increase the yield. Now, however, we are beginning to talk about the more advanced management system which we will deal with later.

Perhaps the pioneer species could produce much more than 3 - 5 m^3/ha/year if they were exploited with a short rotation and it is just a question of producing wood (or biomass). Such a short rotation system may, in the long run, lead to exhaustion of the soil.

Nowadays the volume of presently commercial species and sizes is often said to be in the range of 10 - 25 m^3/ha in West Africa and 10 m^3/ha in Central Africa (see Part I). Assuming that secondary regeneration can reach this mature stage in 100 years, the annual net increment of the presently commercial species may be in the range of 0.1 - 0.3 m^3/ha/year.

Now for an example of the theoretically possible production with this type of "management". In this example it is assumed that all exploitable rainforests (150 million ha) be put under a system of management where in all 1.5 million ha is clear-cut every year. A rotation period of 100 years is assumed since natural regeneration is thought to give a satisfying new crop within this period. Decrease in forest area is not considered.

Information in Part I (e.g. for Gabon) would indicate that one ha of clear-cut rainforest could give 15 - 20 m^3 of sawtimber (including veneer logs etc.) and perhaps 230 m^3 of other wood (of which possibly 100 m^3 of pulpwood). For the whole clear-cut area the yield could be as follows:

Sawtimber	20 - 30	million m^3
"Pulpwood"	150	" "
Fuelwood etc.	200	" "

Sawtimber will have rather a low production even if all forests are used. In the long run it is likely that this figure can be improved due to

increased utilization of secondary species, utilization of smaller trees etc.

The figure for pulpwood is very theoretical as the production of pulpwood from mixed tropical hardwoods is questionable at present. There is of course no market for this amount of fuelwood though theoretically it can be used for the production of charcoal or perhaps metan (energy forestry).

The system of exploitation described here has hardly been tried at all on a large scale. One basic reason for this is that there is no market for all the wood. It is not certain that a clear-cutting system of this type can be used due to environmental constraints. Probably it cannot be used in the whole area of exploitable forests. In hilly terrain clear-cutting is probably impossible. The costs for preventing fires and erosion in exploited areas would no doubt increase the wood costs considerably. It is possible too, that poor soils will become exhausted if all wood material is taken away. If one considers conditions of shifting cultivation however this may be a pessimistic view.

Selective cutting - natural regeneration. Selective cutting of commercial species and few or no regeneration measures is no doubt the most common "management" method used today. It would naturally be of great interest to know what will be the net increment of commercial species in the areas which are selectively cut today. Not all trees that develop in the areas opened up after an exploitation are commercial. On the other hand some small trees grow up to mature size. In Gabon Gloriod estimated that the first cut gave 10 m^3/ha, the second cut after 20 years 5 m^3/ha and the third after another 20 years gave 3 m^3/ha (only big trees are taken). Okoumé which makes up 85 per cent of the exploited volume is a light-demander which only regenerates in openings. In virgin forests very few trees of these species are found in the middle size classes (Baur 1964).

The development described in Gabon is perhaps rather natural as the first exploitation in old forest means that the commercial emergents of several age-classes are taken. The next exploitation after e.g. 20 years can only take the trees of commercial species that were too small at the first exploitation but which has since grown - mainly because of the opening of the canopy.

In the case of light-demanding species like okoumé the commercial volume will hardly ever be the same if the forest is not clear-felled (or opened) for one reason or another. Gloriod told me that in Gabon okoumé is concentrated in areas which have once been used for agriculture. Many commercial species are of this type.

The very vague knowledge about what happens after a forest has been selectively cut makes it difficult to give any meaningful examples of what can be expected in the future. It can be concluded however that the roughly 100 million ha of potentially exploitable forests probably contain an extractable volume of 1000 - 2000 million m^3 of presently commercial species. The 35 - 40 million ha that have been selectively cut contain rather small volumes (at least in the areas where no management has been tried). How long these resources will last depends mainly on the intensity of the exploitation.

If all remaining forests are exploited selectively with e.g. a hundred years rotation (i.e. that one per cent of the area is exploited in 1976 after which the area is left until 2076) the yield could now be 20 - 30 million m^3/year and then probably rise slowly as more species become commercial. From what has been said one may dare to conclude that the yield of presently commercial species (and sizes) will most likely be lower after 100 years.

A continuous selective cutting (e.g. 20 years rotation) will gradually exhaust the forest in presently commercial species. The proportion of non-commercial species are likely to increase as these are not felled.

Silvicultural systems for improvement of the yield of natural forests. The discussions above prove nothing but they do underline the urgency foresters have felt in finding a silvicultural system which would prevent the exploited forests from being more or less useless for the foreseeable future.

Several silvicultural methods have been tried. They all aim at securing an adequate regeneration of valuable species. Nowadays many of them seem to be monocyclic which means that the valuable crop is exploited in one felling operation. To give satisfying regeneration several operations in close contact with the exploitation are necessary. In Baur (1964) the so-called Nigerian Tropical Shelterwood System is e.g. described to include the following operations:

Year I		Op. I. Milliacre assessment Op. IA. Demarcation
	Advance growth stocking sufficient	Advance growth stocking insufficient
	Op. III Climber cutting only	Op. II Climber cutting and cutting of uneconomic saplings
Year 2	Op. V Clearance poisoning	Op. V Clearance poisoning
Year 6		Exploitation
Year 8		Op. VIII Repair of exploitation damage Op. X Post-exploitation climber cutting and freeing Op. XI Removal of overwood
Year 15		Op. XIII Sample enumeration

Some other systems in use include more operations than in the Nigerian Tropical Shelterwood system.

Dawkins discusses the possible yield of commercial species in natural forests in several reports. His main experience is from Uganda. In a report from 1959 he says that the basal area per ha in tropical rainforest all over the world is rather similar - a mean 32 m^2 (African range 23 - 37 m^3/ha). This constant size depends on the large crowns of the trees in tropical forests. When this limiting basal area is

reached no further gross increment (Baur says net increment) can be expected. At a given diameter the number of trees that can grow in an area is therefore limited. The same holds true for plantations of native broadleaved species. To have an acceptable increment the trees must have space to develop crowns of 12 to 18 m diameter. Crowns of 15 m diameter means a maximum number of 50 trees per ha.

The majority of stems in natural stands show a slow increment in spite of the large area they occupy. Dawkins concludes that "no African tropical highforest trees are capable of achieving over all final-crop stems of a stand of 76 cm in less than 80 years, when grown in established forest beneath or alongside trees of an older generation". Some species have proved capable of double that growth rate if their crowns are allowed complete vertical and some lateral freedom.

From a discussion of felling damages Dawkins concludes that the production of sawlogs cannot exceed 1.5 m^3/ha/a in any polycyclic system (a system in which felling cycles are shorter than the rotation). He here assumes that a large tree (d.b.h. 80 - 120 cm) devastates an area of 400 m^2 when felled. This is due to the large crowns of the trees, occurence of climbers etc. In well-managed forests it may be halved.

To show the limits of yield under monocyclic systems, Dawkins has prepared a table which shows the mean annual increment for various ages at maturity. Some of these figures are shown in the table below:

Final crop at maturity per ha		Mean annual increment (m^3/ha) of final crop for various ages at maturity		
Stem of 76 cm d.b.h.	m^3	40	60	80
25	88	2.1	1.4	1.0
50	176	4.2	2.8	2.1

Dawkins concludes that yields exceeding 4.2 m^3/ha/year are unlikely to be achieved extensively in the tropical high-forest. "For estimates covering wide areas and considering the general performance of the faster growing currently desirable species, it would be unwise to bank on more than half the above figures" (2.1 m^3/ha/year). Rukuba (1969) mentions an increment of 1.75 - 3.5 m^3/ha/year in managed forests in Uganda.

These calculations are based on the assumption that sawtimber is the main object and that thinnings below 40 - 50 cm d.b.h. are unsaleable. If the yield from potential thinning is added, the total yield would be nearly doubled. Thinning means exploitation of small trees in the crop while polycyclic systems mean exploitation of only the mature trees (or a proportion of the mature trees). This is the reason for the difference in damage at felling.

In an article in 1964 Dawkins continued discussion of the productivity of the tropical forests. The following examples of productivity are given:

a) Manipulation of moist tropical forest of low to medium altitude leading to the most productive assemblage of species:

6 - 15 m.t./ha/year.
The higher figure would be attained in the most favourable sites.

b) Plantations of other species than Eucalyptus and conifers. Replacement of tropical forests by the best available local or exotic species: 10 - 20 m.t./ha/year.
The range covers medium to richest sites.

c) Plantations of conifers or Eucalyptus on the soils best suited for them:
20 - 35 m.t./ha/year.

Assuming a specific gravity of 0.73 m.t./m^3 of wood and a yield of timber of 60 - 80 per cent of the above figures this would mean in case a) 5 - 12 m^3/ha/year; in case b) 9 - 18 m^3/ha/year; and in case c) 23 - 40 m^3/ha/year.

These higher figures are probably a result of Dawkins' hypothesis "that the ecologically better-placed individuals of a crop give some idea of what the whole crop might produce, when silviculture renders all its constituents similarly placed, i.e. optimum density and exposure". His earlier increment figure of 2 m^3/ha/year can probably be taken as an acceptable mean-value if all forests are put under management.

If 1 million ha is exploited each year and regeneration measures are undertaken in this area and in 0.4 million ha of the already exploited area the present annual yield would be 20 - 30 million m^3. After a 80 - 100 years period or so the managed forests would start to yield. The increment in these forests can optimistically be set to 2 m^3 sawtimber/ha/year. The yield from these forests would then be in the order of 300 million m^3 per year (or perhaps 500 - 600 million m^3 if thinnings are considered).

7.4 Productivity of open woodlands

At present open woodlands are important mainly as producers of fuelwood and other household wood. In some areas as e.g. in the copperbelt in Zambia they produce industrial wood. Small quantities of sawtimber is exploited in nearly all forest-scarce regions.

In densely populated areas the uncontrolled cutting of fuelwood is a serious problem as it often leads to over-exploitation and a degradation of the natural vegetation.

Many countries have tried to make open woodlands more productive. An area has been clear-felled and then been regenerated naturally by coppice and suckers (Griffith 1961). After clear-cutting of open woodlands it is necessary to protect the regeneration from fire and grazing. Some authors (e.g. Gilliusson et al. 1975) do not like clear-cutting at all due to the "delicate ecological belance".

The different silvicultural systems tried have not been especially successful. Griffith (1961) mentions that the long-term productivity of Miombo has been estimated to 0.6 m^3/ha/year. Gilliusson et al. (1975) uses a similar figure. Other sources have mentioned 1 m^3/ha/year (e.g. Lundgren et al. 1975). For Mopane a figure of 0.06 m^3/ha/year has been mentioned by Griffith.

7.5 Productivity of man-made forests

The increment of some of the commonly planted species is reported to be very high. Dawkins gives e.g. 23-40 m^3/ha/year for Eucalyptus and pines. Occasionally even higher figures have been reported. In the plantations that actually have taken place the increment is often lower due to failures etc. In south Africa sustained annual yield from plantations is e.g. given as 12.5 m^3/ha/year (Anon. 1972 a).

Table 7.2 estimates the present increment in existing plantations (in table 5.3). Only plantations where the main aim is wood production have been considered. The high increment figures that are often quoted have been adjusted downwards to allow for failures and so on.

Table 7.2. Increment in man-made forests

Region	Productive forest area	Species			Yearly increment		
		Coniferous	Eucalyptus	Other broad-leaved	Coniferous	Eucalyptus	Other broad-leaved
	1000 ha				million m^3		
North Africa	(500)	(270)	(230)	-	1.5	2.3	..
Northern Savanna R.	6	..	..	6	..	..	..
West Africa I	20	1	1	18	..	..	0.2
" " II	120	-	2	118	..	..	1
Central Africa	220	20	110	90	0.2	1.5	1
East Africa	850	300	500	50	3	7.5	0.5
Southern Africa	1000	620	380	..	90	7.5	..
Total	2700	1200	1200	300	14	19	3

It seems likely that the present growth of the man-made forests is in the order of 35 million m^3. Of this only a minor part is from the indigenous timber species.

If we exclude Southern Africa most of the increment is in different fuelwood plantation and in plantations for the local supply of timber.

The rather low yield of presently commercial species (indigenous) that can be achieved by manipulating the natural rainforest can be increased by establishing plantations. For Gabon Gloriod mentioned that okoumé plantations could yield 350 m^3 in 50 years (7 m^3/ha/year). For a recent planting scheme of limba in Congo the rotation period is planned to be 35 years and the increment 10 m^3/ha/year. Congo has experience of limba plantations since 1949.

For a number of commercial species no acceptable method of regenerating in plantations is known. Some of these species need a very exact balance of sun and shade to be able to survive the young stage (Lundgren et al. 1975).

Present optimistic reports about the fast increment in plantations in the tropics underestimate many difficulties. Little is known about many aspects of plantations in tropical areas (Lundgren 1976).

7.6 Concluding discussion about the possible yield from African forests

Just as an example we shall now make a crude calculation of the potential yield of all wood covered areas. It is assumed that the potentially exploitable forests and exploited forests given in table 7.1 are used for wood production. Of open woodland types 75 per cent is assumed to be used for wood production. The rest is for protection. It is also assumed that this production can be sustained without degradation of the natural environment.

Examples of production:

Tropical rainforest - 375 million m^3
Man-made forests - 35 million m^3
Other closed forest (mangrove, subtropical etc.) - 10 mill ha x 2.5 m^3/ha/year = 25 mill m^3
Other "forests" - 7.5 million ha x 1.5 m^3/ha/year = 10 mill m^3
Degraded closed forest, bush fallow etc. - 30 mill ha x 3 m^3/ha/year = 90 mill m^3
Moist savanna - 350 mill ha x 0.6 m^3/ha/year = 210 mill m^3
Dry savanna - 110 mill ha x 0.3 m^3/ha/year = 35 mill m^3
Mediterranean dry forest - 3 mill ha x 1 m^3/ha/year = 3 mill m^3
Dry scrub - 30 mill ha x 0.1 m^3/ha/year = 3 mill m^3

With all reservations for the rough assumptions one may have the working hypothesis that the present maximum production of wood could be 750 mill m^3 if all wooded areas were utilized. The practically possible production is much less. Furtheron a large part of the theoretic maximum production cannot be utilized with present knowledge and markets.

7.7 Final remarks

This chapter has no doubt been highly speculative and provocative. Few would dare to write a chapter of this kind, based, as it must be, on very little reliable data. But I have felt it necessary to try. No one knows in detail how tropical rainforest can best be utilized. Without some sort of management (mainly regeneration measures) of the selectively cut areas, the future yield of presently commercial species will be low. Utilization of a number of hitherto unmarketed species may, however, boost this low figure somewhat.

All the signs point to the need for management. But at the same time it is often said that management succeeds only under fortunate circumstances (CTFT 1967). The example (in 7.3) of future production of presently commercial species in managed forests is therefore very optimistic (or rather unrealistic). In many areas knowledge is lacking.

The cost for intensive management is also reported to be very high (CTFT 1967). With increasing labour costs it may become still more difficult. In the low-populated forest regions of Central Africa intensive management may be impossible due to lack of labour.

It is evident that the exploitation of the present commercial species cannot rise much even if all forests are put under some sort of management. Better management will only give result over a longer time perspective.

With increasing possibilities of utilizing more wood from the tropical forests, some system of more intensive utilization could perhaps be possible. Even if all wood in the rainforest could be utilized the present amount of the commercial species would not increase. However, if intensive utilization really is possible, the future of these forests would be brighter.

When the yield from naturally wooded areas is insufficient it must be supplemented with wood from plantations or with the import of wood products. In all forest planning, knowledge about the potential productivity of the naturally wooded areas is therefore essential. How much wood will come from plantations depends on the investments in the form of management of these forests. It may sometimes be more advantageous to produce a certain amount of wood from plantations than from the already existing forests. This depends on the coststructure, need for export earnings etc, in the specific country.

The problems of utilizing the tropical closed forest naturally makes one feel tempted to recommend plantations as the best way of ensuring future supply. However, it is certain that not all the natural forests exploited will be transformed into plantations. It is more likely that large areas will be just depleted. Large parts of the existing forests are needed of ecological reasons. If, however, they are depleted and of limited use for wood production their protection may prove impossible. A destruction of more or less all natural forests would no doubt be disastrous from the environmental point of view. Some successful system of utilizing the potential for wood production in tropical forests is therefore of interest not only for the sake of wood production but also for the sake of ecological balance. The future of tropical forests may look gloomy since utilization seems so difficult. It is, however, a fact that up to date research in management and utilization of tropical forests has been relatively limited compared to e.g. the temperate forests. Intensified research gives at least some prospects for a better utilization of the tropical forests. In the long run plantations will of course become of increasing importance.

8 THE FUTURE OF FORESTRY IN AFRICA

8.1 General

In this chapter we shall discuss to what extent the forest resources of Africa can meet the present and an increased future demand for wood in Africa, and to what extent Africa's forest resources can produce wood and wood products for other regions.

To answer these questions adequately it would be necessary to have more detailed projections than the crude figures in chapter 3.4. However, knowledge of the resource potential is so limited that better projections of future consumption would not have changed the discussions of this report to any great extent. With present information the possible development of forestry in Africa (as in the whole world) can only be discussed in a rather crude way.

This chapter discusses to what extent Africa can produce some of the main wood products i.e.:

Fuelwood (and poles)
Timber (for export and local use)
Pulpwood

These are to satisfy different markets:

a) The local market which consists of the village or community. Most wood produced for this market must have no or only very low transport costs. Fuelwood is the clearest example of a product for this market.

b) The national market which consists of a country (occasionally a region of a country). Timber for sawnwood is a typical example of a product for this market. These products can carry some transport costs. Both logs and finished products can be transported.

c) The subregional market which consists of a group of countries. In Africa pulp and board products could be a typical example of a product for this market. It is mainly the end-product or a semi-finished product that is transported. This subregional market is at present rather unimportant in Africa.

d) The export (overseas) market which can by definition only be supplied with products that can carry high transport costs. In the case of Africa most of the well-known species fall into this category whether they are in the form of logs or processed products. The production of pulp and paper from large mills would also fall into this category.

When discussing the extent to which Africa can produce wood and wood products it is always necessary to be clear about which market is to be satisfied. As to industrial wood (and processed wood products) each country or region need not of course be self-sufficient although the possibilities for this must be discussed.

8.2 Discussion about present drain from the African forest

Before discussing the future we shall deal with the present drain of the forests and its relative size compared with existing resources. The figures for production of industrial roundwood and fuelwood (from table 3.11) have in table 8.1 been crudely transformed to the corresponding gross volume. Table 8.1 shows some crude guesstimates about the wood volume burnt for shifting cultivation etc. The figure for the wood volume burnt in closed forest has been reached by utilizing the estimate for decrease in forest area in chapter 6.5. If the area of closed forest cleared is 2 million ha the corresponding gross volume would be 500-600 million m^3. The distribution of this volume by regions is mainly based on population, agricultural practices, wood available and so on.

An attempt to estimate the volume burnt in bush fallow and in open woodlands has been made for comparison. In table 5.1. it has been estimated that the area of bush fallow in the rainforest region is at least 40 million ha. If estimating a mean rotation period of 15 years and a standing volume per ha in the cleared areas of 50 m^3 the volume burnt annually in bush fallow would be about 130 million m^3.

Very little is known about the areas cleared in the open woodland zone. From the scarce information available it has been thought possible that at least 1 m^3 of wood per person is burnt annually. This means that in the whole savanna zone 100-200 mill m^3 of wood would be burnt every year. If we assume on the other hand that 2-4 million ha is cleared every year due to the population increase the burnt volume would be about 50-100 million m^3. To this must be added the volume burnt for other reasons (e.g. bush fallow).

Table 8.1. Drain of wood (in 1973)

Region	Industrial wood	Fuelwood	Volume burnt			Total
			In closed forest	In bush fallow[2]	In open woodland	
	million m^3					
North Africa	1.2	9	..[1]	..	..	10+
Northern Savanna R.	3.4	22	-	-	(25)	50
West Africa I	2.0	13	(10)	(5)	(15)	45
" " II	22.2	107	(150)	(50)	(30)	360
Central Africa	17	46	(200)	(35)	(10)	310
East Africa	17.6	191	(100)	(10)	(100)	420
Southern Africa	14.8	21	..	-	(10)	45
Total	78[3]	400	(500)	(100)	(200)	1300

1/ Fires said to be common in forest land
2/ In the closed forest zone
3/ Due to road-building and so on the actual drain may be larger.

Table 8.1 shows how difficult it is to discuss this topic. One may however dare to conclude that industrial wood amounts to a small share of the total drain. Ninety-five per cent or so of the total drain may

actually be burnt. Of this burnt volume perhaps two-thirds (probably more) is used as fertilizer. Of the total drain 50-60 per cent may be in closed forest. The rest should then be open woodland or bush fallow.

Table 8.2 shows rough estimates of the possible relation between different kinds of drain and different kinds of volumes (volume figures from table 5.6.).

Table 8.2. Rough estimates of the proportion of the wood resources exploited each year

Region	Total drain of wood to gross volume of wood in all land	Fuelwood and industrial roundwood to gross volume of wood in all land	Industrial volume exploited to commercial volume in in all land[1/]	Sawlogs and veneer logs to commercial volume in all land[1/]
	%			
North Africa	4	4	(3)	1
Northern Savanna	2	1	..	0.4
West Africa I	6	2	4	1
West Africa II	8	3	3	2
Central Africa	1	0.1	0.4	0.2
East Africa	5	2	2	1
Southern Africa	3	2	(10)	7
Total	2	1	..	..

1/ The figures for commercial volume in all land are in some cases higher than the figures given in table 5.6

Conclusions from this table can be drawn only with utmost caution (if at all). It is evidently possible to reach completely different conclusions depending on which concepts are compared (and the assumptions made). One may possibly dare to question if the total drain of wood in West Africa and possibly North and East Africa is not too high at present. The figures showing the relation between the present exploitation (of industrial wood and fuelwood) and total gross volume of wood in all land are also high in some regions (especially in North Africa).

The figures showing the proportion of the commercial volume exploited have been included with a lot of hesitation. Part of the industrial volume exploited is not taken from the commercial volume (e.g. part of

other industrial roundwood). If, however, only the official exploitation of sawlogs and veneer logs is considered, the proportion of the commercial volume exploited is still rather high in West Africa. It must be mentioned that the high figure for Southern Africa (which is a crude estimate) depends on the exploitation of wood from fast-growing species in South Africa and Swaziland.

Finally it can be mentioned that the estimated total drain is nearly twice as great as the estimated possible total production of wood from all land.

8.3 Discussion of the market and possible supply of different wood products

8.3.1 Fuelwood and poles

About 90 per cent of the wood volume utilized in Africa is fuelwood (at least according to the statistics). Fuelwood must be supplied from local resources as it is rarely possible to transport it from more distant areas where there may be a surplus. Probably only very little fuelwood is marketed. It is mostly used by the local population for its own needs.

Poles, posts etc. are also needed for different purposes at the local level. They are not needed in the same quantities as fuelwood but according to FAO Production Yearbook 1973 they are second after fuelwood (4-5 per cent of total production). They will not be discussed separately here since much of what is said about fuelwood applies to other household wood too.

Available resources of fuelwood are adequate in most parts of the high forest areas of West and Central Africa while they are inadequate in large parts of all the other regions.

In many parts of Africa urbanization is going fast. Near towns there is often a serious shortage of fuelwood. Destruction of vegetation in suburban areas due in particular to charcoal burning and intensive cultivation occurs in many areas. Lawton (1975) mentions that there is no fuelwood within 64 km of Ouagadougou in Upper Volta. The FAO/SIDA mission of 1974 (FAO 1974 c) mentions that the town Mopti in Mali requires 130,000 tons of wood per year to smoke fish. Deforestation extends over a radius of 100 km. There is also deforestation around many towns in the rainforest zone. A 100,000 ha large afforestation project is e.g. planned to supply Kinshasa in Zaire with charcoal.

Trees in savanna and steppe regions do not only supply wood they are also of great importance for water balance, erosion protection and so on. Used as windbreaks they can increase agricultural production. They can also be a source of emergency grazing during dry periods and give fruits and other secondary forest products. These are all extremely important points in favour of trees.

Lack of fuelwood gives many negative effects in addition to destruction of the wooded vegetation. In degraded wood deficit areas the prices for wood have been rising sharply. In the Sahelian countries for example one-fourth to one-third of the labourer's salary is said to be spent on fuelwood. Here high food prices are often reason enough for famine and malnutrition (Anon. 1975).

The shortage of fuelwood can also influence the nutritional pattern of the population. If fuelwood is very expensive or in short supply consumption of foods demanding a long cooking time is reduced. In some areas in Africa rice is rapidly replacing the traditional foods (millet, sorghum) as a staple cereal, with the consequences of growing malnutrition (protein deficiency) (Anon. 1975).

In dry areas a lot of time which could be better used, is spent on the gathering of bushes, branches and other burnable stuff. This job is done by the women (Zumer-Linder 1975 b).

The problem of fuelwood supply is often underestimated. The whole savanna zone and closed forest zone is normally considered to have adequate resources of fuelwood. An estimate of the total wood volume is then often compared with the fuelwood demand of the population. The result is nearly always that there is no fuelwood deficit (except locally).

