FORESTRY IN NAMIBIA 1850–1990
Antti Erkkilä and Harri Siiskonen

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FORESTRY IN NAMIBIA 1850–1990

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University of Joensuu
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The physical and socioeconomic environment of Namibia is discussed with special reference to the northern parts of the country. The former forest policy and forestry activities as well as forest legislation, including protected tree species, are put into historical perspective. Major forest research publications are reviewed and analysed. The advancement of deforestation in Owanbo was studied by using archival sources, carrying out field studies and analyzing Landsat satellite images. The other trend, bush encroachment, is dealt with from the historical perspective. This study includes a comprehensive bibliography.

Keywords: Namibia, forestry, forests, vegetation, forest history, forest legislation, forest policy, forest research, tree species, bush encroachment, deforestation, remote sensing

Flyleaves: Mountains near Usakos (Photo Harri Siiskonen) The Kwando River (Photo Anti Erkkilä)

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<td>ACN</td>
<td>Action Christian National</td>
</tr>
<tr>
<td>ADM</td>
<td>Administrators Department</td>
</tr>
<tr>
<td>AVHRR</td>
<td>Advanced Very-High-Resolution Radiometer</td>
</tr>
<tr>
<td>CDA</td>
<td>Christian Democratic Action for Social Justice</td>
</tr>
<tr>
<td>CSIR</td>
<td>Council for Scientific and Industrial Research</td>
</tr>
<tr>
<td>DAPP</td>
<td>Development Aid from People to People</td>
</tr>
<tr>
<td>dbh</td>
<td>diameter at breast height</td>
</tr>
<tr>
<td>DERUN</td>
<td>Desert Ecological Research Unit of Namibia</td>
</tr>
<tr>
<td>DTA</td>
<td>Democratic Turnhalle Alliance</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
</tr>
<tr>
<td>FCN</td>
<td>Federal Convention of Namibia</td>
</tr>
<tr>
<td>FINNIDA</td>
<td>Finnish International Development Agency</td>
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<tr>
<td>FMSA</td>
<td>Finnish Evangelical Lutheran Mission Archives</td>
</tr>
<tr>
<td>FNDC</td>
<td>First National Development Corporation</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>LAR</td>
<td>Leaf Area Ratio</td>
</tr>
<tr>
<td>MAI</td>
<td>Mean Annual Increment</td>
</tr>
<tr>
<td>MSS</td>
<td>Landsat Multi-Spectral Scanner</td>
</tr>
<tr>
<td>NAO</td>
<td>Archives of the Native Commissioner Ovamboland</td>
</tr>
<tr>
<td>NASA</td>
<td>U.S. National Aeronautics and Space Administration</td>
</tr>
<tr>
<td>NAW</td>
<td>National Archives of Namibia, Windhoek</td>
</tr>
<tr>
<td>NGO</td>
<td>Non Governmental Organization</td>
</tr>
<tr>
<td>NNNDP</td>
<td>Namibia National Democratic Party</td>
</tr>
<tr>
<td>NNF</td>
<td>Namibia National Front</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
</tr>
<tr>
<td>NPF</td>
<td>National Patriotic Front of Namibia</td>
</tr>
<tr>
<td>PLAN</td>
<td>People's Liberation Army of Namibia</td>
</tr>
<tr>
<td>RDC</td>
<td>Rural Development Centre</td>
</tr>
<tr>
<td>SADCC</td>
<td>Southern African Development Coordination Conference</td>
</tr>
<tr>
<td>SWAA</td>
<td>South West Africa Administration</td>
</tr>
<tr>
<td>SWANU</td>
<td>South West Africa National Union</td>
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<tr>
<td>SWAPO</td>
<td>South West Africa People's Organisation</td>
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<tr>
<td>SWAPO-D</td>
<td>SWA People's Organization – Democrats</td>
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<td>TCL</td>
<td>Tsumeb Corporation Ltd</td>
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<tr>
<td>TM</td>
<td>Landsat Thematic Mapper</td>
</tr>
<tr>
<td>UDF</td>
<td>United Democratic Front of Namibia</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
</tr>
<tr>
<td>UNICEF</td>
<td>United Nations International Children's Emergency Fund</td>
</tr>
<tr>
<td>UNTAG</td>
<td>United Nations Transition Assistance Group</td>
</tr>
<tr>
<td>ZBU</td>
<td>Zentralbureau des Kaiserlichen Gouvernements</td>
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</tbody>
</table>
SYNONYMS

Kavango, Okavango, Kavango district
Kavango River, Okavango River
Kunene River, Cunene River
Owambo, Ovamboland, Owambo district
San, Bushman