FAO (1974 e) gives the following information about the demand for fuelwood in the savanna zone. At present 0.6 m^3/caput and year is assumed to be the consumption of fuelwood in the main part of the savanna zone. With a population of 140 million the total consumption per year would be at least 86 million m^3. The total need for wood would be around 100 million m^3 per year. This should correspond to 0.08 m^3/ha. Even if only one-tenth produce wood the annual cut would not be more than 0.8 m^3/ha. 'Over the whole, therefore, and excluding timber it seems that the natural regeneration and increment of the savanna should be adequate to sustain the present needs. But this conclusion makes no allowance for the factor of distribution. . . . Although the overall picture may appear to be one of some adequacy of fuel and pole supply, there are many instances in which the local picture is one of serious shortage."

Let us accept these figures and consider a village of 500 people. The increment for moist savannas is set at 0.6 m^3/ha. A population of 500 people would need 600 ha of wooded areas spread over an area of about 6000 ha. This is a circle with a radius of 4-5 km. It is unlikely that people will walk so far. They will instead exhaust sources near at hand and produce a fast degradation. If we use the same assumptions a population of 100 people would need to use an area with a radius of 2 km.

With these assumptions it would mean that the maximum population density would be 9/km^2. In the Northern Savanna Region however the present population density in non-desertic regions is already about 10/km^2. The FAO/SIDA mission of 1974 (FAO 1974 c) gives a mean population density (for Upper Volt, Mali, Senegal) of 5.5 persons/km^2 in Sahel and 21.6 persons/km^2 in the Sudano-Sahelian zone. Hance (1970) gives some information about urbanization in these countries. In most countries the urban population is small but in the Northern Savanna Region most people live in villages of a few hundred persons.

In very dry areas the situation is more serious than in savanna areas. Le Houérou (1970) has estimated that there are 700-800 kg of wood per ha (approx. 1 m^3/ha) in arid steppes in Tunisia. The daily consumption has been estimated to 1-2 kg per person (0.5 m^3 per year and person). Some regeneration occurs during the rainy years except in very dry areas (below 150 mm on shallow soils). Under these conditions each person needs very large areas for fuelwood production. Over-exploitation will certainly occur.

If managed well even the very dry areas can, theoretically, give a sustained supply of fuelwood. Shawki (1964) describes a scheme for fuelwood production in the semi-desert region around Khartoum. About 600,000 ha of Acacia desert scrub would be used for fuelwood production. The increment for this type was thought to be 0.5 m^3/ha/year - a very optimistic figure (?). If one tenth of the area were exploited each year the area could give a production of 300,000 m^3 per year. But until the area is fully stocked yield can perhaps only be one tenth of this amount.

People have known for a long time that fuelwood resources have been dwindling in some areas. Little has been done because it was assumed that other kinds of fuel such as kerosene or electricity would take over. The recent energy crisis makes this less likely.

Investments in fuelwood plantations are therefore needed in large parts of Africa. Until very recently fuelwood was considered to be available in adequate quantities more or less free of cost or at least with no investment needed. With increasing population the resources are overused and dwindling. The day that the shortage is felt to be serious will be too late. It takes a long time before fuelwood plantations can ease the situation. At that stage the possible yield of the surrounding natural vegetation will also have been run down. Knowledge of tree-planting is normally not available either. In areas with a large wood deficit it is also often impossible to establish proper fuelwood plantations as they are cut long before they are mature.

The area that at present ought to be planted for fuelwood production naturally cannot be estimated with any accuracy. Such estimates must be made at the district level in each country. Here we shall only examine some figures which may show the magnitude of the problem.

The situation in the savanna (and steppe) areas is of main interest to discuss. Considering a population of 140 million in the savanna zones (this FAO figure seems low) and assuming that 80 per cent of these use fuelwood (or charcoal) if it is available at acceptable costs the total population in the need of fuelwood would be 110 million.

The need for fuelwood (and poles) can be estimated to at least 0.7 m^3 per capita and year or in other words 80 million m^3. Considering an increment of 15 m^3/ha/year (optimistic) in fuelwood plantations, the area of plantations needed to supply this amount would be roughly 5.3 million ha.

Considering an increase in population of 3 per cent per year the population in these regions in ten years (the assumed rotation age for fuelwood plantations) would be roughly 185 million. To supply adequate fuelwood in 10 years time an area of 0.7 million ha of fuelwood plantation would need to be planted per year at present.

It can be argued that in large parts of the savanna areas large quantities of wood are available and that plantations of this size are unnecessary. But we have already agreed that even a rather low population density grouped in small villages can cause a fast degradation of the natural wooded vegetation around these villages. Furthermore, very large areas are needed to supply adequate quantities on a long-term basis. If the natural tree vegetation in the savanna region is used, roughly 130 million ha of open woodland would need to be managed (increment

0.6 m^3/ha/year) in order to give the same amount of wood as 5.3 million ha of plantations for fast-growing species. In 10 years 160 million ha would be needed. Production of wood from natural vegetation is therefore likely to be time-consuming and costly besides having many negative environmental effects. It can be concluded therefore, that in the long run plantations are needed to supply the main fuelwood needs in the savanna zone. In the short run this is not possible.

North Africa at present consumes rather small quantities of fuelwood. From the environmental point of view (e.g. need for protection plantations), use of manure as fuel, and so on, fuelwood plantations would probably be advantageous in the areas where plantations are possible. It can be argued that it may be cheaper to use kerosene as fuel in countries which have a large domestic production of oil (e.g. Algeria). If one consider the environmental benefits of trees this is however not certain. Plantations for both protection and fuelwood production may be possible in some areas.

It is difficult if not impossible to estimate the areas of fuelwood plantations needed in North Africa. In Egypt for example it is not likely that there is much room for fuelwood plantations. In the other countries though we can as an example assume that half the population (20 million persons mainly in rural areas) would be best served by fuelwood plantations. If we estimate an increment of 10 m^3/ha/year in North Africa the area of fuelwood plantations needed would be 1.4 million ha. This is roughly double the present planted area. With a rotation period of 20 years, and a population increase of 3 per cent per year, the area that should be planted now for fuelwood ought to be over 100,000 ha.

In the rainforest zone there is probably less need for fuelwood plantations than in other areas. There may however, be a need for plantations even here at least around large urban centres. If we assume that 10 million people in the rainforest zone (mainly parts of the urban population) could best be supplied with fuelwood from plantations the planted area ought to be in the region of 400,000-500,000 ha (about 50,000 ha should then be planted per year at present).

Another 50 million people live in highland areas, dry areas and so on. In the areas where fuelwood plantations are possible and necessary there may be 30 million people. For those areas 100,000-150,000 ha of fuelwood plantations per year may be needed at present.

For very dry areas it is very difficult to establish any fuelwood plantations. Fuel must be supplied in some other way for example kerosene or charcoal, but as long as these products are costly one must expect a continued deterioration of the scarce wooded cover.

Any general improvement of the forestry situation in many parts of the world has to be initiated at the village level, especially in areas where forest is scarce. Plantations for pulpwood and timber are often impossible to establish unless the local people have sufficient fuelwood (Anon. 1976). Fuelwood plantations must be established in cooperation with the local population. They can rarely be forced through by any large state projects. Of course fuelwood must be available in adequate quantities and must be cheap.

Local plantations for fuelwood and other household wood are often called village forestry. Village forestry has the following main goals (Anon. 1975).

1) Providing a source of fuelwood and household wood at local level.

2) Protection, particularly control of erosion and outflow of water.

3) Providing a source of emergency (or dry season) grazing during the periods when no fodder is available.

4) Providing employment.

The fuelwood plantations will often be scattered trees or plots of trees, trees in lines along roads, trees around pools and houses and so on. Different kinds of agro-silviculture can also be considered. These tree resources can probably best be managed by the local population themselves. Production of wood for local use must in many areas become a natural part of agriculture in the same way as production of food. For the supply of urban areas fuelwood plantations of a more industrial type are needed.

8.3.2 Timber

The end-product of timber as defined here is sawnwood (for construction, furniture, packaging, sleepers etc.), veneer, and plywood. Poles are not included.

At the national level in African countries timber is mainly used for manufacturing sawnwood while the export market is supplied with the well-known timber species which are mainly used for veneer and plywood production (Peck 1974). Export is still mainly of roundwood but processed wood products (plywood, veneer, sawnwood) are increasing in importance.

Local market

Timber can be transported to the local market from more distant areas than can fuelwood. Sometimes a small country can be considered as a single market. Where wood is available in adequate quantities all over a country the local market is normally rather small.

All regions except Southern Africa consume relatively little timber per capita (table 3.16.). It is probably wrong to conclude that this low consumption is because of inadequate resources (at least in the first hand). The forest-rich regions also consume rather little timber. This is at least partly due to the fact that wood is subject to destruction of various kinds in tropical countries. In the savanna zones where the resources of timber are small "demand" has never had a chance to develop. Where wood has not been available other material has been used. The effective demand for sawtimber is evidently rather small in all regions. It is however assumed here that the per capita consumption (demand) of sawtimber will increase in all regions. According to some inventories the savanna areas have a large total volume of timber but this is spread over a wide area and is difficult to utilize. Furthermore the trees are slow-growing and the natural regeneration uncertain. It must be assumed that open woodlands over large areas cannot continue to yield timber to the same extent as now and much less increase this quantity. These areas will, therefore, mainly have to rely on plantations (or possibly import) to cover the future demand for sawtimber.

It is also possible that, even in the moist forest zone, the demand for timber can sometimes best be met from plantations. Due to the selective cutting timber produced from natural forests can often be very costly. In many countries, at least in Asia, the valuable species are actually used for all purposes. In certain countries with closed forest, notably Madagascar and Uganda, a very large proportion of the wood in the closed forest is used for sawtimber for local use (for some forests in Uganda 90 m^3/ha have been mentioned). If the same were done in other countries with resources of closed forest, the supply of adequate quantities of timber would be cheaper. It is naturally difficult to get an even quality of large quantities of sawnwood from the natural forests but for many purposes this even quality is not necessary.

As is indicated in table 5.5. a large proportion of established plantations have timber production as the main aim. Many countries in the savanna zone have plans to produce more or less all timber from plantations. Perhaps in the year 2000 most of the timber needed in North Africa, the Northern Savanna Region, East Africa and Southern Africa will (or rather would need to) come from plantations. It is not unlikely that a large proportion of the need for timber in the savanna areas of West and Central Africa could best be supplied from local plantations. Transport from the rainforest zone may be more costly. Some countries in the rainforest zone (e.g. Nigeria) have also inadequate resources of closed natural forest.

Table 8.3. gives crude estimates of the areas of timber plantations needed in the year 2000 and indicates how much ought to be planted today (around 1976) in the regions where a large share of the timber production in the year 2000 is likely to have to come from plantations. It has here been crudely assumed that plantations will yield 10 m^3(r) of timber/ha/year (5 m^3(r)/ha/in North Africa). Furthermore it has been assumed that outside Northern and Southern Africa 25 per cent of the demand can be supplied by the natural forests. (In West and Central Africa only the savanna zones are considered.)

This table indicates that the area of timber plantations needed in the year 2000 will be about 4.5 million ha. The area that should be planted per year now for production of sawtimber is likely to have to be in the region of 180,000-200,000 ha.

Export market

Africa has supplied the world market (especially Europe) with a number of well-known timber species over many years. West and Central Africa have been the main producers but the other regions have also supplied some quantities.

The West and Central African rainforest produce about 50 commercial species and another 100 species are known to the trade (Erfurth 1973). Some species may be added from the savanna regions, East African mountains and Madagascar. In all, the number may be more than 200. Some of the species occur in very small quantities and so can never be of any great importance. In the rainforest zone the ten most common species at present make up 80 per cent of the export (Erfurth 1973).

Table 8.3. Crude estimates of the area of timber plantations needed in the year 2000.

Region	The need for sawnwood in the year 2000[2/]	Roundwood requirements	Production needed from plantations	Approximate area that should be planted in the year 1976[3/]	Approximate area of plantations needed in the year 2000
	mill. m^3(s)	mill. m^3 (r)		1000 ha	
North Africa	6.3	11	11	90[1/]	2,200
West & Central Africa (mainly savanna areas)	3	5	4	16	400[4/]
East Africa	3.3	6	4.5	18	450
Southern Africa	(7.5)	13	13	50	1,300

1/ The figure for North Africa is optimistic. It is not certain that timber plantations will be mature in 25 years time.
2/ Five per cent annual increase in consumption assumed for all regions. At least in the case of Southern Africa this is most likely an overestimate (Grut 1975). In West and Central Africa only the savanna zone considered (half the consumption assumed to be in the rainforest zone).
3/ A rotation period of 25 years is assumed.
4/ In addition considerable areas are needed in the rainforest zone of some countries (e.g. in Nigeria).

Some of the best known timber species are already reported to be scarce in some countries (e.g. acajou, sipo) and others are expected to become so (e.g. CTFT inventory in Ivory Coast). Perhaps new species may replace some of these on the world market. But the introduction of new species has hitherto been a slow process. From 1961 to 1970 the number of species exported in quantities above 5000 m^3 (r) increased from 27 to 33 (Erfurth 1973). In the 1973 boom a number of relatively unknown species could be sold.

The importers of tropical wood are now said to notice a decreasing diameter, the introduction of new species, unpredictable delivery capacity and so on. For these reasons importers in Europe are said to find it better to continue to maintain the industries in Europe and to buy wood wherever it happens to be available (Anon. 1973). Export from other regions than Africa has also increased. The African Governments on their side want to stop the export of unprocessed wood.

Many pessimistic judgements have been made over the future of tropical woods. One recent article in a Swedish magazine (probably based on German sources) states that over a 15 years period (1954-1968) 15 mill. ha has been destroyed (exploited) in Africa. The African forests would be exhausted within 20-37 years (Anon. 1973).

It is not possible to say how long the resources of certain appreciated species will last if present exploitation continues or increases. In the course of this work several attempts have been made to describe what will happen with the resources of presently commercial species. Some examples are shown in Appendix IV.

In summary these examples indicate a rather drastic reduction of the resources of commercial species in West Africa and to some extent also in Central Africa (except Zaire) if present trends continue. The other regions have a number of well-known species but these occur in rather small quantities and it must be expected that most of these species will disappear from the world market. Most of the production in the naturally wooded areas in North, East and Southern Africa will have to be used to satisfy domestic needs. So what we are concerned with here is, mainly, the conditions in West and Central Africa.

In the examples in Appendix IV we have not discussed increment. Of course tropical forests grow. The relation between increment and exploitation is not known. This is the reason why the resources are often discussed as being static. The increment in exploited forests (40 million ha) in theory could perhaps match the present exploitation. But forests once exploited normally give a lower yield than unexploited forests. If present exploitation in the rainforest is 12 million m^3 the increment in exploited areas would need to be 0.3 m^3/ha/year. This is a rather unlikely mean-value for increment of presently commercial species in selectively cut areas.

All forests are likely to be exploited a first time in nearly all countries before the year 2000. When this happens exploitation must be reduced if very large areas are not going to be exploited each year. A repeated exploitation means a final depletion of the forests. Forests made accessible through exploitation are also disappearing at a great pace. In the case of many countries (especially in West Africa) the stock of valuable species is probably decreasing. If exploitation continues to increase this will certainly soon be the case in nearly all countries.

It can be argued that management of exploited areas could ensure an increased future yield. This, however, has no or little effect on the situation in the coming 25 years.

We have already agreed that the best management techniques for natural tropical forests are not fully known, are very costly and that some regions may have a lack of labour too. Large plantation schemes would therefore probably be necessary to meet long-term demand for the well-known commercial timber species. Perhaps exploiters should be required to plant an area which will at least produce the same amount of wood in the future as is exploited today. If this had been done in 1973 for example areas shown in table 8.6. would have been planted in the main producer countries . Here only the sawlogs and veneer logs have been considered and a mean exploited volume of 250-300 m^3/ha in plantations has been used.

Table 8.6. Estimate of minimum plantations of indigenous timber species needed to replace exploited volume in 1973

Country	Production (1973)	Corresponding planted area
	1000 m^3 (r)	1000 ha
Ivory Coast	5,195	20
Ghana	1,565	6
Nigeria	1,400	5
Cameroon	820	3
Gabon	2,360	9
Congo	575	2

When these plantations would mature in 35-70 years little could be expected to come from selective cutting in the natural forests in these countries if present trends continued. As the demand can be expected to greatly increase the plantations would need to be much larger to meet this demand. Plantations established today will certainly be very valuable when they are mature.

To establish timber plantations of the type discussed here (as well as intensifying the management) is an ordinary financial investment. Fuelwood plantations and timber plantations to meet domestic demand are a must in many areas. But whether timber should be planted for export is an internal economic question. Is it the best way to utilize existing financial resources? The difficulty is that little can be said about future prices.

As was discussed in chapter 3.4.6 the demand for tropical wood would increase considerably. According to FAO/ECE (1975) the import to Europe is expected to rise from 10.5 mill WRME in 1970 to 25-35 mill m^3 WRME. Can Africa really supply most of this increased consumption?

An attempt has been made to estimate the probable development of export in different countries. Information about remaining resources and assumptions about increased demand for tropical wood and increased need for export-earnings have all been utilized.

In the case of West Africa it is quite certain that export will go down although perhaps not as fast as might be assumed from the discussion about remaining resources. It is likely here that the number of species utilized will increase. A large part of the domestic market can certainly be supplied with species that are now considered secondary. Part of the forest reserves are (or have been) also under management aiming at a sustained yield.

An optimistic judgement would be that West Africa in 25 years time could still export wood and wood products from the natural forests corresponding to a volume of 4-5 million m^3 WRME. This amount would, however, only partly come from the well-known species.

In Central Africa (except Zaire) one can expect a continuous increase in wood export. Certain areas like northern Congo and Eastern Cameroon are inaccessible at present but in due time these areas will no doubt be made accessible too. At the end of the century export could very well be in the region of 8-10 million m^3 (roughly 5 per cent annual increase).

It is difficult to foresee what will happen in Zaire. If only wood products are exported the rise in export is likely to be slow at least in relation to the total figure. If, on the other hand, Zaire - due to financial difficulties - is forced to export logs, then export can rise rapidly.

All of this in summary means that the volume exported in 2000 can be in the order of 12-15 million m^3 WRME. If Zaire enters international trade then export may be larger. The estimates given are crude but they indicate that it is unlikely that the African export of tropical wood can amount to 25-35 million m^3 WRME the year 2000.

African countries do not want to continue exporting logs but want to process their own wood. The discussion in this chapter has hitherto not taken this fact into account. Will countries at the end of the century be able to export mainly processed wood products?

In 1973 (and 1971) roughly 80 per cent of the export from West and Central Africa was in the form of roundwood. In 1962 the proportion was roughly the same. The annual increase in industrial production has been fast during the last decennia but this increase has then mainly been used to cover domestic demand. To cover the expected domestic demand of sawnwood and plywood in the year 2000 (approx. 14 mill $m^3(r)$) and still to sell only processed wood the same year (12 mill $m^3(r)$) the industries capacity in West and Central Africa must increase by roughly 6 per cent a year. Growth in the last decennium has been of this size too. It is therefore not unlikely that the countries can manage to process all exploited wood by the year 2000. This, however, certainly requires a firm concentration on the mechanical wood industry.

There are many difficulties for roundwood exporting countries which wish to take over the wood processing themselves. The same trend as now seen in Africa has long been observable in Asia. But there industrialization has not been encouraging. It is evidently difficult for countries in need of export-earnings to slow down the export of logs. At first local industry cannot process internal production. The development of the industry (and the domestic production) must therefore normally go step-by-step. If some African countries stop log export the European industries will certainly try to buy wood in Asia and Latinamerica or buy more from the African countries which allow log export.

In spite of these difficulties it is not likely that the roundwood export from Africa will increase as fast as during the last decennia. On the contrary a decreasing log export must be expected. A firm coordinated action by the African countries would no doubt give them the possibility of increasing their export-oriented forest industry considerably. This is especially the case for Zaire and Congo which have large unutilized forest resources and a relatively small export of logs at present. Zaire does not seem to allow log export at all (in 1973 only 15 000 m^3 was exported).

If the European industry dependant on import of tropical wood does not expand, the amount of processed wood exported from Africa could be increased by 5-8 mill m^3 by year 2000. As the demand in Europe will increase heavily it is likely that processed products can be sold in larger quantities (at least during a boom). It is also likely that the European processing industry depending on wood import will have to decrease.

In this context one must ask if existing resources of commercial species are adequate for such a build-up of the forest industry. In some countries present trends indicate that the resources can be exhausted at the time the domestic industry can be fully developed. Forest inventories must show what is the possible long-term production of the forest (and the industry).

All this discussion has been based on assumptions of an increased demand for tropical wood in Europe and the need for export-earnings. If it were not for the need of export-earnings log export would to a great extent be stopped and industries that could be assured a long-time wood supply would be established. At least for the time being this would mean a drastic reduction in export.

As the countries evidently need export-earning an increase in export is still likely. Whether the forest industry really will manage to expand fast enough to take care of an increased exploitation is not certain. These trends in development makes it likely that all exploitable forests in West Africa and most of Central Africa (except Zaire) will be exploited a first time before the turn of the century with the resulting impoverishment of the natural forests. In a number of countries future exploitation will have to decrease.

Naturally new policy decisions from the Governments in the forest-rich countries can prove this pessimistic view to be wrong. In the long run introduction of intensive management and large plantation schemes of certain species can change the development in another direction.

As can be seen from the lengthy discussions on several places in this report I feel that a discussion of the future supply of tropical timbers is very essential. In spite of all these calculations very little can be said with certainty except that the resources are likely to decrease. How fast this happens depends very much on what assumptions are made.

The main conclusion then is that we do not know enough. Much more background information and much more detailed studies are essential. An increased future demand in the world level (which is likely) and a decreasing future supply (which is also likely) will lead to increased prices. It is essential that todays investment decisions in plantations and management be based as more detailed and reliable data.

8.3.3 Pulpwood

For the time being wood pulp is produced in Morocco, Kenya, Angola, Swaziland, South Africa and possibly Rhodesia. This pulp is produced from wood from plantations. At present natural forests are not used for pulp production. In addition there are pulp mills which utilize esparto grass, straw etc. in Algeria, Egypt and Tunisia. There are also paper mills in some countries which utilize imported pulp.

At present a number of countries are discussing plans for establishing pulp mills. Most of the pulp mills discussed in Africa at present are integrated mills which aim at supplying the domestic market with paper. Non-integrated paper mills based on imported pulp and waste paper have not been successful in the countries tried (Meyer 1974). One may put a question mark for this last statement. In Europe a lot of non-integrated paper mills are in work.

The first paper mill in a country can only produce 50-60 per cent of the total volume of paper (depending on different grades and qualities needed). No export of paper is considered possible during the initial stages due to the difficulties of producing an even quality (Meyer 1974).

Meyer (1974) considers that a paper mill for the domestic market cannot be established until the market allows a mill of 50,000 TPY. Even then a 20-30 per cent tariff protection is necessary. Smaller mills require higher tariff protection.

If short-fibred pulp are used, additions of long-fibred pulp are necessary (perhaps 20-30 per cent) to increase strength. This long-fibred pulp may have to be imported at first (Meyer 1974).

When one utilizes this information to the 1974 consumption in different countries one sees that Algeria, Kenya, Morocco, Nigeria, South Africa and Egypt had adequate markets for a paper mill. Assuming a 7 per cent annual increase in consumption (as in table 3.20.), Ivory Coast, Rhodesia and Tunisia would have adequate markets by the beginning of the 1980:s. Meyer is more optimistic in his judgements. He estimates that consumption will increase 4 times in ten years time (1971-1980). Ghana and Cameroon are therefore thought to have adequate markets.

Present trends indicate that a number of pulp and paper mills will be started. Existing natural resources of coniferous wood are of no importance as future suppliers of pulpwood. Mixed tropical hardwoods or wood from plantations are the two remaining possibilities.

The utilization of the vast resources of closed tropical forests in West and Central Africa for pulp production has been discussed over many years. To date no pulp mill with mixed tropical forests as a resource base has, as far as I know, been started anywhere in the world. The first pulp mills which utilized tropical hardwoods established in Colombia, Phillipines and Taiwan did not utilize mixed tropical hardwoods but selected tropical hardwoods.

There are problems connected with the utilization of mixed tropical hardwoods for pulp production but these problems are sometimes said to be more economical than technical. Meyer (1974) mentions higher logging and transport costs, higher debarking costs, higher woodhandling costs (including chipping), lower pulping and bleaching yields, higher chemical pulping and bleaching consumption and costs as some of the problems.

How well will this unknown pulp sell? What will be the price? Will the quality vary from shipment to shipment? Most pulp mills discussed so far in Africa are aimed at satisfying the internal market. In this case quality requirements should be less stringent than for the export market (Meyer 1974). Export mills are however also discussed.

The problems briefly mentioned here concerning pulp from mixed tropical hardwoods has meant that hitherto pulp production in Africa has been considered feasible using plantations of fast growing species mainly in the savanna and some highland areas. Trials with exotics have been started in a number of countries. Serious plans to start pulpwood production from plantations exist in many countries which have suitable open

savanna areas (e.g. Malawi, Tanzania, Mocambique, Congo, Madagascar) where the establishment of plantations is relatively cheap compared to rainforest region plantations. In some of these countries plantations are going ahead at a fast rate.

As to the forest rich countries of West and Central Africa, investigations have been made at least in the Ivory Coast, Ghana, Nigeria, Cameroon, Gabon and Congo. The problems of producing pulp from mixed tropical forests have often led to the recommendation that plantations of fast-growing species should be used from the very beginning in West and Central Africa too.

The cost of establishing plantations in rainforest areas is very high because the natural forests must be cleared and the plantations continuously weeded during the first years. Plantations delay the start of pulp production. Trial plantations take time and then the rotation period is 10-15 years (Meyer 1974).

An ideal solution in the regions rich in natural forests, could therefore theoretically be to start production by utilizing the natural forests. After exploitation, the clear-cut forest are regenerated by fast-growing exotics (or possible suitable indigenous species). From the technical point of view it is said to be possible to start the production with wood from natural forests and then change to wood from plantations (Meyer 1974).

In this way production could start earlier. The clearing of the natural forest would be paid for by the wood exploited. It can of course be questioned whether it is economic to start the production with mixed tropical forests and then later on change to a new process.

If mixed tropical hardwoods really can be used with success one may question, why a change to wood from plantations within 10-15 years is normally proposed. An area of 300,000 ha could yield enough wood to run a pulp mill of 250,000 TPY for 40-50 years (assuming 150 m^3/ha). Natural forests regenerate fast if protected. Plantations could start at a later date (e.g. after 20-30 years) and not be considered in the first investment. It seems as if a proposed pulp mill in Ivory Coast is based on the assumption that natural forests can be used over a long period (according to Petroff 1974).

Some people have even proposed the continuous use of wood from natural forests. In Gabon at one stage CTFT calculated that natural regeneration in a clear-cut area could give 100 m^3 of pulpwood after 30 years. This is a low increment which means that large areas are needed if natural vegetation is to be used. It is also probable that the species composition will change somewhat from generation to generation. Furthermore, logging in this type of forest may be expensive. In any event there is at present no known interest in utilizing natural regeneration for pulp production in this way.

The pulp mill (export mill) utilizing mixed tropical hardwoods under most serious consideration is the one in Gabon. There has been calculated that 80-90 per cent (or 160 m^3/ha) of the volume in the natural forests could be used for pulping. In addition roughly 10 m^3/ha will be used for timber (okoumé).

Only a few species are said to be unsuitable for pulping. After clear-cut of the natural forests it is planned to plant okoumé which is said to have good pulping properties and an adequate growth. Some proof-cooking of wood from the Kango area has been done but the results of these trials are not available.

The success or failure of the first attempts to pulp mixed tropical forests will be critical. The different opinions about the possibility of utilizing mixed tropical hardwoods indicates that present knowledge about pulping of mixed tropical hardwoods leaves some question marks. The technical problems may be solved but this does not necessarily mean that pulping of mixed tropical hardwoods will become economic. For a non-specialist it is now impossible to judge whether the different plans for pulp mills are realistic or not.

In spite of all these discussions about the use of mixed tropical hardwood for pulp one can dare to predict that most of the future pulp production in Africa will actually be based on wood from plantations. To meet the present demand for paper (0.7 million TPY) in Africa (except Southern Africa) from plantation-grown wood a planted area of roughly 160,000 ha (increment 15 m^3/ha/year and 3.5 m^3/ton of paper) would be required. To meet the need for pulp in the year 2000 a planted area of 1.1 million ha would be needed (if assuming 7 per cent annual increase in consumption). Southern Africa will evidently find it difficult to meet the demand in the year 2000 according to Stratten (1975).

Will African countries be able to satisfy the future demand for paper from domestic production? If mixed tropical hardwoods could be used it would probably be easier. The task of planting about one million ha in a 10-15 years period, which would otherwise be required, is difficult. But perhaps still more difficult would be the increase of industrial capacity by around 10 million m.t.

That African countries may find it difficult to meet the demand by domestic production does not mean that there will be no export to other parts of the world. Countries like Congo, Angola and Mocambique no doubt have both available land (for plantations) and adequate water resources for a fast development of the pulp industry. West and Central Africa can be of importance in the first hand if the natural forests can be utilized. But even in many of these countries - for example Liberia - there are open grassland areas in the closed forest zone which could probably be used for plantations.

Whether large investments for producing pulp for export are made depends on whether adequate resources can be made available. The know-how needed can be bought. A number of wood industries from developed countries show a keen interest in taking part in the building up of the African pulp industry. They are probably not so much interested in investing as in selling their know-how. From the point of view of the African countries it could be an advantage to utilize the know-how, marketing organization and so on of well-established pulp-industries in the build-up phase while still maintaining the financial control over the companies. The fees to the foreign firms could e.g. be paid by giving the foreign companies the right to exploit some pulpwood in the natural forests (if this is possible).

In Sweden for example existing forest resources no longer allow an expansion of the pulp industry. Strangely enough, Sweden still exports

mainly pulp. Quite naturally Swedish forest industries now want to expand by processing the pulp to make paper. This can not be done however without a conflict with their traditional customers among the European paper mills. Swedish forest industry now appears to be interested in assisting in building up the pulp production in tropical countries. In this way their customers could continue to be assured of adequate quantities of pulp. The Swedish forest industry meanwhile could be free to expand by processing their own pulp production into paper products.

It is likely that some countries will manage to produce a surplus but this may not be exported to other African countries but rather to developed countries which can afford to pay. Many African countries which do not have domestic production cannot afford to buy sufficient paper. This will have serious affects on their development.

What the final result of the different trends discussed here will be cannot be said. However, it seems clear that a number of small pulp and paper mills will be established in the 1980:s to cover domestic demands. In Nigeria, Ghana, Ivory Coast, Cameroon, Tanzania, Mozambique and Madagascar integrated paper mills with a production of about 50,000 TPY may start between 1980 and 1985. Many countries have too small market to consider domestic production. The prospects for regional pulp mills do not seem to be promising.

Apart from the one in Gabon pulp mills for export have been considered possible (or at least discussed) for Ivory Coast, Cameroon, Congo, Tanzania and Madagascar (Meyer 1972). In Malawi too an export mill has been discussed. If present trends continue it is possible that some ventures will go into production.

It is clear that the development of the African pulp-industry does not so much depend on existing resources as on decisions about investments in forest production and industries. The eventual use of mixed tropical forests in the start-up phase does not change this statement.

A more detailed discussion of the future African pulp and paper industry can be found in a coming (1977) report by T. Ekström from the Royal College of Forestry.

8.4 Final discussions and conclusions

As a summary of this chapter four basic policy problems will be discussed.

8.4.1 What is the best land use?

In theory, areas in need of protection (e.g. watersheds, steep slopes) should not be used for agriculture, forestry etc.; the areas with the best soils elsewhere could be used for agriculture. Adequate areas should be kept as forest (or planted with trees) to supply the basic needs of the local population. Suitable areas could be used to produce industrial wood and so on. Several methods of classifying the land area in a country have been worked out according to these principles. The aim of such classification is to utilize the existing land resources so that it best serves the people now and in the future. Over-utilization or plain destruction obviously causes a reduction of future potential.

When land becomes scarce (due e.g. to increased population) there is normally a conflict between forestry and other forms of land use. Naturally forestry must then argue for the necessary protection forests (e.g. watersheds). Forestry must also defend its right (or rather its obligation) to have land enough to supply the local people with adequate quantities of wood. These are the minimum requirements for responsible forestry. On the other hand forestry can not take the attitude that all land that happens to be forest today must be kept as forest forever.

In the long run this conflict, all too common today, can only be solved by increasing the production per unit area in both agriculture and forestry. Land capability and land use studies should therefore be undertaken. Even if they are undertaken one can still foresee a continuous decrease of closed forest areas and a continuous degradation and decrease of open woodland areas whatever the land use studies may say as long as investments in agriculture are inadequate to increase the production per unit area.

It is also evident that the purely technical knowledge of how to make the best use of a given land area in the tropics is not fully known.

Here we must mention the concept of agro-silviculture. It is likely that a combination of trees and agricultural crops is suitable in many areas. Species can be found which produce fruits, leaves edible by cattle, useful bark and so on as well as wood. Some trees in agricultural land (e.g. Acacia albida) have important environmental benefits. Forestry and agriculture should not always be thought of as being in competition.

8.4.2 How to utilize existing resources?

It seems to be a fact that it is not fully known how the existing (natural) resources of forest and other wooded areas should be utilized in the best way. Unmanaged the closed tropical forests cannot continue to supply the well-known timber species in the same amount as now (within the areas under exploitation). If some sort of management is not introduced on a large scale the forests will be exhausted in valuable species in a not too distant future. Management systems to produce sustained (or rather increased) yield in the natural forest are however not known in all areas.

It is certain that closed natural forest can yield more than the 10 - 25 m^3/ha of "commercial" species exploited at present. For local use at least a considerably larger volume can be utilized.

Even if a good management system was found or if large plantation schemes were started immediately there will still be a shortage of the valuable species in many countries in a few years time. Many countries will have to decide whether they are going to exploit all valuable species now and then decrease production in some years time or if they should keep production at a low perhaps reduced level which can continue for a longer time. Decisions about investments for future production, management and plantations must also be made.

Prices of tropical wood will most likely increase in coming years. In the future more will be known about the management of natural forests. The processing industry can be expected to develop so that only processed products need to be exported. These factors all speak for retarded exploitation.

On the other hand it can be argued that the capital that can be made available from "mining" of the natural forests should be invested in sectors which give a higher return than does forestry. It is now rather common that only a small share of the profits from forestry are invested back in forestry. But unfortunately profits are not always invested in more promising ventures.

In the moist forest region the supply of fuelwood, poles and local sawnwood will probably remain adequate in most areas. It is the supply of the valuable species which is the main problem.

Exploited forests will often have a limited interest for forestry and this will mean that their interest for protection will be difficult. Nor is it possible within a foreseeable future to transfer large parts of the natural forests into plantations. Management of natural forests must therefore be studied more. The basic aim should be to try to regenerate the valuable species naturally. This is difficult but perhaps not impossible.

The basic difficulty with tropical forests is its mixture of different species. Many of the species not marketed at present will prove to have quite acceptable technical qualities (at least for certain uses).

A research centre (regional) should collect all available knowledge about the properties of different species. Gaps in existing knowledge should be filled in with new research. Utilization of a larger number of species is necessary since this would make exploitation more economic and probably management easier. The market seems to be very reluctant to accept new species so intensive efforts to market secondary species would be necessary.

If producing the same amount of timber from plantations proves cheaper investment in management of the natural forests is of course questionable. After all production of the well-known African timber species is not a must in the same way as fuelwood production is. It is ordinary investment. Doubts are sometimes expressed as to whether developing countries can afford to invest in such long-time ventures as plantations of indigenous species.

In the savanna and steppe zones it is the supply of fuelwood which is the most problematic and these areas cannot produce enough timber either. How should the existing wood resources in open woodlands and steppes be utilized? These wooded areas can certainly supply a considerably amount of firewood, poles etc. for local use if they are managed in the best way. In many cases plantations would be more economic. Open woodland areas have also a tendency to become degraded if used for household wood in an unplanned way. This has many negative effects. As a large-scale transformation of these areas to agriculture would probably have many negative effects, the best future utilization of these areas seems debatable. Would it be best if large open woodland areas (scattered in agricultural areas) were protected and only used for extensive grazing? Can agro-silviculture be introduced at large scale?

8.4.3 Which new resources must be created?

It is evident that Africa´s resources of valuable timber species and fuelwood is dwindling. The picture looks gloomy. It is likely that the future of African forestry must to a great extent depend on plantations.

Most of the plantations will be needed to supply local people with fuelwood, poles and timber, Fuelwood is the most important but is often given the least consideration.

The main task African forestry has to tackle is the supply of fuelwood to people living in dry areas. In many of these areas destruction has gone so far that it will be difficult to restore these resources. In the long run most of the population in the savanna and steppe regions will have to be supplied with fuelwood from plantations.

The discussions in 8.3 indicated that a large area would need to be planted today to supply future local needs not easily satisfied by existing resources. Crude estimates gave annual planting areas of 1 million ha for fuelwood (and poles) 0.15 - 0.20 million ha for domestic timber and 30-40,000 ha for pulpwood (outside Southern Africa). If Africa should continue as an important producer of tropical timber species, and become a net-exporter of pulp and paper products much more would be needed. Protection plantations will be necessary too. The need cannot be quantified at present.

It will be a long time before African countries can manage to plant such vast areas. The natural wooded vegetation must therefore be utilized more than assumed in these examples.1/

Obviously, there is a need for Consumption and Production Studies in each country. What wood will be needed in the future and how much can be expected to come from natural wooded vegetation? In many (most?) countries there will prove to be a great need for plantations (mainly for fuelwood and timber). But there will need to be a compromise between what ought to be done and what can be done. The classification must show priorities for the most needed schemes in each country.

This may sound somewhat depressing but is has proved possible to quickly increase the plantation rate of fuelwood plantations, if the local people become convinced it is needed.

Obviously a large part of future wood production in Africa will have to come from plantations. But it cannot be denied that establishing monocultures mainly of exotics in the tropics - as everywhere - is a difficult task. At present little is known about the long term effects on soil, risk for diseases and so on. These difficulties are often underestimated. (Lundgren 1976.) A lot of research will be needed but it must be assumed that the different problems can be solved. There is evidently also a great need for more knowledge about the establishment of plantations of indigenous species.

In order to avoid duplicating of research work and to make new knowledge about plantations of different species, plantation methods and other developments known, there is a need for a regional research institute in the field of plantations. This institute should summarize knowledge and keep up to date with development in different countries. It should also identify gaps in knowledge and try to innovate research in these particular fields.

8.4.4 Which forest industries shall be established?

All countries show a keen interest in increasing the processing of wood. As has been discussed in 8.3.4 plans exist to establish pulp mills but

1/ The increment figures used in the examples are also on the high side.

strangely, there do not appear to be many plans for the development of mechanical wood industries sector (the pulp mills at least discussed more).

These present trends are actually oposite to what would be considered a normal development of the forest industry sector. It would be more natural if industrialization started with sawmills and then, step-by-step, developed veneer and plywood factories. Pulp mills (at least export mills) would come last when the forest industry sector was more advanced and more experienced.

The mechanical forest industries have several advantages over the more advanced. They can be established in small units, they create an industrial infrastructure in several places and they make better use of already existing natural resources for example. Such industries will probably also lead to an increased interest in assuring a long-term supply of wood. The present trends towards big-scale industrialization can therefore be questioned. Would a fast development of the pulp industry really be the most beneficial development?

There are probably advantages for some countries to establish integrated pulp and paper industries to cover domestic needs. As few countries have markets to make such ventures economic regional mills would usually be the ideal solution. To date interest for such ventures have been limited.

The establishing of pulp mills for export based on wood from plantations no doubt looks promising in some countries. Many Governments may make agreements for cooperation with pulp industries in the industrialized countries. Ideally they would be able to pay for the building and start-up of the pulp mill by selling chips. But this could take away investments and initiatives from the more basic forest industries. From some points of view the present trends, at least in the case of export mills, may benefit industrialized countries which will take part in the build-up of the pulp industry and at the same time continue to make profits from the processing of imported logs from the tropics. These are very serious questions of development cooperation strategies which African countries must consider carefully.

The establishing of simple forest industries can often trigger for the whole industrialization process. This was the case in Sweden for example. The African forest countries must not loose this promising possibility. They must at least gradually reduce the export of logs.

8.4.5 Conclusions

If the present trends continue closed forests in most countries will, step-by-step, be creamed of commercial and potentially commercial species. The forest will become depleted of valuable wood. Plantations of these species (when possible) cannot match this drain. Areas of closed forest will continuously decrease. The more the forest areas are made accessible through forest exploitation the more forests can be expected to be cleared especially if they are near densely populated areas.

Transformation of closed forest to agriculture will - in many areas - increase erosion, exhaust the soils and transform large areas of the present forest area into bush. The areas within the remaining closed forest really suitable for permanent agriculture seem to be rather limited.

It also seems evident that fuelwood shortage will increase in many parts of the savanna and steppe zone. In marginal areas increased desertization can be expected due to overgrazing. cutting of fuelwood etc. The potential of many areas will also decrease with the result that fewer people can earn their living from agriculture.

It is not certain that the proportion of the exported wood that is processed will increase to any higher extent. Even in the future many countries may still mainly export logs. Pulpwood plantations and the pulp industry on the other hand may increase in importance in the 1980:s. Certainly a number of small mills and a few large export mills will go into production.

The difficulties that African forestry has to tackle may have been somewhat overstressed in this chapter. Existing forest resources are no doubt inadequate in many countries. If strong actions are taken to change some of today´s negative trends, for example decreasing fuelwood resources and export of roundwood, forestry can play a significant role in the development of the African society. The market forces often work against the interest of the developing countries. More regional cooperation than at present is probably necessary to break the dependancy of the industrialized countries.

9 COMMENTS ON THE DEVELOPMENT OF THE METHOD FOR REGIONAL FOREST RESOURCE APPRAISALS

9.1 General

The report Forest Resources of Africa (Part I and Part II) has as far as possible described the existing forest resources, the knowledge about these resources, the present utilization of these resources, changes in the resources, the production potentials of forest and other wooded areas and the possibilities for a future utilization of the forest resources.

It is clear that no definite answer can be given to all the questions concerning forestry in Africa. As has been repeatedly pointed out available information is inadequate for this purpose. Obviously this report does not give final truths about Africa's forests. It does not even give the best possible picture that could be reached by utilizing all existing sources of information. Discussions about different aspects of forestry often produce more questions than conclusions.

The intention has been firstly to prepare a reference book about Africa's forest resources and secondly to analyse the potentials for forestry. Although incomplete this report can serve as a base for the work of improving knowledge about the African forests. The report must be revised in due time as better data becomes available. Preferrably this revision should be done in combination with a Consumption and Production Study. This is a job for FAO.

Here we will suggest some ways in which the information may be improved.

9.2 Regional Forest Resource Appraisals

For future work it is important to keep in mind that it is unlikely that Forest Resources of Africa contains the best possible picture that can be given at present. It is probable that certain important sources have been missed, more recent information may now be available in some countries, some sources may have been wrongly interpreted etc. Work ought therefore to start as fast as possible on updating the information given in this report.

In the initial phase of this work the report ought to be sent to the Forest Services, Universities etc. in the different countries for comments. As much new information as possible about the forest resources should be searched for over a couple of years. This means an active search for important information which is missing at present. After two to three years the original country notes, all new information, corrections etc. should be used to rewrite the country notes completely. The country notes ought then to contain an analysis of the potential for wood production in each country. The country notes and even all the maps (with additions included in draft) are then finally sent to all possible sources of information for corrections and additions (or approval). This official last step must be taken by FAO or at least through FAO. After this the country notes are republished in the form of a new regional report.

Each country can be printed as a separate report. This will make it easier to continuously introduce new material, corrections, maps etc.

When a considerable amount of new information has been collected for a country the country notes could then be reprinted completely.

The goal ought to be to publish a list with corrections and new information each year and to renew the whole in - let us say - five years. For some countries this will perhaps mean two complete rewritings while some other countries will need none.

Such an approach could be chosen for all regions. FAO can have part of this work done under some form of subcontract. Every fifth year or so FAO could publish a report in three languages containing summary-tables and an analysis of the situation based on the different regional reports. This quennial report could look like the WFI 1963. If possible maps could be included.

9.3 Regional Consumption and Production Studies

The objectives of Regional Forest Resource Appraisals should be to give information about the potential of existing forests and other wooded areas to produce wood now and in coming years. This information must be compared with projections of the future demand for wood. FAO have made these types of studies for different regions over a long period. The need for regional studies is very well expressed in FAO 1976 b.

"Knowledge of the regional situation in the forest products sector has the primary function of providing Governments with a basis for the formulation of plans and policies for the sector in the countries. It is clear that the detailed planning has to be undertaken by the countries themselves and that regional studies do not substitute for this work. However, the best course for any country to pursue in developing the sector is increasingly dependent on development in neighbouring countries within the region and in more distant regions of the world."

The knowledge about a regions´ forest resources must therefore not be seen as an end in itself but as part of the information needed to do Regional Consumption and Production Studies. It can be discussed how much detail should be included in such studies and which information about forest resources is absolutely essential. With slight overstatement one can say that hitherto the information that happens to be available has been collected. The studies undertaken so far have very much been bound by the limitations of inadequate information.

To solve this problem it would be advisable to undertake a theoretical Consumption and Production Study for a region. This study should identify all the questions that should be answered and about which information is needed.

By utilizing complete quesstimates on all items a theoretical Consumption and Production Study should show what the result could be if all the necessary information was available. In this way one should know exactly which information about forest resources is needed at the regional level.

9.4 National studies

The work to improve the knowledge about a regions´forest resources can only to a limited extent be made as regional studies. The most important

work must be done at the national level. It is important that the Regional Forest Resources Appraisals and the Regional Consumption and Production Studies are linked to work at the national level.

As the present knowledge about forest resources is limited there is no doubt a great need for inventory work in many African countries. As a first step this will often mean a Preliminary(National) Forest Resource Appraisal were all existing knowledge is summarized. Some comments about the need for certain basic studies will be given here.

9.4.1 Preliminary (National) Forest Resource Appraisals

A Preliminary Forest Resource Appraisal is a study of all available information about the forest resources and a preliminary but complete picture of the national forest resource. From such a preliminary appraisal the information can be improved step by step.

Usually quite a lot of information about the forest resource (or wooded areas) is available at the national level. But this information is rarely in the form of National inventories. Usually there are scattered inventories, management plans, maps of different kinds, information from logging operations, the knowledge of local forestry officers and so on.

This existing information should be summarized in the best possible way. The objective of such a task must be to estimate the wood production potential. Such estimates must be prepared for different regions of a country.

In most countries the Preliminary Forest Resource Appraisal will show that there are many gaps which must be filled in. It is not always necessary to undertake detailed inventories to fill in these gaps. Simple reconnaissance surveys of one type or another may often be adequate.

A continuous updating and revision of the information about the forest resources is necessary. A Forest Resource Appraisal must not be a one-time undertaking but develop into a continuously working Forest Resources Data Bank.

Maps are very often valuable in keeping the information up to date. Maps of different types have often been prepared. The Forest Resources Data Bank must continuously include new information on these maps.

9.4.2 Consumption and Production Studies

In each country it is necessary to undertake studies of the present consumption of different wood products and to estimate how much the consumption of these products will increase in coming years.

These consumption studies must be undertaken at different levels for different products. Fuelwood must be studied at a level of small districts, while sawnwood can be studied at a level of larger districts. The need for paper products must normally be studied at a national level.

The estimates of consumption must be compared with the present and possible future production of existing wooded areas and of forest industries. A plan must be worked out for the production of wood and forest industries products.

In districts which cannot produce adequate quantities of fuelwood, plantations (farm forestry) must be established. A program for these must be worked out. Plantations for timber must also be established when it is found necessary i.e. when the existing wooded areas cannot produce adequate quantities.

In the case of pulpwood a decision must be made as to whether there should be domestic production or whether pulp and paper should be imported. If the decision is domestic production then plantations must often be established.

For countries which have large resources of natural forests a policy for the utilization and management of the natural forests must also be worked out.

The end result of the Consumption and Production Studies must be a clear Production Programme for the whole forestry sector including:

a) Management and utilization of existing natural wood vegetation
b) Creation of new resources (Village plantations and industrial plantations)
c) Establishment of forest industries.

It is evident that when natural vegetation can produce very little wood the Forest Resource Appraisal will be a modest undertaking. What is needed in this case is a programme for the establishment of forest plantations. When natural wooded vegetation can yield most of the required wood then the Appraisal must be more accurate.

9.5 Concluding remarks

This chapter has stressed the need for more knowledge about the forest resources. A better knowledge about forest resources, its potentials and limitations is a must if fast development of the forestry sector should come about. It is a fact that over the last years much more resources have been put into space exploration than into the necessary study of the biological resources of the world on which we all depend.

10 SUMMARY

This work summarizes existing knowledge about Africa's present forest resources and discusses future prospects. The work can be seen as an attempt to improve on the World Forest Inventory which has been carried out by FAO at five year interval.

It must be clearly stated that present knowledge of forest resources is limited. Only 10-15 per cent of the closed forest area is covered by relatively reliable inventories. Knowledge about non-inventoried areas is, actually, based on crude estimates at least as concerns volume.

Background about production, trade and consumption

In 1973 the production of industrial roundwood was estimated as 43 million $m^3(r)$ while the production of fuelwood was estimated to be 273 million $m^3(r)$. The production of processed wood products is relatively small. The production of sawnwood was about 5 million $m^3(s)$ and the production of wood-based panels 0.75 million $m^3(s)$. The production of plywood and veneer is concentrated to West and Central Africa. Outside Southern Africa production of pulp, particle board and fibreboard is very small.

Africa has a positive balance of trade in wood products. This is because of the large export of roundwood exported from West and Central Africa. Other regions have a negative balance of trade. Of processed wood products, Africa has a net import of sawnwood, particle board and paper products. Africa has a net export of pulp (mainly South Africa and Swaziland), fibreboard, plywood and veneer.

The present per capita consumption of processed wood products is small. Per 1000 capita it corresponds roughly to 50 m^3 WRME (world average approx. 380 m^3 WRME). The consumption of other industrial wood (e.g. poles) is 45 $m^3(r)$/1000 capita and the consumption of fuelwood 700 - 800 $m^3(r)$/1000 capita.

The increase in consumption of processed wood products has been relatively fast during the last decade. This fast increase in consumption must be expected to continue. According to the preliminary estimates prepared in this report the total consumption of industrial wood (in WRME for processed products) is estimated to increase 5-6 times up to the year 2000 and the consumption per capita 2-3 times.

Investigations made by FAO indicate that the demand for tropical hardwood in the world will increase fast. The world demand for pulp will also increase fast. The production of processed forest products in Africa has risen relatively fast the last years. Even if this development continues it is probable that Africa will still find it difficult to produce enough to cover domestic demand.

Forest resources

The total area of closed forest is about 190 million ha while the area of open woodlands may be about 600 million ha. There is also an intermediate category of dry forest types (e.g. the maquis vegetation in the Mediterranean region) which covers 10-15 million ha. Coniferous forests cover in all not more than 2-3 million ha.

The total area of man-made forests is now about 3 to 3.5 million ha. Eucalyptus and pines occupy about one-third each of these plantations. The main objective of the man-made forests established hitherto is to produce timber and, to some extent, fuelwood. In recent years the production of pulpwood is increasing in importance. During the last years about 150,000 ha has been planted annually. If present plans are followed this should now increase to more than 200,000 ha a year.

The total volume in closed forest is about 40,000 million m^3. About half of this volume is found in Zaire. In open woodland there is an additional volume of 15,000 - 20,000 million m^3. The volume in the closed forest that is now classified as "commercial" is about 5,000 million m^3. The "potentially commercial" volume is perhaps of the same size. With the present demand for different species and sizes, and the present exploitation technique it is probable that not more than 1,000 - 2,000 million m^3 would reach the market.

Changes in the environment and in the area of forest

Because of the fast increasing population many areas are more and more intensively utilized for agriculture. Over-utilization of the resources (e.g. the soil) can mean that the potential of an area is reduced.

Shifting cultivation is the basic reason why forest resources are decreasing. In the report it has been estimated that the closed forest area decreases annually by about 2 million ha.

In dry areas overgrazing is increasingly a serious problem. Over-exploitation of the wood resources occurs in many areas.

Many of the environmental problems in Africa can be solved if the production per area unit is increased. In this way the necessary protection measures can be concentrated better and areas unsuitable for agricultural production (e.g. steep slopes) would not be needed.

The potential for wood production

Obviously the potential for wood production is decreasing as the closed forest area is continually reduced. Selective cutting of valuable species means also that the potential of exploited areas is reduced at least as far as the presently commercial species are concerned. The area of closed forest that is unexploited at present has in this report been estimated to be roughly 140 million ha (110 million ha of these are estimated to be potentially exploitable). Each year commercial exploitation is likely to take place in an area of about 1 million ha. Most of this is being exploited for the first time. It has here been estimated that the remaining closed forest area in 25 years time will be 140 million ha.

Knowledge about how much the tropical rainforest can produce is limited. If clear-cutting and natural regeneration is utilized the possible net-increment may be 3-5 m^3/ha/year (rotation period about 100 years). Of this increment only a minor share is in species that is commercial at present. If selective cutting is utilized it is likely that the forest will be impoverished step-by-step.

A number of silvicultural systems to make the tropical forest more productive - i.e. increase the volume of commercial species - have been

worked out. Using one of these systems it may be possible to reach an annual production of 2-4 m^3/ha. But up to date these systems have proved successful only under very favourable conditions and they are said to be costly.

Plantations of valuable tropical hardwood species seem to be able to produce 7-10 m^3/ha/year. In the case of many species methods as to how to establish plantations are not well known.

In plantations of Eucalyptus and pines the net-increment is often reported to be 20-40 m^3/ha/year. This figure may be optimistic. The actual increment in the plantations that have been established seems to be lower.

The open woodlands have a very low production. In the Miombo a possible production of 0.6-1 m^3/ha/year has been found in some crude investigations.

If all closed forest, open woodland and so on were utilized for production of wood the present production could probably be 700-800*million m^3. The practically possible production is much less.

Discussion about the future of forestry

The present exploitation for industrial wood, fuelwood, shifting cultivation and so on is so large that it is most likely that the total amount of wood is decreasing.

The present production of fuelwood is estimated to be at least 7 times as large as the production of industrial wood. In the open woodland (and steppe) areas that are densely populated it is clear that the fuelwood resources are decreasing. This often produces large environmental problems. It is likely that large parts of Africa outside the rainforest zone will need fuelwood plantations. Probably about 1*million ha should be planted annually. It is also certain that plantations for the production of timber ought to be established in most areas outside the rainforest zone.

Resources of hardwood species known to the export market are dwindling. The production in West Africa must certainly be reduced in coming years. If present trends continue resources in Central Africa (except Zaire) will also be considerably reduced towards the year 2000. The resources in Zaire are evidently so large that a heavy increase would be needed before one could start to talk about any serious reduction of the resources.

Plantations of the presently commercial species or improved management (regeneration measures) can - in a more distant future - improve the situation. But it is uncertain whether any such actions really will take place on large scale.

Most countries aim to stop exporting roundwood and instead export processed products. How fast they will succeed in this is difficult to foresee.

There is now a great interest, both among African Governments and among foreign companies, in starting pulp production. Pulpwood would be produced not only from plantations of fast-growing species but also

from the rainforest. Whether Africa within a foreseeable future will become an important pulp producer depends very much on the failure or success of the first attempts. There are many difficulties to overcome.

In this connection the concentration on pulp production must be questioned. It would be more logic if a major breakthrough of the African forest industry first come in sawmills, veneer and plywood mills. From the development point of view these industries have important advantages.

Final remarks

This report must be considered a preliminary attempt. It must be improved step-by-step. The information about the forest resources in different countries presented in this report can be sent to the Forest Service in the respective countries for comments. After a continuing collection of information over a two-three years period a new edition of the report could be published.

Full and reliable information about forest resources is needed to ensure that future demand for forest products can be met. If the resources are insufficient investments in increased forest production will be necessary. To be able to answer all important questions a much better knowledge than exists at present is necessary. The regional studies can only give a frame for the national studies. Most of the work must be done at the national level.

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12 SAMMANFATTNING (Summary in Swedish)

Målet för det här redovisade arbetet är i första hand att beskriva den nuvarande kunskapen om Afrikas skogsresurser. Så långt möjligt har också diskuterats vilka framtidsutsikter skogsbruket i Afrika har. Arbetet kan ses som ett försök att förbättra den World Forest Inventory som från 1947 med fem års intervall har gjorts av FAO.

Det måste slås fast att den nuvarande kunskapen om skogstillgångarna är bristfällig. Endast 10-15 procent av skogstillgångarna är täckta med någorlunda tillförlitliga inventeringar. "Kunskapen" om ej inventerade delar bygger till en stor del på grova skattningar - åtminstone vad beträffar volymen.

Bakgrund om produktion, handel och konsumtion

År 1973 uppskattades produktionen av industrivirke till 43 milj $m^3(r)$ medan produktionen av brännved uppskattades till 273 milj $m^3(r)$. Produktionen av skogsindustriprodukter är relativt liten. Av sågat virke var produktionen ca 5 milj m^3 (s) (Sverige 9,4 milj m^3). Plywood och faner-produktionen är 0,75 milj $m^3(s)$ - framför allt koncentrerad till Väst och Central Afrika. Utanför Sydafrika är produktionen av massa, spån och fiberplattor obetydlig.

Afrika har för tillfället en positiv handelsbalans med träprodukter. Detta beror på en stor export av rundvirke från Väst och Central Afrika. Övriga regioner har en negativ handelsbalans. Afrika som helhet har ett underskott i handeln med sågat virke, spånplattor och papper. Förutom på plywood, faner och fiberplattor har Afrika ett överskott i handeln på massa. Detta beror på en relativt stor export av massa från Sydafrika.

Den nuvarande konsumtionen av skogsindustriprodukter är låg. Per 1000 capita motsvarar den ungefär 50 m^3 WRME. (Sverige konsumerar ca 2000 $m^3(r)$/1000 capita.) Konsumtionen av rundvirkesprodukter är 45 $m^3(r)$/1000 capita och av brännved 7-800 $m^3(r)$/1000 capita.

Konsumtionsökningen (av industriprodukter) har relativt sett varit ganska snabb det senaste decenniet. Konsumtionen kommer sannolikt att stiga ganska snabbt också under den följande 25 års perioden. Enligt en preliminär beräkning beräknas totala industrivirkeskonsumtionen (i m^3 WRME) stiga 5-6 gånger och konsumtionen per capita 2-3 gånger.

Av de preliminära beräkningar som gjorts av FAO framgår att efterfrågan av tropikträ kommer att öka. Det kommer antagligen också att bli en stor marknad för export av massa. Industriproduktionen i Afrika har stigit relativt snabbt de senaste åren. Även om denna utveckling fortsätter kommer Afrika troligen att få svårigheter att producera tillräckligt för det interna behovet.

Skogstillgångarna

Den totala arealen av sluten skog är ca 190 milj ha medan arealen savannskogar är ca 600 milj ha. Det finns också en intermediär kategori av torra skogstyper (t ex buskvegetation i Medelhavsområdet) som täcker 10-15 millioner ha. Barrskogar täcker inte mer än 2-3 milj ha.

Den totala arealen av planteringar är nu 3-3,5 milj ha. Eucalyptus och tall upptar ungefär en tredjedel vardera av dessa planteringar.

Planteringarna syftar framför allt till timmerproduktion och i viss mån även brännvedsproduktion. I en ökande grad syftar de också till produktion av massaved. Under senare år har den totala årliga planteringsarealen legat på ca 150,000 ha. Enligt planerna kan den nu vara mer än 200,000 ha per år.

Den totala volymen i sluten skog är ca 40,000 milj m^3. I savannskogar etc. finns ytterligare 15,000-20,000 milj m^3. Den volym som nu klassas som kommersiell är ca 5,000 milj m^3. Den potentiellt kommersiella volymen är betydligt större. Med nuvarande efterfrågan och avverkningsteknik kan man räkna med att 1000-2000 milj m^3 kan nå marknaden. Cirka hälften av denna volym finns i Zaire.

Miljöförändringar

På grund av ökande befolkning blir många områden allt hårdare utnyttjade för exv. jordbruk. Överutnyttjande av tillgångarna (ex marken) kan leda till att ett områdes produktionspotential minskar.

Svedjebruk är den väsentligaste orsaken till att skogstillgångarna minskar. I rapporten har beräknats att den årliga minskningen för närvarande kan vara i storleksordningen 2 milj ha.

I torra områden minskar på många håll vedtillgången på grund av avverkning för brännved. Överbetning är också ett allvarligt problem.

För att komma tillrätta med många av miljöproblemen i Afrika krävs framför allt att produktionen per arealenhet ökar. På så sätt kan nödvändiga skyddsåtgärder koncentreras bättre och områden olämpliga för jordbruksproduktion behöver ej utnyttjas.

Produktionspotentialen

Eftersom skogsarealen reduceras år från år minskar den produktiva arealen. Selektiv avverkning av värdefulla arter leder också till att dessa områdens framtida potential minskar vad beträffar produktionen av dessa arter. Den areal sluten skog som är oavverkad för tillfället har skattats till ungefär 140 milj ha (100 milj ha av dessa potentiellt exploaterbara). Varje år sker kommersiell avverkning på ca 1 milj ha. Större delen av denna areal exploateras för första gången. Om 25 år väntas den totala kvarvarande skogsarealen vara i storleksordningen 140 milj ha.

Kunskapen om vad den tropiska regnskogen kan producera är bristfällig. Med kalavverkning och naturlig föryngring kan den möjliga nettotillväxten eventuellt vara i storleksordningen 3-5 m^3/ha/år (rotationsperiod ca 100 år). Av denna tillväxt utgörs bara en liten del av arter som är kommersiella för tillfället. Med selektiv avverkning är det sannolikt att skogen steg för steg utarmas.

En mängd system har utarbetats för att göra den tropiska skogen mer produktiv - dvs öka förekomsten av värdefulla arter. I några av dessa system kan man kanske i praktiken räkna med att få en produktion av 2-4 m^3/ha/år. Hittills har dock dessa skötselsystem lyckats endast under mycket gynnsamma omständigheter. Kostnaderna blir också mycket höga.

Planteringen av de värdefullt tropiska lövträden verkar kunna ge en produktion av åtminstone 7-10 m^3/ha/år. För många av dessa arter gäller att de är mycket svåra att plantera.

När det gäller planteringen av exoter som Eucalyptus och tall kan tillväxten vara i storleksordningen 20-40 m^3/ha/år. Medelproduktionen i de planteringar som skapats brukar dock vara lägre än vad som antyds i de mest optimistiska rapporterna.

Savannskogarna har en mycket låg produktion. För miombon i Östafrika har en tillväxt i storleksordningen 0.6-1 m^3/ha/år beräknats vid de grova undersökningar som gjorts.

Om all sluten skog, savannskog osv. började utnyttjas för produktion av trä skulle den totala produktionen av trä för tillfället kunna vara i storleksordningen 700-800*milj m^3.

Diskussion om skogsbrukets framtid

Den nuvarande avverkningen för industrivirke, brännved, svedjebruk etc. är så stor att det är ganska säkert att tillgångarna minskar.

Brännvedsproduktion är för tillfället åtminstone 7 gånger så stor som industrivirkesproduktionen. I de delar av savannzonen som är tättbefolkad är det klart att brännvedstillgången minskar. Detta skapar ofta stora problem. Det är sannolikt att stora delar av Afrika utanför regnskogen skulle behöva etablera planteringar för brännvedsproduktion. Den areal som skulle behöva planteras för tillfället är förmodligen i storleksordningen 1*milj ha per år.

Det är ganska säkert att planteringar för produktion av timmer borde skapas i praktiskt taget alla områden utanför regnskogszonen.

När det gäller de arter som är välkända på exportmarknaden är det tydligt att tillgången minskar. Västafrikas produktion måste säkerligen minska under de närmaste åren. Framemot år 2000 kan tillgången också börja sina i Centralafrika (utom Zaire). I Zaire som har mycket stora resurser verkar tillgångarna kunna räcka länge.

Planteringen av de värdefulla trädslagen eller bättre skötsel (föryngringsåtgärder) kan i en mera avlägsen framtid förbättra tillgången. Om sådana åtgärder verkligen kommer att företas i någon större omfattning är ytterst osäkert. För dessa åtgärder bör ställas samma krav på lönsamhet som på investeringar i allmänhet.

De flesta länder vill nu sluta exportera rundvirke och istället exportera förädlade produkter. Om de verkligen kommer att lyckas (inom en nära framtid) i sina föresatser är svårt att säga.

Intresset är nu stort, både bland afrikanska regeringar och utländska företag, att starta massaproduktion i Afrika. Härvid planeras att utnyttja både den naturliga regnskogen och planteringar av snabbväxande trädslag. Om Afrika verkligen kommer att bli av betydelse på massamarknaden beror på framgången eller misslyckandet med de första försöken. Svårigheterna som måste övervinnas är många.

I det här sammanhanget kan man fråga om satsningen på massaproduktion verkligen är vettig. Det vore mera logiskt om uppbyggnaden av den afrikanska skogsindustrin startade med sågverk, faner och plywoodindustrin. Ur utvecklingssynpunkt har dessa industrier stora fördelar.

Slutord

Den här rapporten måste betraktas som en preliminär studie som måste förbättras steg för steg. Uppgifterna för olika länder kan skickas till Skogsstyrelserna i respektive länder för kommentarer. Efter två-tre års kontinuerligt insamlande av material kunde rapporten publiceras i ny upplaga.

Uppgifter om skogstillgångarna behövs för att se hur den framtida efterfrågan på skogsprodukter kan mötas. Är resurserna otillräckliga är investering i ökad skogsproduktion ofta den bästa lösningen. För att verkligen kunna svara på alla väsentliga frågor krävs det bättre kunskaper om skogsresurserna än för tillfället. De regionala studierna kan bara ge en grov ram för de nationella studierna. Det mesta arbetet måste givetvis göras på nationell nivå.

APPENDIX I

Summary-tables

A. General

The summary-tables contain certain basic information about the forest conditions in Africa found in the country notes and in the regional summaries. To make these tables as complete and useful as possible, some figures from the FAO Production Yearbook, FAO Forest Products Yearbook, WFI 1963 and other sources have also been used.

The limitations of the information in the country notes has been discussed in 3.1 to 3.3 in Part I. These limitations are in the main valid also for the summary-tables.

The intention is that the information given in the summary-tables shall be as comparable as possible. This may sometimes mean that figures given by a country may be adjusted somewhat to make this possible. The reason is that data is not available in the same form in all the different countries. This means that the tables are full of compromises. Very often it has been impossible to put a meaningful figure under one heading (though related information may have been available). The same table filled in at different times sometimes show discrepancies - basic information in the country notes has been interpreted differently from time to time.

In the definitions given in this Appendix (under point D) the different terms used have been defined. There are certainly variations as to the interpretation of these definitions. Footnotes are given when there are known to be more serious divergences.

The definitions of the terms together with the scattered comments on the different tables given under B intend to give the necessary background facts for a clear understanding of the tables.

B. Comments on the tables

Table S I - Land use

Source: FAO Production Yearbook 1973. See also comments under 3.2.1.

Table S II - Natural closed forest

The main effort in this report has been put into identifying the area of closed natural forest and man-made forest in the respective countries. In the summary-tables natural forest and man-made forest are shown separately, but man-made forests may sometimes have been reported as natural forests. In reality the areas of man-made forests are normally so small that a mistake makes very little difference. Often, exclusion of the man-made forests from the total forest area would make figures for the area of natural forests look more exact than they actually are. The total closed forest area (including natural and man-made forest) has for the sake of completeness been included in Table S VII.

The areas of mangrove and bamboo are shown separately but not because

these areas are especially valuable. The areas covered by these vegetation types are far from completely known.

Table S III - Open woodlands, scrub and brushland

The information in this table is more uncertain than the figures for area of closed forest as rather few countries have detailed information on this subject. The comparability of the information is poor. The accuracy classification of the information has been close to impossible.

The table includes both national estimates and other estimates. As can be seen in the land use table countries in the savanna zone have often reported large areas of forest land. This information has then often been used as the area of open woodlands. Other figures used are estimates of the area of different vegetation types.

It has often been difficult to judge whether a degraded formation should be classified as open woodland or as scrub and brushland. Scrub and brushland has been included only to try to separate these from more valuable wooded areas.

Information about bush fallow, which covers considerable areas in many countries, is unreliable. Bush fallow is of little importance from the forestry point of view but sometimes such areas may be shown as forest. They may also have importance as suppliers of fuelwood and scattered timber trees. From the environmental point of view these areas must often be considered as forests.

Tables S IV and S V - Man-made forest

The same comments as were given under "Comments to the country notes" in Part I apply.

Table S VI - Vegetation types

This table mainly gives information from the "Vegetation map of Africa south of the Tropic of Cancer" (Anon. 1959). For the North African countries the information comes from a vegetation map in "Tree planting practices in African savannas" (FAO 1974 e).

Actually, this table shows climatic (or ecologic) types rather than actual vegetation. Large parts of the areas shown under a specific vegetation type (e.g. moist forest) in this table have been transformed into agricultural land, bush etc.

Table S VII - Inventories

This table tries to show the extent of undertaken inventories. It may sometimes be difficult to decide whether an inventory have been undertaken in closed forest or in open woodlands. There are also many different types of inventories. When no detailed inventory results have been available it can sometimes be difficult to figure out whether the area given concerns the total area covered by the inventory or the forest area really inventoried.

Table S VIII - Summary of inventory results and national estimates

When possible the basic results from inventories are shown in this table. It is very difficult to compare inventory results as information collected differs from practically all points of view. It can sometimes be unclear to which part of the inventoried area the volume figures actually belong.

The table also contains the national estimates which have been done for the whole forest (or wooded) area in some countries. It is not always known what the figures actually mean.

Table S IX - Standing timber

This table gives the guesstimates of total standing timber which have been calculated in the regional summaries (chapter 4). It is unnecessary to point out that these guesstimates are very unreliable but necessary for the different discussions. The rather detailed background to these figures given in chapter 4 will hopefully make it possible for persons with local knowledge to adjust these figures in the correct direction.

It is clear that such totals of the gross volume in a tropical country is of a rather limited use. At present however it is the only volume figure which in any way can be made comparable. The different types of commercial volume can at present not be made comparable in a meaningful way.

Figures concerning the volume in plantations have only rarely been given. Figures are here shown only when some background information is available or when this resource is thought to be of basic importance. Due to the lack of information about age distribution etc. it is normally impossible to make any meaningful guesstimates of the volume in plantations. Naturally it is the sustained yield in the plantations which is of major importance. Even this information is difficult to give as the plantations are often very young and will yield some time in the future.

That the volume from the plantations is normally not shown does not make much of a difference to the total picture.

Table S X - Ownership

As far as possible this table shows the present ownership. Only to a limited extent does the information come from the country notes. To make the table more complete information has also been taken from WFI 1970 Africa questionnaire answers and sometimes from the 1963 WFI. Sometimes it has been necessary to make an evaluation of what seems to be the most probable truth.

In the sources information is sometimes given for the area of forest and other wooded areas (or the area classified as forest) without giving any specific information about the ownership conditions in different types of wooded areas. This is the main reason why a breakdown in ownership has been done for the area of forest and other wooded areas. Naturally it is the ownership in closed natural forest and in man-made forests which is of basic interest. In open woodland the ownership may be unclear in areas which are not designated as forest reserves.

Table S XI - Area of forest reserves and protection reserves

It is of utmost importance to know how large part of the forest resource in a country is in one way or another reserved for production of for protection.

The figures concerning forest reserves and protection reserves have been extracted from the country notes, WFI 1970 Africa questionnaire answers, Timber Trends and Prospects in Africa, WFI 1963 etc. The intention has also been to try to identify the area of the forest reserves that are covered by protection reserves. This has not always been possible. The information is rather incomplete and it is therefore difficult to say how large a part of the wooded area (reserved or not) really can be used for forest production.

The areas given for National parks have been taken from "United Nations List of National parks and equivalent reserves". The figures showing the area of closed forest in National parks are incomplete. The area of National parks is given as the information for protection reserves is so incomplete. The wooded areas of National parks are evidently rarely included in the figures for protection reserves (which they should according to the definition).

Table S XII - Exploitation pattern

The information concerning concessions and management plans have, in the main, been extracted from the country notes in Part I, answers to the WFI 1970 Africa questionnaire and so on.

The information concerning exploited, unexploited, potentially productive, and accessible forest is to a very high degree a personal judgement which cannot be traced to any source. It is considered necessary to try to get hold of this information.

Table S XIII - Roundwood production

For the sake of completeness, figures on removals are shown in the summary-tables. They have been taken from FAO Yearbook of Forest Products 1973.

Many of these figures are unreliable. The figures given on fuelwood are - in some cases - pure guesses (guesstimates). In the case of industrial wood, the national figures sometimes show the actually recorded removals. Often the recorded removals cover only parts of the actual total removals, which are therefore considerably higher. The figures given by FAO include as far as possible estimates of unrecorded removals.

In the country notes exploitation figures are only given when they have been traced in some original source. These figures may not always correspond with the figures given in the Yearbook of Forest Products.

Table S XIV - Other information

This table includes certain information which does not naturally fit into any of the other tables. The information about population comes from FAO Production Yearbook 1973. As far as possible the figures for population density and closed forest as percentage of land have been calculated for the land area.

C. Judgement of accuracy

The accuracy of the information presented in the summary-tables as well as in the country notes quite naturally varies very much. An effort has been made to evaluate the accuracy of the information presented for different countries. The evaluation has been done for each country for different types of summary-tables: Closed forest (Table S II), Open woodland (Table S III), Man-made forest (Table S IV) and Standing timber (Table S IX). In the case of the other summary-tables it is impossible for me to judge the accuracy. In Table S II the evaluation is done basically for the area of closed forest; in Table S III for the total area of open woodland; in Table S IV for the total area planted; in Table S IX for the total volume of standing timber.

The accuracy has been classified in five crude classes ranging from very good to very limited. These classes can be described as follows

Accuracy class	Rough estimate of accuracy level[1] Per cent
1. Well known. Information based on good inventories.	- 5 to + 5
2. Relatively well known	- 10 to + 10
3. Rather unreliable information. Partly based on inventories	- 20 to + 20
4. Poorly known	- 40 to + 40
5. Practically unknown. Information close to a guess.	More than - 40 to + 40

1/ Most likely the true value of figures classified as being in one of these classes fall within the limits given.

It must be clearly stated that this classification is my own most subjective judgement. It is very crude - a country might be moved up or down one or even two classes. Naturally, if all the information that actually exists in the countries had been available to me accuracy would be much improved.

The definitions of terms differ often between a country and this report so the accuracy classification is not only a judgement of whether the original national figures are correct or not. A different definition will naturally cause a down-grading of an otherwise exact figure but this condition is often explained by the country notes.

In the case of forest and other wooded areas (Table S II and S III) and standing timber (Table S VII) the classification refers to the present day situation (1975). In the case of man-made forests (Table S IV) the figures are nearly always some years old and therefore often relatively inaccurate. The judgement is therefore made for the year of estimate since new plantings and so on make it quite impossible to meaningfully classify the present day situation. In the case of standing timber the judgement has been made as if the area figures were correct. Otherwise most countries would have been placed in accuracy class 5.

It must also be noted that the area of closed forests and man-made forests is far more often overestimated than underestimated. The minus-signs in the accuracy classification are therefore normally more valid than the plus-signs.

Finally it must be said that this very crude and subjective classification of accuracy must be seen as an attempt to show in a simple form something which is actually very complicated. It is a subjective impression put on paper in the form of a figure.

D. Definitions of the terms used in the summary-tables

The terms used in the summary-tables are defined here. The definitions of the terms have - as far as possible - been taken from the 1970 WFI questionnarie for Africa (FAO). The terms are defined only the first time they occur in one of the tables. It has sometimes been necessary to add comments to the definitions.

Table S I - Land use
(Definitions from FAO Production Yearbook 1973)

Total area refers to the total area of the country, including area under inland water bodies. The definition of inland water bodies generally includes major rivers and lakes.

Land area refers to total area, excluding area under inland water bodies.

Agricultural area is subdivided in three categories namely arable land (including fallow land), land under permanent crops and land under permanent meadows and pastures. For detailed definitions of these terms see Appendix I in Part I.

Forests and woodlands (Forest land) refers to land under natural or planted stands of trees, whether or not productive. 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 be shown under agricultural area although some countries include them under forests.

Other area includes unused but potentially productive land, build-on areas, wasteland, parks, ornamental gardens, roads, lanes, barren land, water bodies, and any other land not specifically listed above.

Table S II - Natural closed forest

The area of "forest and other wooded areas" (natural) has been subdivided into two separate tables; Table S II Closed forest and Table S III Open woodland, scrub and brushland. "Forest and other wooded areas" are defined as: "Areas covered with trees and/or shrubs and not used primarily for agriculture or other non-forestry purposes" (FAO).

Forestry purposes: "Wood production and benefits from the environmental effects of forests".

Accuracy class: See page 175

Year of estimate: This figure is intended to show the year of the estimate. Often anyhow it shows the year the figures were provided or the year of a report in which the figure has been given. If the information is based on unpublished reports it is not always possible to give any year of estimate. That a year of estimate is given does not always mean that all the figures come from the same year, only that most of the figures or the most important figures come from this year.

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. All open woodland as defined under Table S III are excluded even if trees cover more than 20 per cent of its area (FAO). Generally can be said that this category includes vegetation types (forest types) which give (can give) mainly industrial wood. Open types which mainly give fuelwood are not included.

For more details see Appendix I in Part I.

Broadleaved (non-coniferous, hardwoods): All trees classified botanically as "Angiospermae" - e.g. maple (Acer), alder (Alnus), ebony (Diospyros), beech (Fagus), lignum vitae (Guiaicum), poplar (Populus), oak (Quercus), sal (Shorea), teak (Tectona), casuarina (Casuarina). - FAO.

Mangrove: Mangrove vegetation occurs in brackish swamps by river estuaries along tropical and subtropical coasts.

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). - FAO.

Other forests: This category includes certain categories which it is unclear if they shall be classified as closed forest or open woodlands e.g. dry deciduous forest, certain mediterranean types.

Table S III - Open woodland, scrub and brushland

Open woodland: Land, other than closed forests, with trees whose crowns cover 5 to 20 per cent of the area, not primarily used for agricultural or other non-forestry purposes (such as grazing of domestic animals).

The category includes mainly savanna belts found north and south at the equatorial forest region. "Open woodland" as 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 forest) 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. (FAO).

For more details, see Appendix I in part I.

Open woodland (moist): Relatively dense types of open woodlands like Guinea savanna, Miombo etc. are shown under this heading.

Open woodland (dry): More open and lower types of open woodlands like Sudan savanna, Mopane etc. are shown under this heading.

Scrub and brushland: This is a residual category which 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 (FAO).

For more details, see Appendix I in Part I.

Bush fallow: In this category is shown the areas that are covered by secondary vegetation grown after the areas have been cultivated for a number of years. If these areas are not cleared again they will normally return to forest. Within brackets are given some figures for open woodland areas.

Open woodland according to Vegetation Map of Africa: For each country the area of open woodland has been calculated from the Vegetation Map of Africa South of the Tropic of Cancer by dot-counting. In this figure agricultural land etc. is included in the respective vegetation type. According to this map then open woodland covers considerably larger areas than in reality. It still gives an impression of the "natural" occurance of these vegetation types.

Table S IV - Man-made forest. Species.

Man-made forest includes forests established by afforestation, reforestation and artificial regeneration. For definition of these terms see Appendix I in Part I.

Year of estimate: This relates to the year of estimate for total area planted.

Total area planted: This figure includes the total area of afforestation, reforestation and artificial regeneration.

Table S V - Man-made forests. Planting rates and purposes.

Actual planting rate: This shows the area that has been reported as planted during some of the last years. The actual period for these plantations are normally given in the country notes.

Planned planting rate: This shows the area that is planned to be planted for a coming period of years. In some cases, when the information dates some years back, the plantation should already have taken place.

Purpose of present plantations: A planted area can naturally often be used for many different pruposes. Here the information is given when the man-made forest has been established with a special purpose in mind, when it is now used for a special purpose or when plans exist to use it for a special purpose.

Table S VI - Vegetation types

This table is based on the Vegetation Map of Africa south of the Tropic

of Cancer and map in the FAO 1974 e. The definitions that follows show in the main the relation between the terms used in Table S VI and in the Vegetation Map of Africa. A more detailed description of the different description of the different types can be found in chapter II of Part I.

Moist forest: Moist forest at low and medium altitudes.

Other closed forest types: Montane evergreen forest; Temperate and subtropical evergreen forest; Dry deciduous forest (with abundant Baikiaea plurijuga - and Madagascar types); Closed forest in the Mediterranean zone; Mangrove.

Maquis, montane communities: Maquis-Mediterranean; Montane communities - undifferentiated; Montane communities - with afro-alpine communities.

Rel. moist woodlands: Forest-savanna mosaic; Coastal forest-savanna mosaic; Woodlands and savannas(of which: Undifferentiated - relatively moist types; South-eastern areas - with abundant Brachystegia and Julbernardia; South-western areas - principally on Kalahari sand.)

Rel. dry woodlands: Woodlands and savannas (of which: Undifferentiated - relatively dry types; Ethiopian types; With abundant Colophospernum mopane).

Thicket, bamboo: Itigi type; Madagascar types; Ethiopian evergreen types etc.

Wooded steppe: Wooded steppe with abundant Acacia and Commiphora.

Grasslands: Madagascar grass savanna and grass steppe; Grass steppe with thicket clumps - Western Uganda type; Montane grassland; Temperate and subtropical grassland; Grass steppe on Kalahari sand; Grass steppe - Luanda type; Karoo succulent steppe.

Desert-Subdesert: Subdesert steppe; Desert.

Table S VII - Inventories

Closed forest area: This is in principle the area of natural closed forest as shown in Table S II and the area of man-made forests shown in Table S IV. The figures are rounded.

Relatively detailed inventories: These inventories are undertaken to yield relatively detailed and accurate information about the forest resources in a country or region. Naturally measurement of field plots is necessary. Ideally all species and all diameters are measured. Often though it has been considered necessary to include inventories which have not measured all trees or which have excluded trees of non-commercial sizes.

Nationwide: Such detailed inventories cover more or less all forests in a country (National inventory) and are intended to provide information for forestry planning at the national level. Accurate figures are normally given only for large areas.

Preinvestment or regional: Such inventories are undertaken mainly in connection with investigations for the development of the forestry sector in a specific region.

Reconnaissance surveys: A preliminary survey of a forest area, made in order to gain a general knowledge of all facts likely to be useful in determining future management. A reconnaissance survey may occasionally be based entirely on aerial photographs. In any case the relative number of field plots is small.

Management plan inventories: Such inventories are made to collect information necessary for the preparation of management plans for a forest area. The results are not always of a type useful for planning at the national level. It may often be difficult to add the results from different inventories together. The results may often also be old and outdated.

In open woodlands: The information given here refers to the areas given in Table S III.

Note: A problem arises here as to how old an inventory can be to be included. No definite rules can be set but hardly any of the inventories included are older than 10-15 years.

Tables S VIII - Summary of inventory results and national estimates

Area: Here is shown the area for which information about standing timber is given. In the case of inventories it shows the inventoried area (forest area).

Standing timber: Volume of standing trees, all species, all diameters, all ages and including bark unless otherwise specified. Species which do not reach upright trunk forms (brushes) are not considered as trees. (Definition in WFI 1970 Africa questionnaire.)

It has only occasionally been possible to follow this tidy definition. Each inventory uses its own definitions. For more details see the footnotes to the tables or the country notes.

Presently commercial volume: It is often unclear if the inventory figures show the actually marketable volume or the gross volume of species classified as commercial. The last is certainly the most common. Same details are given in the country notes.

Inventories normally give a much higher volume of commercial volume than what is actually extracted. In Gabon e.g. three times as much.

Potentially commercial species: Means generally the volume of species which are at present not marketed but which have the technical properties to become so. (The volume utilizable for pulp is not included here.)

Table S IX - Standing timber

Gross volume: The volume, with bark, of trees up to 10 cm top diameter. The volume of branches thicker than 10 cm is, in theory, included. This volume should show the volume that can be used for fuelwood.

Commercial volume: The standing volume that can be removed. Includes only species and sizes that are merchantable as industrial wood at present. This varies somewhat from country to country.

Exploitable volume: Here the volume that can actually reach the market should be shown. Some commercial species are not exploited because they are found in such small quantities or so rarely. Part of the commercial gross volume is destroyed in extraction and access to some areas is too difficult. It is unnecessary to point out that it is difficult to make any over-all estimates of this volume at present.

Outside forest - gross volume: A considerable volume is often found outside the areas of forest and other wooded areas (e.g. in agricultural land, bush fallows). This volume is of interest mainly in the countries which have limited forest resources.

Table S X - Ownership

Public (forests): This category includes forests owned by national state, and regional government, government-owned corporations and crown forests (state forests); and forests belonging to towns, villages, communes and other local authorities (other public forests). - FAO.

Private (forests): Forests owned by enterprises, individuals, families or corporations engaged in agriculture as well as forestry; tree farms without agriculture in the same holding and areas owned by institutions (religious, educational, etc.). - FAO.

Ownership not yet defined: Forests for which ownership status is in doubt or has not yet been established. - FAO.

Table S XI - Area of forest reserves and protection reserves

Forest reserves (Permanent forest): Forest (wooded areas) effectively protected against destruction and in which provisions (such as obligatory regeneration often clear-cut) are established to ensure maintenance of the forestry vegetation.

"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 (FAO).

Protection reserves: Forest (wooded areas) in which all industrial cutting and all destruction, such as burning etc., is prohibited, and the management of which is principally aimed at the protection of natural resources, of fauna and flora, or at other purposes not directly related to the production of wood. - FAO.

The intention was that the area of protection reserves should show the area of forest and other wooded areas that are excluded from production of wood. Often they make up a part of the forest reserves and is managed by the Forest Service. They may here in the main include forest in watersheds, steep hills etc.

National parks: Areas (not only wooded areas) for which the definition given for protection reserves also applies. National parks are normally established of scientific reasons, for wild life protection, protection of specific environment etc.

Table S XII - Exploitation pattern

This table mainly concerns closed natural forest.

Exploited: Areas which are affected by selective cutting of valuable species or other forms of exploitation (e.g. continuous utilization and management of an area).

Unexploited: Areas which have not since long been touched by any form of commercial exploitation and in which exploitation for household wood is of limited importance.

Potentially productive: That part of the unexploited area which could be economical exploited if it was made accessible. From the unexploited area is subtracted inundated areas, areas with extremely difficult access, low-productive forests and so on.

Concessions: A contract granted by the state to individuals or communities to extract and/or process and market timber commercially from a defined area of forest. Concessions can sometimes be granted for a relatively long period of time.

Management plans: Forests are considered as being under management plans if their management is conducted on the basis of systematic plans defining felling areas or quantities and silvicultural treatment. - FAO.

Accessible: The closed forest areas that are accessible or can be incorporated in timber production without the need for major infrastractural work. It has here been considered from the viewpoint of internal demand.

Table S XIII - Roundwood production

Roundwood production: The quantities removed from forests and from trees outside the forest during the calender year or during the forestry year, but excluding losses and unutilized waste in logging and roundwood transportation. Figures are given in solid volume of roundwood without bark. - FAO.

Roundwood: Wood in the rough. Wood in its natural state as felled or otherwise harvested, with or without bark, round, split, roughly squared or other forms (e.g. roots, stumps, burls, etc.). It may also be impregnated (e.g. telegraph poles) or roughly shaped or pointed. It comprises all wood obtained from removals, i.e., the quantities removed from forests and from trees outside the forest, including wood from natural, felling and logging losses during the period-calendar year or forest year. The statistics include recorded volumes, as well as estimated unrecorded volumes. - FAO.

Industrial roundwood: The commodities included are sawlogs or veneer logs, pitprops, pulpwood and other industrial roundwood. - FAO.

Fuelwood: Wood in the rough (from trunks, and branches of trees) to be used as fuel for purposes such as cooking, heating or power production. Wood for charcoal, pit kilns and portable ovens is included here. - FAO.

APPENDIX IE

SUMMARY-TABLES

Table S I. Land use

Country	Year	Total area	Land area	Agricultural area		Forests and woodlands	Other area
				Arable land and land under permanent crops	Permanent meadows and pastures		
		1000 ha					
Algeria	1970	238 174	..	6 792	37 416	2 424	191 542
Angola	1953	124 670	..	900[x]	29 000[x]	43 200[x]	51 570
Benin (Dahomey)	1963	11 262	..	1 546	442	2 157	7 117
Botswana	1972	60 037	58 537	512	41 080	962	17 483
British Indian Ocean Territory	1970	8	..	-	-	-	8
Burundi	1972	2 783	2 565	1 166	435	70	1 112
Cameroon	1970	47 544	46 944	7 300	8 300	30 000	1 944
Cap Verde Islands	1967	403	..	40	10 F	1	352
Central African Rep.	1968	62 298	..	5 900	100	7 400	48 898[3)]
Chad	1972	128 400	127 000	7 000	45 000	16 500	59 900
Comoro Islands	1965	217	..	90[x]	15	35	77
Congo	1963	34 200	..	630	14 300[x]	16 250[1)]	3 020
Egypt	1972	100 145[2)]	..	2 852	-	2	97 291[3)]
Equatorial Guinea	1963	2 805	..	221	104	2 289[4)]	191
Ethiopia	1970	122 190	110 100	13 250	65 670	8 800	34 470
Fr. Terr. of Afars, Issas	1972	2 200	..	1[x]	244[x 5)]	8[1)]	1 947
Gabon	1962	26 767	..	127	5 100[x]	20 000	1 540
Gambia	1967	1 130	1 000	200[6)]	400	303	227
Ghana	1968	23 854	23 002	2 574[15)]	11 237[7)]	2 447	7 596
Guinea	1960	24 586	..	1 500 F	3 000 F	1 046[1)]	19 040
Guinea Bissau	1971	3 612	2 800	275[x]	1 280[x]	1 000[1)]	1 057
Ivory Coast	1971	32 246	31 800	8 887	8 000[x]	12 000	3 359
Kenya	1960	58 264	56 925	1 670[21)]	3 944[8)22)]	2 267[1)]	50 383
Lesotho	1970	3 035	..	386	2 495[16)]	-	154
Liberia	1971	11 137	..	366	240[x 17)]	3 622	6 909
Libyan Arab Republic	1971	175 954	175 954	2 521	7 000	534	165 899
Madagascar	1970	58 704	58 154	2 856	34 000	12 470	9 378
Malawi	1959	11 848	9 408	2 640[9)]	596	2 314	6 298
Mali	1970	124 000	122 000	11 600	30 000	4 457	77 943
Mauritania	1964	103 070	..	263	39 250	15 134	48 423
Mauritius	1972	186	185	106	7	57	16
Morocco	1970	44 655	..	7 505	7 650[18)]	5 164	24 336
Mozambique	1966	78 303	..	2 700[x]	44 000[x]	19 400	12 203
Namibia[10)]	1960	82 429	..	642	52 906[8)]	10 427[1)]	18 454
Niger	1972	126 700	126 670	15 000	3 000	12 000[11)]	96 700
Nigeria	1961	92 378	..	21 795	25 000[x]	31 069	14 514
Réunion	1972	252	251	56	8	98	90
Rhodesia	1956	39 058	..	1 837[12)]	4 856[13)]	23 570[1)]	8 795
Rwanda	1972	2 634	2 509	808	817	329	680
St. Helena, Ascension, Tristan da Cunha	1962	31	..	2	2	1	26

Table S I. Land use

Country	Year	Total area	Land area	Agricultural area		Forests and woodlands	Other area
				Arable land and land under permanent crops	Permanent meadows and pastures		
		1000 ha					
Sao Tomé and Principe	1956	96	..	30[x]	1 F	-	65
Senegal	1970	19 619	19 200	5 564[x]	5 700[x]	5 318[1)]	3 037
Seychelles	1967	38	37	17	0.4	5	16
Sierra Leone	1964	7 174	..	3 664[19)]	2 204	301	1 005
Somalia	1960	63 766	62 734	957	20 568	14 401	27 840
South Africa	1960	122 104	..	12 058	90 390[8)]	4 105[1)]	15 551
Sudan	1968	250 581	237 600	7 100	24 000[14)]	91 500	127 981
Swaziland	1971	1 736	1 720	152	1 268	92	224
Tanzania	1970	94 509	..	16 251[20)]	40 202	31 074	6 982
Togo	1965	5 600	..	2 160	200	530[1)]	2 710
Tunisia	1961	16 361	15 536	4 510	3 250	690[x]	7 911
Uganda	1967	23 604	19 365	4 888	5 000[x]	9 172[1)]	4 544
Upper Volta	1970	27 420	27 380	5 377	13 755	4 101	4 187
Western Sahara (Spanish Sahara)	1972	26 600	..	2	5 000	-	21 598
Zaire	1972	234 541	..	7 200[x 16)]	24 803	100 000	102 538
Zambia	1962	75 261	..	4 800[x]	33 800[x]	34 000[x]	2 661

Notes to Table S I

1) From WFI 1963
2) Of which inhabited and cultivated area accounts for 3 558 000 ha
3) Including rough grazing
4) 1960
5) 1953
6) Estimated area of shifting cultivation and bush fallow
7) Savanna
8) On agricultural holdings
9) 1972
10) Including the territory of Walvis Bay
11) Used also for grazing
12) Excluding fallow in villages
13) On farms and estates
14) Acacia short grass scrub
15) 1970
16) 1962
17) 1964
18) 1966
19) Including some 3 500 000 ha with bush fallow
20) IBRD 1974 gives 4 465 000 ha
21) IBRD 1973 gives 2 257 000 ha
22) IBRD 1973 gives 8 565 300 ha

[x] Unofficial figure
F FAO estimate

Table S II. Natural closed forest

Country	Accuracy class	Year of estimate	Closed forest					Other forests
			Total	Broadleaved	of which		Coniferous	
					Mangrove	Bamboo		
			1000 ha					
Algeria	4	1971	490[1]	60	-	-	430	..
Angola	4	1963	1 000[2]	1 000	750[3]	-	-	(2 760)
Benin (Dahomey)	4	1971	200	200	..	-	-	(50)
Botswana	4	1967	..	..	-	-	-	(1 000)[4]
Burundi	4	1971	100	100	-	..	..	-
Cameroon	3	1971	17 500	17 500	100	..	-	-
Central African Rep.	3	1971	3 000	3 000	-	..	-	-
Chad	..	1971	-	-	-	-	-	-
Comoro Islands	4	1964	42	42	..	-	-	-
Congo	3	1971	17 000	17 000	..[24]	-	-	-
Egypt	..	1971	-	-	-	-	-	-
Equatorial Guinea	4	(1971)	1 120[5]	1 120	+	-	-	-
Ethiopia	5	1971	5 000	3 150[6]	-	1 000	850	-
Fr. Terr. of Afars, Issas	5	..	6	(4)	..	-	(2)	-
Gabon	2	1970	21 500	21 500	1 095[23]	-	-	-
Gambia	4	..	25	25	25	-	-	-
Ghana	3	1970	1 800[22]	1 800	+[10]	-	-	-
Guinea	5	1971	700[7]	700	400[21]	-	-	500
Guinea Bissau	4	1965	760[8]	760	460	-	-	180
Ivory Coast	3	1966	9 000[9]	9 000	+[10]	-	-	-
Kenya	4	1972	922	..	35	(290)	(400)	-
Lesotho	..	-	-	-	-	-	-	-
Liberia	3	1968	2 500	2 500	+[10]	-	-	-
Libyan Arab Republic	5	1972	70[11]	..	-	-	(60)	-
Madagascar	5	1964	6 000[27]	6 000	500[3]	-	-	-
Malawi	5	1972	(20)	..	-	..	..	-
Mali	..	1972	-	-	-	-	-	-
Mauritania	..	1972	-	-	-	-	-	-
Mauritius	3	1967	2	2	..	..	-	-
Morocco	3	1971	400[12]	200	-	-	200[13]	3 800
Mozambique	4	1963	1 500	1 500	1 500[3]	-	-	-
Namibia	..	1972	-	-	-	-	-	-
Niger	..	1972	-	-	-	-	-	-
Nigeria	4	1970	4 400	4 400	+[10]	-	-	-
Réunion	5	..	..[14]	..	..	..	..	-
Rhodesia	4	..	..	..	-	-	-	800[15]
Rwanda	4	1971	300	300	-	..	..	-
Senegal	4	1971	220[16]	220	200	20	-	210[25]
Seychelles	..	1970	..	..	..	..	..	-
Sierra Leone	3	1970	285	285	+	-	-	-
Somalia	4	1972	160	40	..	..	120	-

Table S II. Natural closed forest

Country	Accuracy class	Year of estimate	Closed forest					Other forests
			Total	Broadleaved	of which		Coniferous	
					Mangrove	Bamboo		
			1000 ha					
South Africa	2-3	1971	255	D	-	..	..	-
Sudan	5	1962	300	..	-	..	..	-
Swaziland	..	1971	-	-	-	-	-	-
Tanzania	3	1975	1 020	..	80	..	..	-
Togo	2	1971	380[17)]	380	..	-	-	70
Tunisia	3	1969	180[18)]	100	-	-	80	70
Uganda	3	1972	722[19)]	732	-	45	..	-
Upper Volta	..	1971	-	-	-	-	-	-
Zaire	4	1972	90 000	90 000	280[26)]	..	..	-
Zambia	5	1972	..	..	-	-	-	650[20)]

Notes to Table S II

1) Possibly an overestimate (potential commercial forest land)

2) In addition probably an area of 2 760 000 ha with moist semi-deciduous forest. Sometimes called closed forest - sometimes woodland

3) Mangrove and riparian forest

4) Dry deciduous forest. This forest is probably of open woodland type

5) Of which 120 000 ha on Fernando Poo

6) Of which 690 000 ha with mixed forest

7) In addition another 500 000 ha with "exploitable forests". This is probably open woodlands

8) In addition 180 000 ha with palms

9) Of which around 0.6 million ha in small blocks (10-500 ha). If the forest clearance has continued at the same speed 1966-1976 as 1956-1966 the present forest area should be 5-6 million ha. However, if all small forest blocks is classified as forest the forest area is considerably more.

10) Separate information not available

11) Probably an overestimate

12) This is mainly the area of "timber woodlands". In addition there is 4.5 million ha with "forest land". 3.8 million ha of this may be called forest. Large parts are coppice.

13) Of the total area of forest and other wooded areas around 1.3 million ha is covered by coniferous species

14) The total area of "natural forest" is 100 000 ha. The main part of this area is degraded

15) Mainly dry deciduous forest

16) This is the area of mangrove and bamboo. In Casamance region there is also around 200 000 ha with "valuable forest" (dry dense forest)

17) In addition 70 000 ha with dry dense forest

18) This is the forest area dense enough for utilization. In addition there is 70 000 ha of other natural forest

19) In addition there are some areas with unreserved forests (perhaps 175 000 ha)

20) This is the area of dry deciduous forest. Another estimate gives the area as 230 000 ha

21) Probably not included under total

22) Closed forest area outside forest reserves is unknown. Sometimes reported to be 200 000-500 000 ha. Synnott (1976a) gives total closed forest area as 1 950 000 ha

23) Swamp forest and mangrove

24) 5 million ha inundated and non-exploitable

25) "Valuable forest" in Casamance. In reality woodland

26) Swamp forest. The figure seems low

27) Synnott (1976a) reports 10 million ha

Table S III. Open woodland, scrub and brushland

Country	Accuracy class	Open woodland			Scrub and brushland	Bush fallow[15]	Open woodland according to Veg. Map of Africa
		Total	of which				
			Moist	Dry			
		1000 ha					
Algeria	4	..	..	..	2 000	-	..
Angola	4	70 000	60 000	10 000	..	..	118 000
Benin (Dahomey)	3	6 500	D	..	..	..	11 000
Botswana	5	(30 000)	-	(30 000)	..	..	52 500
Burundi	5	(200)	(200)	..	..	..	700
Cameroon	4	12 500	D	..	..	4 500	22 000
Central African Rep.	5	(40 000)	D	..	..	..	58 000
Chad	5	(16 500)[8]	1 500	15 000	..	-	57 000
Comoro Islands	3	..	..	..	..	(9)	..
Congo	5	10 000[10]	..	..	..	..	13 000
Egypt	..	-	-	-	..	-	-
Equatorial Guinea	4	..	..	..	..	1 000[1]	-
Ethiopia	5	28 000	3 000	(25 000)[9]	..	..	60 000
Fr. Terr. of Afars, Issas	4	-	-	-	100	-	-
Gabon	3	3 000[10]	3 000	..	..	..	4 000
Gambia	4	275	275	..	..	(200)	1 000
Ghana	4	10 000	(10 000)	..	..	..	16 000
Guinea	4	14 000	4 000	10 000	..	..	24 000
Guinea Bissau	4	130	..	..	..	..	2 000
Ivory Coast	4	10 000	..	..	..	5 700[7]	17 000
Kenya[16]	5	75	..	..	360	..	39 000
Lesotho	-	-	-	-	-	-	-
Liberia	..	..	..	..	..	..[2]	1 000
Libyan Arab Republic	5	-	-	-	390	-	-
Madagascar	5	7 000[3]	..	..	..	3 580	2 000
Malawi	3	7 000	(1 700)	..	300	..	9 000
Mali	5	(4 500)[11]	..	..	..	..	73 000
Mauritania	5	(15 000)	-	(15 000)	..	..	27 000
Mauritius	3	7	..	..	48	..	..
Morocco	3	..	..	..	700	..	..
Mozambique	4	65 000	60 000	5 000	..	..	76 000
Namibia	5	10 000	-	10 000	..	..	48 000
Niger	5	(12 000)[8]	-	12 000	..	..	57 000
Nigeria	5	30 000[13]	..	..	..	..	78 000
Réunion	4	100[4]	..	..	..	..	..
Rhodesia	3	23 000	15 000	8 000	..	..	36 000
Rwanda	4	(1 000)	(1 000)	..	..	..	1 000
Senegal	4	5 100	(2 600)	(2 500)	..	(2 400)[14]	19 000
Seychelles	4	4[4]	..	..	..	..	..
Sierra Leone	3	44	..	..	12	3 660	2 000
Somalia	4	..	-	..	10 000	..	34 000

Table S III. Open woodland, scrub and brushland

Country	Accuracy class	Open woodland			Scrub and brushland	Bush fallow[15]	Open woodland according to Veg. Map of Africa
		Total	of which				
			Moist	Dry			
		1000 ha					
South Africa	3	2 700	-	2 700	..	..	39 000
Sudan	5	39 000	..	..	..	..	122 000
Swaziland	4	40	..	40	..	..	..
Tanzania	3	32 600	..	..	10 700	..	82 000
Togo	3	3 000	..	..	115[5]	..	5 600
Tunisia	3	-	-	-	323	-	-
Uganda	4	8 500[6]	..	..	..	..	17 000
Upper Volta	5	(4 100)[12]	1 000	..	..	..	27 000
Zaire	5	90 000	..	..	..	..	99 000
Zambia	4	37 500	..	..	..	..	62 000

Notes to Table S III

1) Secondary forest or bush
2) Known to be considerable areas with bush fallow
3) Includes western forest and southern forest (bush)
4) Degraded forest and scrub
5) Secondary growth
6) Of this area 6.4 million ha has recently been transferred for agricultural development
7) Degraded closed forest (blocks less than 10 ha)
8) This is the area classified as "forest". The really tree-covered area is certainly much larger but it is probably mainly used for grazing
9) Wooded grassland, scrub and thickets
10) Probably mainly grassavanna
11) This is the area given as forest land in different reports. The tree-covered area is considerably larger
12) This is the area of classified woodlands. The area actually covered by trees are larger
13) May be 60 million ha
14) Included in open woodland
15) Bush fallow areas in the open woodland zone are shown within brackets
16) According to WFI 1970 Questionnaire

Table S IV. Man-made forest. Species

Country	Accuracy class	Year of estimate	Total area planted	Species			
				Eucalyptus	Other broadleaved	Pine	Other coniferous
			1000 ha				
Algeria	4	1972	(200)	..	..	..	..
Angola	2	1970	120	102	..	12	6
Benin (Dahomey)	2	1972	18.4	..	18.4	..	..
Botswana	..	..	0	0	..	..	..
Burundi	3	1971	25	17	4	..	4
Cameroon	3	1970	9	(1)	(7)	(1)	..
Cap Verde Islands	..	..	2	..	..	..	..
Central African Rep.	..	..	1	0	0	..	..
Chad	..	..	0	..	0	..	..
Comoro Islands	..	..	0	..	..	..	..
Congo	3	1972	12	(4)	6	(2)	..
Egypt	4	..	(10)	..	..	-	-
Equatorial Guinea	..	..	-	-	-	-	-
Ethiopia	3	1971	40	40	..	0	..
Fr. Terr. of Afars, Issas	..	..	..	..	..	..	..
Gabon	2	1971	25	0	25	0	-
Gambia	3	1971	0.8	0	0	-	-
Ghana	3	1975	34[8]	0	21	..	..
Guinea	4	1971	2	-	1.5	0.6	-
Guinea Bissau	4	1970	0.3	..	..	..	..
Ivory Coast	4	1971	28[13]	0	28	0	..
Kenya	2	1975	160[1]	8	7	55	68
Lesotho	..	..	0	..	..	..	..
Liberia	4	1971	1	..	1	..	..
Libyan Arab Republic	3	1972	75[2]	..	..	..	..
Madagascar	3	1975	(280)	200	..	80[9]	..
Malawi	2	1971	37[3]	3	0	34	..
Mali	..	1972	1	..	1	..	..
Mauritania	..	..	-	-	-	-	-
Mauritius	2	1970	7	3	..	3	1
Morocco	2	1971	294	169	22	71	33
Mozambique	3	1971	21[4]	..	..	D	..
Namibia	..	..	0	..	..	..	..
Niger	..	..	0	..	..	..	..
Nigeria	4	1975	100[10]	3[5]	32	0	0
Réunion	3	..	9	..	D	..	..
Rhodesia	4	1975[12]	100[11]	20	20	- 60 -	
Rwanda	3	1971	29	22	5	1	1
Senegal	3	1970	14	..	14	..	..
Seychelles	..	1970	1	..	1	..	..
Sierra Leone	3	1970	6.5	..	6.5	..	..

Table S IV. Man-made forest. Species

Country	Accuracy class	Year of estimate	Total area planted	Species			
				Eucalyptus	Other broadleaved	Pine	Other coniferous
			1000 ha				
Somalia	5	1970	(15)	..	..	..	..
South Africa	1	1974	1 099[7]	362	160	- 544 -	
Western Sahara (Spanish Sahara)	..	..	-	-	-	-	-
Sudan	5	1969	81	8	71	0.2	1.6
Swaziland	1	1973	96	22	6	68	..
Tanzania	3	1975	65	- 17 -		- 48 -	
Togo	4	1971	3	0	3	..	..
Tunisia	3	1969	114	D	..	D	..
Uganda	3	1971	20[6]	8	3	9	0
Upper Volta	..	..	2	..	2	..	..
Zaire	5	..	50	..	50	2	..
Zambia	1	1974	24	8	..	16	..

Notes to Table S IV

1) Information from Synnot (1976a). Breakdown in species from 1970. Should also be 141 000 ha with private plantations. These are mainly for fuelwood.
2) Private plantations may cover 22 000 ha (in 1968)
3) Another 4 000 ha in tea and tobacco farms. To 1975 another 8 000 ha should have been planted on the Vipya plateau
4) Another 1 000 ha of private plantations
5) Breakdown from 1967 (36 000 ha)
6) There should also be 7 000 ha with private fuel and pole plantations
7) 33 000 ha is temporarily unplanted
8) According to Synnot (1976a). Breakdown in species from 1972
9) According to Grut (1975)
10) According to Synnott (1976a)
11) According to Stratten (1975) 112 000 ha
12) Information from Grut (1975)
13) In addition 14 000 ha with enrichment plantations

Table S V. Man-made forest. Planting rates and purposes

Country	Actual planting rate	Planned planting rate	Period[6]	Purpose of present plantations			
				Fuelwood	Timber	Pulp	Other
	1000 ha/year			1000 ha			
Algeria	25	(45)	1972-1973	..	..	..	..
Angola	(15)	(17)	1974-1981	..	..	(40)	..
Benin (Dahomey)	..	..	..	..	..	-	..
Botswana	..	..	..	..	..	..	..
Burundi	0.25	0.25	year	D	..	-	..
Cameroon	..	1.3	1972-1976	..	D	-	..
Central African Rep.	..	..	..	..	..	-	..
Chad	..	..	..	..	..	-	trials
Comoro Islands	..	..	..	..	..	-	..
Congo	..	(6)	year	..	6	6	..
Egypt	..	..	..	..	..	-	..
Equatorial Guinea	..	..	..	..	..	..	..
Ethiopia	..	..	..	D	..	-	D
Fr. Terr. of Afars, Issas	..	..	..	..	..	..	..
Gabon	..	..	..	-	25	-	-
Gambia	..	..	..	..	..	..	..
Ghana	..	6	year	..	21	-	-
Guinea	..	0.8 - 1.8	year	..	..	..	..
Guinea Bissau	..	..	..	..	..	..	..
Ivory Coast	..	4	year	..	28	..	..
Kenya	6	6	year	(140)	(125)	(15)	..
Lesotho	..	..	..	..	..	..	trials
Liberia	..	1.5	1972-1976	..	..	..	..
Libyan Arab Republic	4	5	1972-1975	..	..	..	..
Madagascar	12	(10)[4]	year	200	- 80 -		..
Malawi	(3)	(3)[5]	year	(4)	14	23	..
Mali	..	..	..	..	..	-	..
Mauritania	-	-	-	-	-	-	-
Mauritius	..	..	..	..	..	-	..
Morocco	25	20	1968-2000	D	..	+	..
Mozambique	..	..	..	..	..	..	..
Namibia	-	-	-	-	-	-	-
Niger	..	..	..	..	..	-	trials
Nigeria	12[3]	15	1970-1974	..	D	-	..
Réunion	..	..	..	..	..	-	..
Rhodesia	..	..	..	..	..	..	..
Rwanda	0.25	0.25	year	D	..	-	..
Senegal	..	7.5	..	..	..	-	..
Seychelles	..	..	..	..	..	..	..
Sierra Leone	..	..	..	..	6.5	-	..
Somalia	..	..	..	..	..	-	..
South Africa	(25)[1]	..	..	(30)	495[7]	(230)	(70)

Table S V. Man-made forest. Planting rate and purposes

Country	Actual planting rate	Planned planting rate	Period[6]	Purpose of present plantations			
				Fuelwood	Timber	Pulp	Other
	1000 ha/year			1000 ha			
Sudan	..	4.5	year	..	D	..	..
Swaziland	..	..	..	(1)	29	(60)	..
Tanzania	(6)	(5)	year	..	D	..	..
Togo	..	..	..	..	..	..	..
Tunisia	11	18	year	..	..	..	..
Uganda	..	2	year	(8)	(11)	..	..
Upper Volta	..	..	..	..	..	..	trials
Western Sahara (Spanish Sahara)	..	..	..	-	-	-	-
Zaire	..	..[2]	..	..	..	..	..
Zambia	3	2.5	year	..	..	..	..

Notes to Table S V

1) Yearly increase in planted area
2) Plans exist for large-scale fuelwood plantations near Kinshasa
3) Information in 1975
4) According to Grut (1975) 58 000 - 64 000 ha planned to be planted in the Mangoro area (1975 - 1984)
5) According to Grut (1975) 6 000 ha/year is planned to be planted on the Vipya plateau for the next five years
6) For planned plantations
7) In addition about 270 000 ha of mining timber

Table S VI. Vegetation types

Country	Moist forest	Other closed forest types[1]	Maquis, montane communities[2]	Relatively moist woodlands (savannas)	Relatively dry woodlands (savannas)	Wooded steppe	Thicket, bamboo	Grasslands	Desert, subdesert
	million ha								
Algeria	-	5.7	4.8	-	-	-	-	18.6	208.6
Angola	2.7	..	..	91.6	26.6	..	-	1.4	2.4
Benin (Dahomey)	-	..	-	7.9	3.3	-	-	-	-
Botswana	-	1.9	-	-	13.0	39.5	-	..	-
Burundi	-	..	0.3	0.7	-	-	..	1.6	-
Cameroon	22.1	0.2	2.7	15.6	4.1	2.3	-	-	-
Central African Rep.	3.3	-	-	54.6	4.4	-	..	-	-
Chad	-	-	-	3.8	41.9	11.4	-	-	69.9
Congo	21.0	..	-	12.8	0.4	-	-	-	-
Egypt	-	-	-	-	-	-	-	-	100.1
Equatorial Guinea	2.6	..	0.2	-	-	-	-	-	-
Ethiopia	-	5.0	0.6	-	19.1	40.8	12.7	16.7	15.5
Fr. Terr. of Afars, Issas	-	-	0.1	-	-	-	-	-	2.1
Gabon	22.8	..	-	3.9	0.1	-	-	-	-
Gambia	-	0.025	-	0.9	0.1	-	-	-	-
Ghana	7.7	0.2	-	14.0	1.5	-	-	-	-
Guinea	0.8	0.3	0.8	22.7	-	-	..	-	-
Guinea Bissau	..	0.7	-	2.1	-	-	-	-	-
Ivory Coast	14.9	0.2	0.1	17.0	-	-	-	-	-
Kenya	0.4	..	4.2	8.6	..	30.3	..	..	13.4
Lesotho	-	-	-	-	-	-	-	3.0	-
Liberia	9.9	0.1	..	1.1	-	-	-	-	-
Libyan Arab Republic	-	-	4.9	-	-	-	-	-	171.0
Madagascar	11.1	10.4	..	2.0	-	-	3.5[5]	31.2	-
Malawi	-	-	0.4	6.1	2.9	-	-	-	-
Mali	-	-	-	11.0	20.8	41.5	-	-	48.8
Mauritania	-	-	-	-	-	27.2	-	-	75.8
Morocco	-	12.6	7.7	-	-	-	-	15.1	9.2
Mozambique	0.1	1.4	0.4	47.9	28.5	-	-	-	-
Namibia	-	-	-	-	14.1	34.5	-	..	33.6
Niger	-	-	-	-	11.4	45.6	-	-	69.7
Nigeria	10.2	2.8	1.0	46.0	29.3	3.0	-	-	-
Rhodesia	..	2.4	0.4	19.0	15.7	0.6	-	-	-
Rwanda	-	-	0.4	1.1	-	-	..	1.0	-
Senegal	-	0.2	-	4.7	5.8	8.4	-	-	-
Sierra Leone	4.8	0.4	0.1	1.9	-	-	-	-	-
Somalia	-	0.1	0.9	2.3	-	31.6	-	-	27.8
South Africa	-	1.3	0.2	2.3	24.9	11.7	6.0	33.7	42.1
Sudan[4]	-	-	0.6	16.9	32.8	72.7	..	..	115.0
Swaziland	-	-	-	-	1.1	-	-	0.6	-

Table S VI. Vegetation types

Country	Moist forest	Other closed forest types[1]	Maquis, montane communities[2]	Relatively moist woodlands (savannas)	Relatively dry woodlands (savannas)	Wooded steppe	Thicket, bamboo	Grasslands	Desert, subdesert
	million ha								
Tanzania	0.7	0.5	4.6	52.3	6.6	23.5	0.4	..	0.2
Togo	-	..	-	4.8	0.8	-	-	-	-
Tunisia	-	0.7	4.4	-	-	-	-	3.3	7.1
Uganda	0.8	-	0.7	13.0	3.3	0.7	..	0.7	-
Upper Volta	-	-	-	3.8	20.5	3.0	-	-	-
Western Sahara (Spanish Sahara)	-	-	-	-	-	-	-	-	26.6
Zaire	119.1	..	2.8	93.3	5.3	-	-	13.2	-
Zambia[3]	-	2.1	-	54.9	8.5	-	-	2.7	-

Notes to Table S VI

1) Montane forest, mediterranean closed forest, temperate forest, mangrove

2) Partly forest

3) Not included is 6 million ha with swamps

4) Not included is 13 million ha with swamps

5) Normally called scrub forest

Table S VII. Inventories in wooded areas

Country	Closed forest area	In closed forest				In open woodlands		
		Relatively detailed inventories		Reconnaissance survey	Management plan inventories	Relatively detailed inventories	Reconnaissance survey	Management plan inventories
		Nationwide	Preinvestment or regional					
	1000 ha							
Algeria	(700)	-	18	88	..	-	-	-
Angola	1 100	-	198[1]	-	-	-	2 600	-
Benin (Dahomey)[6]	270	-	-	-	-	-	-	-
Botswana	0	-	-[2]	-	-	518[2]	-	-
Burundi	125	-	-	-	-	-	-	-
Cameroon	17 500	-	3 000	-	-	-	-	-
Central African Rep.	3 000	-	1 400	-	-	-	-	-
Chad	0	-	-	-	-	-	-	-
Congo	17 000	-	2 000[3]	-[4]	-	-	-	-
Equatorial Guinea	1 120	-	-	-	-[5]	-	-	-
Ethiopia	5 000	-	-	..[7]	-	-	-	-
Gabon	21 500	-	2 600[9]	3 300[8]	..	-	-	-
Gambia	25	-	-	-	-	-	-	-
Ghana	1 800	-	-	-	1 100	-	-	..
Guinea	700	-	..[10]	..	-	-	-	-
Guinea Bissau	750	-	-	-	-	-	-	-
Ivory Coast	9 000	9 000[11]	-	-	-	-	-	-
Kenya	1 080	-	920[12]	..	..	..	..	..
Liberia	2 500	1 600	-	-	-	-	-	-
Libyan Arab Republic	150	-	-	-	-	-	-	-
Madagascar	6 000	-	200[14]	..[13]	-	-	-	-
Malawi	(60)	-	(60)[15]	-	(18)[15]	..	..	..
Mali	1	-	-	-	-	-	-	-
Mauritania	..	-	-	-	-	-	-	-
Morocco	700[25]	-	15	60	-	-	-	-
Mozambique	1 500	-	-	-	-	..	..	-
Nigeria	4 500	-	400[26]	-	..	-	-	-
Rhodesia	100	..	..	..	..	..	..	..
Rwanda	330	-	-	25[16]	-	-	-	-
Senegal	230	-	-	-	-	320[17]	-	-
Sierra Leone	290	-	-	-	197	-	-	-
Somalia	170	-	..[18]	-	-	-	-	-
South Africa	1 350	..	1 100[19]	..	..	..	..	..
Sudan	400	-	(100)	..	..	-	10 500	-
Swaziland	96	-	96[19]	-	-	-	-	-
Tanzania	1 085[27]	-	1 400[20]	-	(43)	5 700[20]	-	..
Togo	380	-	(90)[21]	380	-	-	1 480	-
Tunisia	360	-	-	-	(360)	-	-	-
Uganda	740	-	60[23]	-	500[22]	-	-	900[22]
Upper Volta	2	-	-	-	-	-	-	-

Table S VII. Inventories in wooded areas

Country	Closed forest area	In closed forest				In open woodlands		
		Relatively detailed inventories		Reconnaiss-ance survey	Manage-ment plan invento-ries	Relatively detailed invento-ries	Reconnaiss-ance survey	Manage-ment plan invento-ries
		Nation-wide	Preinvest-ment or regional					
	1000 ha							
Zaire	90 000	-	-	..[24]	-	-	-	-
Zambia	24	-	-	-	-	-	40 750	3 650

Notes to Table S VII

1) Inventory in Cabinda
2) Inventory in dry deciduous forest
3) In addition several small inventories by the Forest Service
4) In 1962-63 FAO (Rollet) made something of an reconnaissance survey of 10.5 million ha in northern Congo
5) Around 50 000 ha have been covered by some extensive concession surveys
6) An inventory is planned
7) A reconnaissance survey of all forests within a radius of 450 km from Addis Ababa has been undertaken
8) An area of 15.5 million ha in the first and second zone has been covered by a reconnaissance survey or rather a summary of scattered local inventories. The 3.2 million ha mentioned here has recently been inventoried by CTFT
9) Mainly in the third zone
10) Some inventories have been undertaken with assistance from Czechoslovakia
11) The inventory covered 15.6 million ha in the south
12) A recent inventory covered 1.4 million ha. Part of this inventory was a reconnaissance survey
13) The recent UNDP project made a crude evaluation of all forests. This was partly based on biological inventories (25 blocks in different vegetation types)
14) Of which 100 000 ha in dry deciduous forest on the west-coast
15) Part of these inventories may have been done in open woodlands
16) Inventory of plantations
17) This inventory is done in "forêt seche dense" (dense Guinea savanna)
18) An inventory is just now going on in the Golis range in the north
19) The plantations are covered by some form of inventory
20) 7.1 million ha are covered by a low-intensity inventory. The inventory ought perhaps to be classified as a reconnaissance survey
21) This area is probably also covered by a reconnaissance survey
22) 1.4 million ha covered by management plan inventory. Not known exactly how much of this is in open woodlands
23) This area is probably covered by management plan inventories
24) An inventory covering extensive areas is undertaken at present
25) Very difficult to say what is the natural closed forest area
26) A National inventory will start
27) A recent source gives 106 000 ha in productive closed forest and 4.2 million ha in productive savanna woodland

Table S VIII. Summary of inventory results and national estimates

Country (district)	Area	Standing timber[36]		Presently commercial volume	Potentially commercial volume	Standing timber per ha	Number of trees per ha
		Total	Broadleaved				
	1000 ha	million m^3				m^3/ha	
Algeria (inv)	106						
Cedar zone	12.5	..	..	..	..	..	..
Pine zone	93.5	..	..	..	..	50-125[1]	75-175[1]
Angola (inv)	2 800						
Cabinda	198	..	..	..	..	55[2]	..
Cuanda Cubango	2 500	..	..	4 m^3/ha[3]	..	8-45	..
Benin (Dahomey)							
National estimate	250	..	..	- 5 -		..	..
Botswana (inv)	518						
Chobe	285[4]	..	..	0.26 o.b.	..	..	..
Cameroon (inv)	3 000						
Haute Nyong[5]	1 875	188	188	(125)	..	101	..
Deng Deng[6]	300	22	22	(12)	..	70	..
"-[7]	76	..	..	8.3[37]	3.9	..	..
Edea[8]	100	41[38]	41	..	..	396[9]	253[9]
Central African Rep							
Inv	1 400	..	..	49 m^3/ha[9]	..		..
National estimate	3 000	..	..	147[10]	..	275-300[11]	..
Congo							
Inventories	2 000						
Northern Congo[12]	1 170	185	185	(18)	..	134	..
Sibiti-Zanaga[12]	829	46	46	7.6	..	56	..
National estimate	17 000	..	..	70	..	..	..
Gabon (inv)							
Zone 1 & 2	14 785	..	..	186[13]	..	..	..
Intensive inv 1	1 200	..	..	(39)[14]	..	..	..
Intensive inv 2	440	..	..	(12)[14,35]	..	..	..
Extensive inv	3 300	..	..	(92)[14]	..	..	..
Kango	100	..	..	10 m^3/ha	160 m^3/ha[16]	260-350[15]	..
Ghana							
National estimate	1 500	330[17]	330	83[18]	..	..	..
Guinea							
National estimate	700	..	..	10[39]	..	..	..
Ivory Coast							
Inventories	15 670						
CTFT[20]	13 090	..	..	- 670 -		..	..
DRC	2 580[41]	..	..	38 m^3/ha[40]	..	175[21]	..
National estimate	(8 000)	..	..	(493)[19]	..	..	..
Kenya (inv)[22]	1 264	109	79	53	..	..	..
Liberia (inv)[23]	1 573	..	..	- 47-95 m^3/ha -		80-112	27-48

Table S VIII. Summary of inventory results and national estimates

Country (district)	Area	Standing timber[36]		Presently commercial volume	Potentially commercial volume	Standing timber per ha	Number of trees per ha
		Total	Broadleaved				
	1000 ha	million m^3				m^3/ha	
Madagascar							
Inventories							
Fierenana[24]	61	..	..		(56 m^3/ha)	56	33
Morandava[25]	100	..	..	..	..	4-5	27
National estimate	12 000	575[26]	575	..	..	..	..
Morocco							
National estimate	5 000	153[30]	(135)	..	..	..	..
Nigeria							
East region[27]	400	74	74	22	..	..	..
Senegal							
National estimate	(3 700)	..	..	(43)	..	..	..
Sierra Leone							
Inventories	197						
Goma[28]	(26)	3	3	1.8	..	..	..
Tama, Tonkoli[29]	26	..	..	1.1	..	..	..
National estimate	300	..	..	(10)	..	..	..
Sudan (national est)	40 000	(1 500)[31]	..	..	..	..	..
Tanzania							
Inventories							
Rain forest	106	21	..	..	..	197	..
Savanna woodland	4 209	196	..	..	..	47	..
National estimates	34 600	1 406	..	..	..	41	..
Rain forest	337	66	..	..	..	197	..
Savanna woodland	25 800	1 203	..	..	..	47	..
Intermediate woodland	8 500	127	..	..	..	15	..
Togo (inv)[32]	2 555[42]	32	32	(4.6)	..	..	..
Tunisia (national est)	360	7.8[33]	..	..	..	..	..
Uganda (national est)	700	..	..	15[34]	..	..	..

Notes to Table S VIII

1) Figures for 30 per cent of the pine forests
2) Volume of 55 species above d.b.h. 50 cm
3) Exploitable volume is 10.2 million m^3
4) Productive area
5) Volume of 30 species above d.b.h. 62 cm
6) Volume of 27 species above d.b.h. 62 cm
7) Min. diam. not known
8) All species (342) above d.b.h. 15 cm
9) Figures for dense forest
10) 11 species above 62 cm d.b.h.
11) All species above 20 cm d.b.h.
12) Volume of trees above d.b.h. 60 cm
13) Extracted logs from exploitable trees. Minimum d.b.h. 50 cm. Volume in m^3o.b.
14) Volume actually utilizable after removal of the waste. Trees with a d.b.h. above 50 cm are considered. Volume in m^3o.b.

Continuation see page 203. (End of Table S IX)

Table S IX. Standing timber

Country	Natural closed forest					
	Gross volume				Commercial volume	Exploitable volume
	Total	Per ha	Broadleaved	Coniferous		
	million m^3	m^3/ha	million m^3			
Algeria	20	40	3	17	5[1]	..
Angola	60[6]	250	60	-	5[7]	3
Benin (Dahomey)	25	140	25	-	4	..
Botswana	-	-	-	-	-	-
Burundi	15	150	D	..	..	(-)
Cameroon	4 300[6]	250	4 300	-	800[7]	130
Central African Republic	800[6]	275	800	-	150[7]	35
Chad	-	-	-	-	-	-
Congo	4 200[6]	250	4 200	-	400[7]	100
Equatorial Guinea	300[6]	250	300	-	50	20
Ethiopia	700	175	550	150	150	..
Gabon	5 600[6]	275	5 600	-	300[7]	150
Gambia	-	-	-	-	-	-
Ghana	460	200	460	-	115	..
Guinea	50	75	50	-	10	..
Guinea Bissau	15[8]	50	15	-	4	..
Ivory Coast	1 530	170	1 530	-	400	..
Kenya	110	(90)	80	30	40	..
Liberia	400	160	400	-	60	..
Libyan Arab Republic	2	(25)	..	..	0.3	..
Madagascar	540	90	(540)	..	150	..
Malawi	..	..	..	..	..	..
Mali	-	-	-	-	-	-
Mauritania	-	-	-	-	-	-
Morocco	25	60	12	13	15	..
Mozambique	..	..	..	..	..	..
Namibia	-	-	-	-	-	-
Niger	-	-	-	-	-	-
Nigeria	660	150	660	-	70	30 m^3/ha[18]
Rhodesia	..	..	..	..	..	..
Rwanda	40	150	D	..	..	..
Senegal	-	-	-	-	-	-
Sierra Leone	55	200	55	-	10	..
Somalia	20	125	10	10	..	..
South Africa	35	150	..	..	..	..
Sudan	50	150	..	..	10	..
Swaziland	-	-	-	-	-	-
Tanzania	140[15]	150	(110)	(30)	33[20]	33
Togo	50	140	50	-	13	..
Tunisia	7	40	(5)	(2)	2	..

Other natural forests		Plantations	Open woodlands		Outside forest	All land	Country
Gross volume	Commercial volume	Gross volume	Gross volume	Commercial volume	Gross volume	Total gross volume	
million m^3							
30 [2]	..	10	.. [3]	..	..	(60)	Algeria
150	..	..	1 400	..	..	(1 600)	Angola
(3)	..	..	90	..	10	130	Benin (Dahomey)
30 [5]	0.3	..	600	..	..	(630)	Botswana
..	..	..	..	..	..	..	Burundi
25	..	..	180	..	90	4 600	Cameroon
-	-	..	800	..	..	1 600	Central African Rep
-	-	..	350	0	300	650	Chad
..	..	..	100	..	..	4 300	Congo
..	..	-	..	..	50	(350)	Equatorial Guinea
..	..	..	60	..	120	900	Ethiopia
150	..	..	30	..	..	(5 800)	Gabon
1	..	..	9	..	(10)	20	Gambia
..	..	..	150	..	60	670	Ghana
20	..	..	250	..	50	370	Guinea
25	..	-	3	..	10	55	Guinea Bissau
..	..	..	150	..	430	2 100	Ivory Coast
4	..	6 [17]	10	..	..	(130)	Kenya
..	..	..	..	..	90	500	Liberia
4 [2]	..	3	.. [3]	..	..	(9)	Libyan Arab Republic
10 [11]	..	..	30 [9]	2	120 [10]	700	Madagascar
-	-	..	200	(10)	..	(200)	Malawi
-	-	..	120	5	330	450	Mali
-	-	..	(150)	0	65	215	Mauritania
115 [2]	..	15	.. [3]	..	..	(155)	Morocco
200	..	..	2 000	100	..	(2 200)	Mozambique
-	-	..	200	..	..	(200)	Namibia
-	-	..	160	0	120	280	Niger
..	..	..	450	..	300	1 400	Nigeria
40	0.5	..	610	..	..	650	Rhodesia
..	..	..	5	..	..	(50)	Rwanda
20 [19]	..	..	130	30 [12]	60	210	Senegal
..	..	..	1	..	75	130	Sierra Leone
..	..	..	..	..	50 [13]	70	Somalia
..	..	(120)	50	..	..	(200)	South Africa
..	..	..	1 500	15	..	(1 550)	Sudan
-	-	(14)	0	..	..	(15)	Swaziland
10	..	..	1 200	(400) [16]	..	1 500	Tanzania
4	..	..	45	..	10	110	Togo
4 [2]	..	2	.. [3]	..	..	15	Tunisia

Table S IX. Standing timber

Country	Natural closed forest					
	Gross volume				Commercial volume	Exploitable volume
	Total	Per ha	Broadleaved	Coniferous		
	million m^3	m^3/ha	million m^3			
Uganda	150	200	(150)	..	15[14]	..
Upper Volta	-	-	-	-	-	-
Zaire	22 000[6]	250	22 000	..	2 200	500
Zambia	..	..	..	..	..	..

Notes to Table S IX

1) Timber
2) Maquis
3) Included under other natural forest
4) Not available. Included under natural closed forest
5) Dry deciduous forest
6) Trees above d.b.h. 10 cm
7) Commercial species above d.b.h. 60 cm
8) Probably of open woodland type
9) Dry deciduous forest in the west an southern scrub forest
10) Including exploited forest and degraded forest
11) Mangrove
12) Commercial volume in all land
13) Part of this in open woodland
14) Estimated from inventory information. In certain regions more or less all species are however utilized for sawnwood
15) Volume in productive forest areas is 66 million m^3
16) A recent report gives higher figures about commercial volume than what has earlier been used (in all 400 million m^3 of sawlogs)
17) Volume in 101 000 ha of coniferous plantations
18) The volume that is actually exploited at present
19) Including "valuable forests" in Casamance
20) Sawlogs in productive forest area

Other natural forests		Plantations	Open woodlands		Outside forest	All land	Country
Gross volume	Commercial volume	Gross volume	Gross volume	Commercial volume	Gross volume	Total gross volume	
million m^3							
..	..	..	200	..	..	..	Uganda
-	-	..	120	5	160	280	Upper Volta
60	..	..	1 300	..	(200)	24 000	Zaire
30[5)]	3	..	1 500	70	..	1 600	Zambia

Notes to Table S VIII. Cont. from page 199

15) Total wood volume (including branches above 7 cm)
16) Potentially utilizable for pulp
17) All trees above d.b.h. 9.7 cm
18) Commercial species above d.b.h. 68 cm
19) Trees above 60 cm d.b.h. Volume in m^3o.b. 30 species included
20) Volume of 43 species above 36 cm d.b.h. Forest area included is 6.4 million ha
21) All species above 10 cm d.b.h.
22) Volume of all trees above d.b.h. 15.2 cm
23) The volume of all species above d.b.h. 15 cm. Volume in m^3o.b.
24) Volume of all trees above 40 cm d.b.h.
25) Volume of all trees above 30 cm d.b.h. (m^3o.b.)
26) Volume of trees above d.b.h. 30 cm. Forest area included here is 8 million ha
27) Volume of all species above 15 cm d.b.h.
28) Net volumes under bark with a d.b.h. above 39 cm
29) Merchantable species above d.b.h. 58 cm
30) All species, all diameters, bark included
31) Volume of fuelwood
32) Volume of all species above 62 cm d.b.h.
33) Volume over bark. Ninety per cent of total volume included.
34) The volume of commercial and potentially commercial trees with a d.b.h. above 50 cm
35) 26 species included
36) Details of measurement are rarely known in detail. Bark is probably included in most cases when no information is given
37) This is the gross volume o.b. The net volume over bark is 6.2 million m^3
38) 36.6 million m^3 utilizable in the form of logs
39) One million m^3 of export quality
40) Export quality. Min. d.b.h. 70 cm
41) Forest area included is about 1.5 million ha
42) Volume information for 1 740 000 ha (of which 1 290 000 ha wooded savanna)

Table S X. Ownership

Country	Forest and other wooded areas		Closed forest		Open woodlands (scrub and brushland)		Man-made forest		Ownership not yet defined
	Public	Private	Public	Private	Public	Private	Public	Private	
	1000 ha								
Algeria	(2 700)	..	490	..	2 000	..	(200)	..	..
Angola	72 660	..	(3 445)[1]	..	..	..	13	107	..
Benin (Dahomey)	2 153[3]	4	(250)	..	..	..	14	4	..
Botswana	D	..	-	-	..	..	..	..	..
Burundi	..	..	100	..	..	..	25	..	..
Cameroon	..	..	17 500	..	..	..	9	..	..
Central African Rep.	(9 117)[2]	..	3 000	..	..	..	..	..	..
Chad	..	..	-	-	..	..	..	..	..
Congo	..	..	17 000	..	..	..	12	..	..
Equatorial Guinea	..	..	1 120	-	..	..	..	..	..
Ethiopia	..	..	5 000	-	..	..	40[17]	..	..
Gabon	..	..	21 500	..	..	..	25	..	..
Gambia	..	..	..	..	40[4]	..	..	..	..
Ghana	12 250[2]	..	1 800[5]	-	..	..	21	..	..
Guinea	..	..	700	-	..	-	2	..	..
Guinea Bissau	..	..	750[6]	..	..	..	..	..	..
Ivory Coast	..	..	5 240[7]	..	..	..	28	..	..
Kenya	1 812[8]	..	920	..	850[9]	..	138	141	..
Liberia	5 585[2]	..	2 500	-	..	..	..	..	..
Libyan Arab Republic	535	(22)	70	..	(390)	..	75	22	..
Madagascar	15 193[19]	139[19]	6 000	..	(9 000)	..	100	139[19]	..
Malawi[21]	1 500[10]	100[10]	..	..	..	..	37	4	600[10]
Mali	..	..	-	-	..	..	..	..	..
Mauritania	..	..	-	-	..	..	..	..	..
Mauritius	..	..	2	..	7	..	6	1	..
Morocco	4 400[19]	46	400	-	..	-	248	46	..
Mozambique	66 500	..	1 500	..	..	..	21	1	..
Namibia	..	..	-	-	..	..	..	..	..
Nigeria	9 800[19]	-	1 900[11]	-	7 700[11]	-	70	..	21 500[19]
Réunion	70	30	..	..	..	..	5	4	..
Rhodesia	13 662[2]	9 907[2]	..	..	..	..	13	81	..
Rwanda	..	..	300	..	..	..	27	2	..
Senegal	3 743[12]	..	(220)	..	..	..	14	-	..
Sierra Leone	..	..	122[18]	(37)	..	..	7	-	..
Somalia	10 120[2]	-	160	-	..	..	(15)	..	..
South Africa	3 401[2]	704[2]	250	..	..	..	350	700	..
Sudan	..[13]	..	300	-	..	..	80	..	..
Swaziland	40	76	-	-	40	-	..	76	..
Tanzania	44 230	60	1 020	..	..	..	(65)	..	..
Togo	450[2]	80[2]	..	..	..	..	..	..	..

Table S X. Ownership

Country	Forest and other wooded areas		Closed forest		Open woodlands (scrub and brushland)		Man-made forest		Ownership not yet defined
	Public	Private	Public	Private	Public	Private	Public	Private	
	1000 ha								
Tunisia	690[19]	-	253	-	(323)	-	114	..	..
Uganda	..	..	722[14]	..	(810)[14]	..	20	7	..
Upper Volta	3 500[15]	..	..	..	3 500[15]	..	2	..	..
Zaire	..	..	..[20]	..	..	..	(50)	..	..
Zambia	37 500	(1 190)[16]	..	..	37 500	(1 190)[16]	24	..	..

Notes to Table S X

1) From WFI 1970 Questionnaire. Closed forest usually said to be 1 million ha. Moist deciduous forest included here
2) Information from WFI 1963
3) Information from WFI 1970 Questionnaire. This is the area of forest reserves (forêt classé)
4) The area of gazetted Forest parks
5) Part of this area under tribal ownership
6) Part of this area is probably open woodlands
7) This is the area of forêt classé (according to 1970 WFI Questionnaire). Practically all closed forests are publicly owned
8) Information from WFI 1970 Questionnaire. This is the reserved area
9) Includes all forest land not classified as closed forest. Includes also certain protection reserves not shown under total
10) Information from WFI 1970 Questionnaire. Concerns open woodland areas
11) Reserved areas
12) Information from WFI 1970 Questionnaire. This is the area of forêt classé. The whole area of forest and other wooded areas is given as 5.3 million ha
13) There is said to be no privately owned "forests" in Sudan. With forests is then meant forest reserves
14) Information only available for forest reserves. The overwhelming part of the wooded area seems in one way or another to be publicly owned
15) The area of forêt classé
16) Information from WFI 1970 Questionnaire. Another source gives all forest land as publicly owned
17) Not known if all private plantations were nationalized in 1975
18) Protection reserves not included. Information from WFI 1970 Questionnaire.
19) Information from WFI 1970 Questionnaire
20) Probably public
21) According to FAO 1975a forest and other wooded areas cover 6.9 million ha (1.9 million ha public, 97 000 ha private and 4.9 million ha under no effective control)

Table S XI. Area of forest reserves and protection reserves

Country	Forest reserves			Protection reserves				Area of National parks	of which approx closed forest
	Total	of which		Total	Closed forest	Open woodland	Man-made forest		
		Closed forest	Open woodland						
	1000 ha								
Algeria	..	..	..	..	..	..	..	..	..
Angola	..	(3 000)[1]	..	1 965	60[2]	1 905[2]	0.3[2]	3 450[3]	-
Benin (Dahomey)	2 144[12]	16[13]	2 128	775[14]	..	..	..	777[3]	-
Botswana	..	..	..	..	..	..	..	10 000[4]	-
Burundi	..	(100)[5]	-	..	..	..	..	-	-
Cameroon	..	625[6]	..	..	..	..	..	910[7]	..
Central African Rep.	633[8]	239[8]	..	..	..	..	..	1 420[3]	-
Chad	..	-	500[9]	..	..	..	..	407[3]	-
Comoro Islands	..	4[10]	..	..	..	..	..	..	..
Congo	..	50[9]	..	..	..	..	..	110[11]	(75)
Equatorial Guinea	..	..	..	..	..	..	..	30[11]	20
Ethiopia	..	350[2]	..	..	..	-	-	18[7]	3
Fr. Terr. of Afars, Issas	..	..	..	..	..	..	..	10[11]	6
Gabon	..	1 300[9]	..	..	..	..	..	423[11]	390
Gambia	..	..	40	..	..	..	..	-	-
Ghana	2 438	1 785	653	..	..[15]	..	..	960[3]	-
Guinea	1 000[9]	..	..	..	..	..	..	13[11]	8
Guinea Bissau	..	..	..	40	..	..	..	..	..
Ivory Coast[2]	..	5 243	..	..	2 040[21]	1 256	..	1 570[7]	420
Kenya	1 676[16]	750	346	..	124	..	..	2 480[7]	60
Lesotho	-	-	-	..	-	..	..	6	-
Liberia	..	1 600	..	..	(41)	..	..	(40)	(40)
Libyan Arab Republic	..	..	..	..	..	..	..	-	-
Madagascar[2]	..	(6 132)	..	..	(1 038)[21]	..	..	1 050[7]	(200)[17]
Malawi	..	..	1 576	..	..	(1 347)	..	310[3]	-
Mali	..	-	(1 100)[9]	..	..	..	..	350[3]	-
Mauritania	..	-	(100)[9]	..	..	..	..	10	-
Mauritius[2]	..	2	..	..	2[21]	..	..	1[11]	1
Morocco	..	..	..	..	..	..	..	37[11]	(15)
Mozambique	..	..	..	..	..	..	..	575	..
Namibia	..	..	..	..	..	..	..	6 500[3]	-
Niger	..	..	(600)[9]	..	..	..	..	300[3]	-
Nigeria	..	1 900	7 700	..	..	..	..	600[3]	..
Réunion	..	..	..	..	..	..	..	-	-
Rhodesia	..	..	(1 700)[9]	..	..	..	..	2 840[7]	..[18]
Rwanda	..	..	..	..	..	..	..	(274)[7]	(10)
Senegal	..	..	(3 743)[2]	..	..	..	..	(828)[3]	-
Seychelles	..	..	..	..	..	..	..	..	..
Sierra Leone[2]	308	..	..	..	186[19]	44	-	-	-
Somalia	400[9]	..	..	200[2]	..	..	..	625[3]	-

Table S XI. Area of forest reserves and protection reserves

Country	Forest reserves			Protection reserves				Area of National parks	of which approx closed forest
	Total	of which		Total	Closed forest	Open woodland	Man-made forest		
		Closed forest	Open woodland						
	1000 ha								
South Africa	..	(250)	..	..	..	..	..	2 980[7]	(40)
Sudan	1 190	300	890	..	..	(550)	..	2 450[3]	-
Swaziland	..	..	..	..	..	..	..	3	-
Tanzania	12 880	1 055	11 440	1 443	770	..	-	3 690[7]	(5)
Togo	(400)[9]	..	..	(150)[10]	..	..	..	64[3]	-
Tunisia	..	367	..	..	..	..	..	12	-
Uganda	1 522	722	810	233[22]	..	..	..	900[7]	(30)
Upper Volta	3 500[12]	..	3 500	..	..	..	..	530[3]	-
Zaire	..	..	..	(775)[10]	..	..	..	5 260[11]	3 150
Zambia	6 700	-	6 700	2 136	..	..	..	5 900[3]	-

Notes to Table S XI

1) The so-called "moist semi-deciduous" forest probably included. Information from WFI 1970 Questionnaire
2) Source WFI 1970 Questionnaire
3) Includes open woodlands
4) Includes open woodlands. In 2 500 000 ha only hunting is forbidden
5) Of this area 50 000 ha is said to be needed for protection while the rest could be used for production
6) Larger areas may be reserved as forest areas often have been reservd and closed to exploitation pending the development of suitable plans. Reserve is often used in the meaning of closed forest
7) Includes open woodlands and closed forest
8) Figures from 1964 report. Larger areas have been indicated as "fôret classê" in later reports
9) Information from Timber Trends and Prospects in Africa
10) Source WFI 1963
11) Includes closed forest
12) Fôret classê
13) Plantations not included. Probably in the figures for open woodlands
14) Area of National parks set aside as game reserves in the north of the country. Included in the area of forest reserves
15) In closed forest 310 000 ha are under protection, or inaccessible, or of other reasons at present not yielding commercial timber
16) The breakdown in closed forest and open woodlands is not complete. Only 60 000 ha of plantations is included under closed forest
17) In addition National parks are found in dry deciduous forest
18) Some remnants of Widdringtonia
19) Inaccessible forests included
20) Of this area 5 320 000 ha is classified as protected forest
21) Included in the area of forest reserves
22) Source: Atlas of Uganda 1969

Table S XII. Exploitation pattern (mainly in natural closed forest)

Country	Exploited	Unexploited	Potentially productive	Concessions	Management plans (natural forest)	Management plans in man-made forest	Accessible forests
	1000 ha						
Algeria	..	..	490	..	..	..	490 E
Angola	(150) E	(100) E	(100) E	65[10]	5[1]	113[1]	900 E[2]
Benin (Dahomey)	100 E	150 E	100 E	..	..	14[1]	250 E
Botswana	..	..	..	..	..	..	..
Burundi	100 E	..	-	..	..	(25)[1]	..
Cameroon	(8 500)	9 000	8 000	6 000[3]	..	..	10 000 E
Central African Rep.	500 E	2 500 E	2 000 E	(300)	..	..	1 500 E
Chad	-	-	-	-	-	..	-
Congo	4 000	13 000	7 000 E	(2 500)	-	..	5 000 E
Equatorial Guinea	260	740	500 E	..	..	..	700 E
Ethiopia[4]	300 E	3 700 E	(1 500) E	..	..	..	(500) E
Gabon	5 000	15 000	12 000 E	6 000	-	..	6 000 E
Gambia	..	..	..	..	..	..	..
Ghana[5]	1 000 E	800 E	400 E	(1 400+)[6]	1 400	..	1 500 E
Guinea	..	(700)	700 E	..	..	..	400 E
Guinea Bissau[7]	150 E	100 E	100 E	..	..	..	700 E[2]
Ivory Coast	(5 000) E	4 000 E	3 000 E	6 390	-	5[1]	7 000 E
Kenya[4]	400 E	200 E	100 E	+	(1 052)[8]	101[1]	450 E
Liberia	500 E	2 000 E	1 500 E	1 655	..	..	1 000 E
Libyan Arab Republic	..	..	..	..	..	..	70 E
Madagascar	3 000 E	3 000 E	1 500 E	+	-	..	3 500 E
Malawi	..	..	-	(2)[1]	..	23[1]	..
Mali	-	-	-	-	-	..	-
Mauritania	-	-	-	-	-	..	-
Mauritius	..	..	..	-	0	7[1]	..
Morocco	..	..	(400) E	-	400[1]	90[1]	(400) E
Mozambique	..	..	..	..[11]	..	..	1 000 E[2]
Namibia	-	-	-	-	-	..	-
Niger	-	-	-	-	-	..	-
Nigeria	3 000 E	(1 000) E	(500) E	1 500 E	1 900[1]	54[1]	3 500 E
Réunion	..	..	..	..	..	..	..
Rhodesia	..	..	..	..	..	..	..
Rwanda	100 E	200 E	..	..	..	..	150 E
Senegal	..	..	..	..	71[1]	..	150 E[2]
Sierra Leone	50 E	(250) E	80 E	+	92[1]	..	200 E
Somalia	75 E	75 E	50 E	..	..	..	100 E
South Africa	..	..	..	..	..	(1 099)	(255) E
Sudan	..	100 E	50 E	..	56[1]	9[1]	50 E
Swaziland	..	..	..	..	..	89[1]	..
Tanzania	(500) E	(500) E	(300)	(12)[9]	8[1]	35[1]	(300) E
Togo	200 E	200 E	150 E	..	..	..	350 E
Tunisia	..	..	180	-	143[1]	..	180 E

Table S XII. Exploitation pattern (mainly in natural closed forest)

Country	Exploited	Unexploited	Potentially productive	Concessions	Management plans (natural forest)	Management plans in man-made forest	Accessible forests
	1000 ha						
Uganda	200 E	500	300	(260)	(500)	..	400
Upper Volta	-	-	-	-	-	..	-
Zaire	(5 000) E	(85 000) E	(70 000) E	..	-	-	20 000 E
Zambia	..	..	..	..	..	21 [1)]	..

Notes to Table S XII.

1) Information in WFI 1970 Questionnaire
2) Mangrove included.
3) Rather old figure
4) Bamboo not included
5) Only the forest reserves are considered
6) In addition some areas in non-reserved forests
7) Mangrove not included
8) Includes not only natural closed forest. Information from WFI 1970 Questionnaire
9) Licences are given
10) In open woodland licences has been given
11) Concession was earlier given for 800 000 ha (mainly in open woodland)

Table S XIII. Roundwood production in 1973

Country	Industrial roundwood			Fuelwood	All roundwood production		
	Conifers	Broadleaved	Total		Conifers	Broadleaved	Total
	1000 m^3						
Algeria	110 F	56 F	166 F	1 160 F	880 F	446 F	1 326 F
Angola	-	1 240 F	1 240 F	6 180 F	-	7 420 F	7 420 F
Benin (Dahomey)	-	160 F	160 F	2 000 F	-	2 160 F	2 160 F
Botswana	-	45 F	45 F	650 F	-	695 F	695 F
Burundi	1	30	31	870	1	900	901
Cameroon	-	1 300 F	1 300 F	6 650 F	-	7 950 F	7 950 F
Central African Rep.	-	466 F	466 F	1 980 F	-	2 446 F	2 446 F
Chad	-	390 F	390 F	3 110 F	-	3 500 F	3 500 F
Congo	-	705	705	1 310	-	2 015	2 015
Egypt	-	74 F	74 F	111 F	-	185 F	185 F
Equatorial Guinea	-	550	550	370	-	920	920
Ethiopia	150 F	1 070 F	1 220 F	23 000 F	2 900 F	21 320 F	24 220 F
Fr. Terr. of Afars, Issas	..	3 F	3 F	20 F	..	23 F	23 F
Gabon	-	2 360 F	2 360 F	1 100 F	-	3 460 F	3 460 F
Gambia	-	10 F	10 F	180 F	-	190 F	190 F
Ghana	-	1 878 F	1 878 F	8 255 F	-	10 133 F	10 133 F
Guinea	-	465 F	465 F	2 460 F	-	2 925 F	2 925 F
Guinea Bissau	-	100 F	100 F	430 F	-	530 F	530 F
Ivory Coast	-	5 695 F	5 695 F	5 200 F	-	10 895 F	10 895 F
Kenya	415 F	470 F	885 F	10 625 F	945 F	10 565 F	11 510 F
Liberia	-	525	525	1 245	-	1 770	1 770
Libyan Arab Republic	..	71	71	330 F	..	401	401
Madagascar	..	1 513 F	1 513 F	4 100 F	-	5 613 F	5 613 F
Malawi	39 F	212 F	251 F	4 200 F	44 F	4 407 F	4 451 F
Mali	-	235 F	235 F	2 620 F	-	2 855 F	2 855 F
Mauritania	-	36 F	36 F	500 F	-	536 F	536 F
Mauritius	3 F	9 F	12 F	80 F	3 F	89 F	92 F
Morocco	85 F	334 F	419 F	2 480 F	585 F	2 314 F	2 899 F
Mozambique	-	835 F	835 F	8 240 F	-	9 075 F	9 075 F
Niger	-	170 F	170 F	2 320 F	-	2 490 F	2 490 F
Nigeria	-	2 960 F	2 960 F	56 800 F	-	59 760 F	59 760 F
Réunion	-	2 F	2 F	28 F	-	30 F	30 F
Rhodesia	154 F	348 F	502 F	5 400 F	164 F	5 738 F	5 902 F
Rwanda	..	60 F	60 F	3 870 F	..	3 930 F	3 930 F
Senegal	-	371 F	371 F	2 220 F	-	2 591 F	2 591 F
Sierra Leone	-	132 F	132 F	2 554 F	-	2 686 F	2 686 F
Somalia	..	65 F	65 F	3 000 F	..	3 065 F	3 065 F
South Africa	4 364	5 091	9 455	7 500[1)]	(4 454)	(6 001)	16 955
Sudan	..	1 278 F	1 278 F	19 800 F	..	21 078 F	21 078 F
Swaziland	1 295 F	100 F	1 395 F	450 F	1 295 F	550 F	1 845 F

Table S XIII. Roundwood production in 1973

Country	Industrial roundwood			Fuelwood	All roundwood production		
	Conifers	Broadleaved	Total		Conifers	Broadleaved	Total
	1000 m^3						
Tanzania	113 F	1 059 F	1 172 F	31 500 F	163 F	32 509 F	32 672 F
Togo	-	105 F	105 F	1 150 F	-	1 255 F	1 255 F
Tunisia	17	65 F	82	1 670 F	187	1 565 F	1 752
Uganda	14 F	1 061 F	1 075 F	13 600 F	14 F	14 661 F	14 675 F
Upper Volta	-	450 F	450 F	3 920 F	-	4 370 F	4 370 F
Zaire	-	1 880 F	1 880 F	12 800	-	14 680	14 680
Zambia	-	436 F	436 F	4 550	-	4 986	4 986

F = FAO estimate

1) Estimate in Grut 1975

Table S XIV. Other information

Country	Population 1973	Population density	Closed forest in percentage of land area	Closed forest area per caput
	1000 inh	inh./km^2	%	ha
Algeria	15 536	7(92)[1]	0.3	0.05
Angola	6 075	5	1	0.2
Benin (Dahomey)	2 912	26	2	0.09
Botswana	667	1	-	-
Burundi	3 873	151	5	0.03
Cameroon	6 186	13	37	2.8
Cap Verde Islands	260	65	-	-
Central African Republic	1 632	3	5	1.8
Chad	3 987	3(7)[1]	-	-
Comoro Islands	262	121	19	0.2
Congo	1 004	3	50	17
Egypt	36 940	(1 038)[2]	-	-
Equatorial Guinea	298	11	40	3.8
Ethiopia	26 757	27(29)[1]	5	0.2
Fr. Terr. Afars, Issas	101	4	0	(0.06)
Gabon	495	2	80	43
Gambia	387	39	2	0.06
Ghana	9 947	43	8	0.2
Guinea	4 208	17	3	0.2
Guinea Bissau	579	21	(27)	1.3
Ivory Coast	4 641	15	28	1.9
Kenya	11 986	21(27)[1]	2	0.09
Lesotho	1 105	36	-	-
Liberia	1 244	11	22	2.0
Libyan Arab Republic	2 200	1(79)[1]	1	0.07
Madagascar	7 546	13	10	0.8
Malawi	4 797	51	0.6	0.01
Mali	5 479	4(7)[1]	-	-
Mauritania	1 257	1(5)[1]	-	-
Mauritius	929	502	5	0.01
Morocco	16 965	38(77)[1]	(2)	(0.04)
Mozambique	8 243	11	2	0.2
Namibia	673	1	-	-
Niger	4 215	3(7)[1]	-	-
Nigeria	59 607	65	5	0.07
Réunion	475	189	(4)	(0.02)
Rhodesia	5 605	15	0.3	0.02
Rwanda	3 923	156	12	0.07
St. Helena, Ascension, Tristan da Cunha	5	16	-	-
Sao Tomé and Principe	61	64	..	..
Senegal	4 227	22	1	0.05
Seychelles	56	151	(3)	(0.02)

Table S XIV. Other information

Country	Population 1973	Population density	Closed forest in percentage of land area	Closed forest area per caput
	1000 inh	Inh./km^2	%	ha
Sierra Leone	2 839	40	4	0.1
Somalia	3 003	5(9)[1]	0.3	0.06
South Africa	21 665	17(27)[1]	1	0.06
Sudan	17 372	7(15)[1]	0.2	0.02
Swaziland	461	27	4	0.2
Tanzania	14 333	15	1	0.08
Togo	2 017	36	7	0.2
Tunisia	5 586	36(100)[1]	2	0.06
Uganda	9 304	48	4	0.08
Upper Volta	5 737	21	-	-
Western Sahara (Spanish Sahara)	51	0.2	-	-
Zaire	18 735	8	38	4.8
Zambia	4 709	6	0	0.05

Notes to Table S XIV

1) Within brackets population density in the non-desertic zone. The small population in the desert zone have been neglected.

2) Same as under 1). The inhabited and cultivated area accounts for 3 558 000 ha.

Appendix II

Wooded areas in need of protection

In this report (e.g. chapter 4) all wooded areas have been discussed as potential sources of wood. But of course there are many areas which should not be utilized for wood production because they are better needed for protection. There are also areas with unique vegetation which ought to be kept as National parks. The extent of such areas was not known when this report was being prepared. The areas of protection reserves and National parks given in summary-table SX I shows the areas that are already protected but not the areas that ought to be protected.

IUCN has launched a programme aimed at ensuring that representative samples of the various types of natural biomes and ecosystems are conserved in a coordinated system of National parks and related protected areas. Within this programme Lamprey (1975) published a report which discussed the biomes in East Africa which are in need of additional reservation. Hedberg, I. & Hedberg, O. (1968) gives "African sites of scientific interest in urgent need of protection". Not all the sites mentioned are wooded. As an example this list is quoted here.

"African sites of scientific interest in urgent need of protection"

Angola: maintenance of existing reserves

Annobon: summits of Santa Mina, Quioveo and Pico do Fogo

Benin (Dahomey): Savalou-Dassa, site of Encephalartos

Botswana: Central Kalahari Reserve

Burundi: part of lakes of mid Nyabarongo with savanna woodland

Cameroon: Cameroon Mountain-montane grassland and forest

Cape Verde Is.: Pico da Antonia (on Santiago)

Ethiopia: High Simien

French Terr. Afars, Issas: Dai Forest

Ghana: W. Accra Plains-thickets in coastal savanna

Guinea: Mt. Gangan

Ivory Coast: Tonkoui Mountains

Kenya: Kakamega Forest-most easterly point of the Western type forest

Liberia: the present National Forest of Vai and Sapo (Krahn-Bassa) to be designated protected areas.

Madagascar: maintenance of existing reserves and protection of endemic families Didiereaceae and Sarcolaenaceae etc.

Malawi: Malawi Hills-lowland rain forest

Mali: Kita-Toukoto-relict forests of Gilbertiodendron glandulosum

Mautitania: Atar region, maintenance of fenced areas

Mozambique: Chipenhe, Gaza dist.-sacred forest of Chirindzeni

E. Nigeria: Oban Forest Reserve
N. " : Mambila Plateau

Principe: Papageio Peak-summit forest

Rhodesia: a site of Androstachys johnsonii

Rwanda: effective protection of Kibira Forest

Sao Tomé: Pico-montane forest

Senegal: Diantêm-Guibourtia forest

Seychelles: Central Mahé with its outlier Mount Sebert

Sierra Leone: Loma and Tingi Mountains-upland savanna, montane forest, tropical rain forest

Socotra: area to the E. of Hadibo

Somalia: Proposed Cordeauia reserve

South Africa: L. Bangwazi, N. Natal-swamp forest

Sudan: Jebel Marra

Tanzania: Usambara Mts.-range of types from moist lowland to dry montane forest

Togo: sites at Palimé-thick humid rain forest

Uganda: Lake Nabugabo-swamp

Zaire: Lukaya River, Kimuenza

Zambia: establishment of a reserve at Matonchi farm, Mwinilunga dist.-floristically rich savanna woodland

The follow-up of these recommendations is discussed in Hedberg, I.: Follow-up of the AETFAT meeting in Uppsala in 1966 on "Conservation of vegetation in Africa south of the Sahara". - Boissiera 24. pp. 437-441.

Appendix III

Addendum to Part I

The summary-tables in Part II sometimes contain more recent information than the country notes in Part I. When this new information was found at a late stage it has not always been included in the regional summaries. This Addendum gives some of the more important new information that has been traced since the publication of Part I. It is not always certain that the new figures are better than the figures in Part I. Where the sources for these figures are not known they have not always been included in the summary-tables.

Angola: Synnott (1976a) reports the area of Miombo to be 30 million ha.

Cameroon: (Source FAO 1975 a). Inventory A. (Haute Nyong and Boumba-Ngoko). Trees with a d.b.h. of 20 cm and more were counted. In Part I only the volume of trees from d.b.h. 62 cm is given.

Inventory B. (Deng Deng). In the CTFT Inventory 27 species were measured. The FAO inventory measured 45 species. The total area covered by this inventory was reported to be 300,000 ha. Trees down to 10 cm d.b.h. were measured.

There is a preliminary CTFT inventory of 300,000 ha in the Mamfe and Kumba Divisions.

Ghana: Synnott (1976a) gives the planted area as 34,000 ha.

The Annual Report 1972 states that the log production in 1972 exceeded the 1960 production. Forest inventories for working plans should cover 1.1 million ha.

Kenya: "Forest" given as 1,664,650 ha. An area of 141,000 ha should be private forests (FAO 1975 a). Synnott (1976a) gives the planted area as 160,000 ha.

Liberia: 1.6 million ha inventoried (FAO 1975 a).

Madagascar: In Mangoro area about 32,000 ha of Pinus kesiya have been planted since 1969. A further 58,000 - 64,000 ha are planned to be planted between 1975 and 1984. The total area planted in this area will then be 90,000 - 96,000 ha. Future plantings will also include Pinus elliottii. Average yield is estimated to be 12 m^3/ha/year (Grut 1975).

Malawi: By 1975 some 30,000 ha of plantations had been established on the Vipya plateau. The plan is to add 6,000 ha/year during the next five years and thus give a total area of 60,000 ha. The mean annual increment is estimated as 17 m^3/ha/year at the planned rotation of 15 - 20 years (Grut 1975).

The area of "forests" given as 6.9 million ha (67 per cent unproductive). Of this area 26.2 per cent is said to be under state control, 1.4 per cent private ownership, 0.8 per cent community ownership and 71.6 per cent under no effective control. In all inventories cover about 78,000 ha (FAO 1975 a).

Synnott (1976 a) gives the area of Miombo as 1.7 million ha.

Nigeria: Some recent publications estimate a larger closed forest area than given in Part I. Apparently existing cultivation is included in some of these figures. The area of plantations is given as 100,000 ha (Synnott 1976 a)

Mozambique: Synnott (1976 a) gives the area of Miombo as 40 million ha.

Rhodesia: Total area planted 100,000 - 112,000 ha. Of the plantations 60 per cent coniferous, 20 per cent eucalypts and 20 per cent wattle (Grut 1975).

Synnott (1976 a) reports the area of Miombo as 30 million ha.

Senegal: The inventory in Casamance cover 320,000 ha (FAO 1975 a).

Sierra Leone: Inventories for working plans cover 197,000 ha of forest (FAO 1975 a).

South Africa: At the end of March 1974 the planted area was 1,099,000 ha (conifers 51 per cent, eucalypts 34 per cent, wattle 14 per cent, other species 1 per cent). Forty-five per cent of planted area mainly used for sawtimber production. The area of man-made forests increases by 20,000 ha a year (Grut 1975).

- Page 196 (in Part I) first paragraph: . . . broadleaved plantations 6.5 million m^3.

Sudan: Bayoumi (1971) gives the total planted area (including failed and replanted areas) in 1969 as 88,747 ha.

- Page 200 (in Part I). Approximate area of montane vegetation in the table is 600,000 ha.
- Page 202 (in Part I). The figures in the table about planted areas are in ha (total area planted 80,860 ha).

Swaziland: The plantations in 1973 was given as 96,075 ha (conifers 71 per cent, eucalypts 23 per cent, other 6 per cent). Thirty per cent of the plantations were mainly managed for sawtimber production. A new 17,000 ha afforestation scheme was recently started (Grut 1975).

Tanzania: In Gilliusson et al. 1975 was given the following information.

Type of wooded area	Gross area	Productive area[2/]	Gross volume		Potential annual cut	
					Sawtimber	Fuelwood, poles
	1000 ha		m^3/ha	million m^3	1000 m^3(r)	
Closed (rain) forest	936	337	197	66	332	332
Savanna woodland	32,641	25,803	47	1,213	5,202	12,140
Intermediate woodland[1/]	10,794	8,486	15	127		6,364
Total	44,371	34,626	41	1,406	5,534	18,836

1/ Woodland in a transitional form to bushland and thickets. Includes also 80,000 ha of mangrove.
2/ Protected areas and areas in National parks excluded.

In the productive closed forest 106,000 ha and in productive savanna woodland 4.2 million ha have been inventoried.(FAO 1975 a states that 7.1 million ha have been inventoried.)

The present plantations should consist of 48,000 ha of coniferous and 17,000 ha of broadleaved. In the year 2000 a planted area of 1,423,000 ha is estimated to be needed.

Uganda: Forest inventories for working plans cover 1,398,293 ha. CIDA has undertaken an inventory of 59,000 ha (FAO 1975 a).

The CIDA final report from 1973 gives 732,499 ha of closed forest in reserves (incl. bamboo), about 150,000 ha of private forests in Buganda and some closed forest on public land (in Bunyoro and in small patches all over the country). These areas may cover 22,000 - 30,000 ha.

- Page 221 (in Part I). Mgahinga montane forest 6,000 ha.
- Page 223 (in Part I). . . . 155,000 ha of private forests in Buganda. . .

Zambia: In 1975 plantations cover 23,000 ha (two-thirds pine and one-third eucalypts). These plantations are managed primarily for sawtimber production (Grut 1975).

Forest inventories for working plans cover 3,647,000 ha. A reconnaissance survey covers 40,745,600 ha (FAO 1975 a).

Algeria: Since the final preparation of Appendix III a new report (The Algerian forest. Ministry of Information and Culture) has come to hand. Some of the most essential information is given here.

Forest and other wooded areas are reported to be 3.0 million ha (of which 800,000 ha scrub). The areas to afforest would amount to 4 million ha of which 2 mill ha of highly-sloped lands adapted to forest, 0.5 million ha protecting areas to afforest and 1.5 million ha of afforestation or reconstitution of weathered forest.

The legal status of the forests is as follows:

Forests belonging to the state	2,439,000 ha
Common forests	275,000 ha
Self-managed forests	100,000 ha
Private forests	350,000 ha

The state controls almost all forest, even private forest.

The distribution by vegetation types is as follows:

Quercus suber	436,000 ha
Other Quercus spp.	419,000 ha
Cedrus atlantica	23,000 ha
Pinus halepensis	792,000 ha
Tetraclinis articulata	143,000 ha
Juniperus spp.	277,000 ha
Pinus pinaster	12,000 ha
Other	116,000 ha
Scrubs	780,000 ha

Only one-third of the forests can be considered productive. The rest is made of weathered or very young forests that may become productive but not for a very long time. The different types are briefly described below:

Pinus halepensis: This is found in some massifs with an average area of about 80,000 ha. The productive area is about 200,000 ha. A large part of the remaining area is very weathered.

Quercus suber: This species is most important from the economic point of view. Sometimes it is mixed with Q. faginea. Together they occupy a block of 400,000 ha on the eastern littoral. Some scattered blocks of, in all, 80,000 ha are situated around Alger and Oran. The forests of cork-oak are generally in a condition of advanced weathering because of repeated fires and excessive exploitation. Most of them are old (100 years or more).

Quercus faginea and Q. afares: Quercus faginea (sometimes mixed with Q. afares) is situated in three blocks on the lowland of the eastern littoral. The forests are said to be dense but the timber is almost worthless. The area is about 65,000 ha.

Other Quercus spp.: These species occupy about 350,000 ha. They form mainly scrubs which are of importance for protection and fuelwood supply only.

Cedrus atlantica: These forests are said to be old.

Pinus pinaster: These forests have been damaged by fires rather recently so most of them are young.

Juniperus spp: These species form more or less scattered scrubs.

Tetraclinis articulata: This species is found in the western and central parts. In certain places it forms massifs with relatively dense bushes.

The 160,000 ha of forests developed until now is expected to yield about 70,000 m^3 of industrial wood. The cork-oak forests are often old and must soon be replaced by new stands.

The area of National parks is given as 27,000 ha. Of this area at least 8,000 ha seems to consist of forest and other wooded areas.

The area afforested per year has increased from 6,500 ha in 1963 to 50,000 ha in 1973. During the colonial time only 25,000 ha is said to have been afforested. More than 350,000 ha should have been worked since independance.

The establishment of a green barrier between the Tunisian and Moroccan border (1500 km) has been discussed. This would include work (largely afforestation) on 3 million ha in the continental high plateaus. A yearly planting area of 150,000 ha is aimed for.

Some other recent sources checked mean that some of the figures in this report are outdated. Forests that can be exploited within 30 years would cover 500,000 ha and young forests would cover another 500,000 ha. The rest of the forest area should be badly degraded. About 200,000 ha should have been planted up to the beginning of the seventies.

Appendix IV

Changes in the resources of commercial species - Examples of calculations

Example 1: Changes in the status of the forests.

Intense attempts have been made to develop the estimates of present status of the forests (table 7.1) and try to forecast the status of the forests in the year 2000 using different assumptions about intensity of the exploitation.

Table A. shows the final results of such an analysis. The present exploitation of commercial wood is expected to continue. The following basic assumptions have been made:

a) In the case of West and East Africa roughly 70 per cent of the transformation of forest to agriculture will take place in already exploited forests. In Central Africa (except Zaire) only half of the clearing will take place in already exploited forests while in Zaire only 20 per cent. These relations are expected to remain more or less the same in coming years.

b) The clearing for agriculture in unexploited forests is thought to take place in the potentially exploitable forests.

c) The mean yield per ha is expected to remain the same though this is a pessimistic assumption.

Table A. Development of the closed forest resources up to the year 2000 if the present exploitation of industrial wood continues.

Region	Total area exploited till 2000[2]	Pot. expl. remaining	Expl. forest destroyed	Unexpl. forest destroyed	Status the year 2000			
					Expl. area	Potentially exploitable[1]	Other forest	Total forest area
	million ha							
West Africa	7.5	(-2)	5	2.5	7	0	2.5	9.5
Central Africa (excl. Zaire)	12.5	17.5	6	6	26.5	11.5	8	46
Zaire	2.5	67.5	2	8	5.5	59.5	15	80
East Africa	2.5	2.5	3.5	1.5	6	1	3	10

1/ And unexploited
2/ The areas touched by exploitation each year are often assumed to be larger than the figures given in table 7.1.

Even taking into account the wildness of the assumptions made one may dare to conclude that in West and East Africa the present rate of exploitation cannot continue.

Example 2: Changes in the resources of presently commercial species (gross volume).

Rather than discussing the changes in area indicated above one may instead take the estimated volume of so-called commercial species as a base for calculations. Even these calculations are impossible without making a lot of assumptions. Some of the difficulties are discussed here.

Table 5.6. gives the gross volume of the commercial species in West and Central Africa as 4,500 million m^3. If one considers secondary species with technically acceptable qualities this volume may rise to 10,000 - 15,000 million m^3. The extractable volume of presently commercial (utilized) species must, however, be reduced to perhaps 1,000 - 1,500 million m^3 if one considers inaccessible regions, waste and and so on (10 - 15 m^3/ha in 100 million ha of potentially exploitable forest). Some quantities must be added for areas which can be exploited a second time.

In 1973 the production of industrial wood in West and Central Africa was said to be 20.5 million m^3. Of this production 17 million m^3 has here been estimated to be in the rainforest zone and 13.5 million m^3 in areas classified in table 5.1. as closed forest. (In for example Ghana and Nigeria part of the production is in non-forest land.) The production of "commercial species" from closed forest areas has here been estimated to 12 million m^3 (75 per cent at least of production of other roundwood products thought to be of non-commercial species). The production of commercial species in non-forest land has been estimated as 2 million m^3.

With this rate of exploitation resources would last for up to 100 years. But Zaire´s enormous resources make it difficult to consider West and Central Africa as a whole. One must also take into account the decrease in forest area and the most likely increase in production bearing in mind that there will soon be no commercial timber in non-forest land.

The rate at which hitherto uncommercial species will be utilized naturally influences the rate at which presently commercial species will be exploited. However, very little can be said about how e.g. a 4 per cent annual increase of the mean volume exploited per ha will influence the exploitation of hitherto commercial species. Probably it will reduce the rate at which these species are exploited but it is not likely that the amount of these species exploited will be reduced as much as the exploitation of other species increase. It is more probable that the total volume exploited in a country will increase as more species become commercial.

Table B. summarizes the guesstimated volume for export, domestic consumption and destruction in West and Central Africa (except Zaire) if todays trends continue (see 3.4.) and if the resources were not limited.

The following crude estimates of the background figures (for 1973) must be given:

	West Africa	Central Africa (except Zaire)
Production of industrial wood in rainforest zone	9.5 mill m^3	5.5 mill m^3
Production of wood from presently commercial species in rainforest zone	8.5 "	5.0 "
Export	6.5 "	3.5 "
Internal consumption	2.0 "	1.5 "

It is also estimated that the present exploitation of commercial species in non-forest land will continue at about 2 million m^3 per year up to 1990 and then cease. Most of this will be in West Africa.

In addition it is estimated that the 19.5 million ha of forest land cleared in the coming 25 years will contain 160 million m^3 of commercial species (based on same assumptions as for table A. and an estimated commercial volume of 15 and 3 m^3/ha in unexploited and exploited forest respectively).

As the 1973 export figures were exceptionally high they have been used as the mean value for the period 1976-1980. Thereafter export has been estimated to increase by 3.5 per cent a year (as assumed in FAO/ECE 1975). The internal consumption has been estimated to increase by 6.5 per cent a year.

Table B. Estimates of present and future drain of presently commercial species in Western and Central Africa (except Zaire)

Period	Western Africa			Central Africa (except Zaire)		
	Export	Domestic consumption	Destruction	Export	Domestic consumption	Destruction
	million m^3					
Start value	6.0	2.4	..	3.2	1.8	..
1976-2000	235	140	50	125	105	110

With the assumptions made the amount of wood from commercial species to be utilized in one form or another should be roughly 430 million m^3 in West and 340 million m^3 in Central Africa. These volumes cannot be compared directly with the figures for volume of commercial species in table 5.6. as these figures are gross volumes. However, in the case of West Africa the gross volume that will be depleted to produce 430 million m^3 of wood is more than the 700 million m^3 optimistically given as commercial volume in closed forest. The same holds true if the volume of commercial species in non-forest land in the rainforest zone is considered. In the case of Central Africa (except Zaire) the total gross volume of commercial species should be adequate to give this production.

Example 3: Changes in the resources of presently commercial species (extractable volume).

If we instead discuss extractable volume then the depletion of the forests looks more alarming. In the case of West Africa the extractable volume can optimistically be estimated as about 140 million m^3 (15 m^3/ha in 5.6 million ha of potentially exploitable forests, 3 m^3/ha in 8 million ha of exploited forests and 30-40 million m^3 in non-forest land). This is much less than the 430 million m^3 estimated to be the drain of commercial species in the coming 25 years. In the case of West Africa it is not even likely that the available resources of commercial species can meet the domestic demand (if the volume utilized per ha is not increased). Timber plantations must evidently be established in the rainforest zone in West Africa.

For Central Africa the situation does not seem as alarming as for West Africa. If we use the same optimistic assumptions the extractable volume would amount to about 480 million m^3. This figure is to be compared with an estimated drain of 340 million m^3 in table B. If we on the other hand utilize a mean extractable volume of 10 m^3/ha in potentially exploitable forests, which is the normal present day volume in exploitations, then the resources would be depleted by the year 2000.

It must be said that the figures utilized for extractable volume per ha are rather conservative if considered over a 25 year perspective. When resources are plentiful (as often at present) only the most valuable trees are taken. When resources become scarce the extractable volume per ha will probably increase.

As Zaire at present has very little exploitation and more forest resources than all the other countries combined the exploitation must naturally increase very rapidly before one can start talking about any depletion of the resources of this country.

LiberTryck Snabbtrycket Stockholm 1977