LOCAL TERMS

efundja, flood
egumbo, homestead
mahangu, pearl millet, Pennisetum glaucum
mikolo, dugout canoe
omiramba, floodwater courses
omukwaniilwa, king
omuramba, floodwater course
oshana, floodwater course

OTHER TERMS

aolian – deposited or eroded by wind
alkaline – pH between 7 and 14
alluvial – deposited from flowing water
catenae – a sequence of soil profiles in association with a certain topography
colluvial – deposited at the foot of a slope by gravity
loamy – mixture of sand and dead vegetable material
pan – seasonally flooded depression
Acknowledgements

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Our second journey for data collection, from 15th to 22th October 1990, took us to Kavango and Owambo. We were guided by Mrs. Eva Hilbert, Mr. Stefanus Max and Mr. Thomas Nghipotelua (Grootfontein Forestry Section), all specialists in the woody vegetation of Namibia. During the field work the Evangelical Lutheran Church of Namibia kindly accommodated us on their premises.

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Introduction

Yet this was not an ordinary day. A great tree stood by itself, away from other trees. It was the Omumborombonga tree and it held a secret.

The secret was a woman’s voice that said, “We have been here for too long. I am dying to see some light”.

And a man who said, “I too cannot wait to see what is outside. Shall we find out?”

Even as they spoke, a big crack appeared in the tree trunk and the man helped the woman out through it. Soon she was in the open, the morning sun dazzling her eyes.

“Oh, how beautiful!” she said in amazement.

“Only beautiful?” the man’s voice boomed beside her.

Together, they walked on the warm sand for the first time, away from the shade of the great tree. And that day became a great day.

The woman was called Kamungarunga and the man Musisi. They were husband and wife and once they had seen the vast country, they decided to make their home out there.

(Namibian folktale, Asare 1990)

Forests and trees have had an undeniable role in the development of the Namibian way of life. They have provided both African and European populations with fuelwood, building material and food, as well as fodder for their cattle. In addition to their economic value, forests have also had an important social, cultural and psychological impact.

During the last few decades Namibian forests and woodlands have diminished rapidly, especially in the northern parts of the country. In central Namibia logging, fires and overgrazing have generated a serious bush encroachment problem. The spread of invader bush species has decreased the grazing capacity of the pasture lands dramatically and caused serious losses for livestock farmers. Accordingly, in the northern regions deforestation has caused shortage of fuelwood and building material, as well as soil erosion. Yet,
considering the prevailing harsh climate, Namibia can still be regarded as a fairly well wooded country.

We believe that in order to understand the present state of forestry in Namibia, one has to be aware of past practices. Therefore, we have deemed it necessary to study Namibian forestry since the 1850s.

The present study was started four months before Namibia gained her independence. Two journeys were made to the Republic of Namibia in 1990 for the collection of data. The field survey covered the northern part of the country, especially Ovambo. Bremen, Frankfurt and Koblenz, as well as Pretoria and Johannesburg, were visited in order to acquire essential literature and to establish contacts with researchers and institutions involved in Namibian forestry. The holdings of the National Archives of Namibia have been the main archival source.

The main objectives of the present study were: 1) to analyse past forest policy, forest legislation and forest research in Namibia, 2) to study the role of forests for the people of Namibia, 3) to bring to light new information on the woody vegetation in northern Namibia, 4) to collect relevant references on forestry in Namibia, and 5) to establish contact with researchers involved in Namibian forestry.

The main emphasis has been put on those issues that we believe are important for understanding the present state of forestry and the needs of the future development of forestry. These issues include, e.g. deforestation, bush encroachment, forest research, forest inventories and management plans, as well as commercial fellings. The advancement of deforestation in Ovambo has been studied by using archival sources, carrying out field studies and analyzing satellite images.

This report is divided into three parts. PART I gives basic information about Namibia, its geography, climate, soils, vegetation, people, economy and government. PART II concentrates in more detail on the most wooded areas of the country – Ovambo, Kavango and Caprivi. We believe that anyone involved with forestry in Namibia must have basic information about the country. There are clear linkages between different sectors, e.g. forestry, agriculture, energy and water development. Knowledge of related fields helps to promote cooperation and to tackle issues on which there are conflicting interests. More specific information, e.g. about
climate, soils or vegetation, is to be found in the publications mentioned in this report.

PART III analyses the forest policy, forest legislation and forestry activities in Namibia from the nineteenth century until the present. The subjects discussed also include, e.g. deforestation, bush encroachment, and forest products used by the African population. Works written by the early explorers have been used in analyzing long-term changes in the woody vegetation, especially the deforestation in Ovambo. The long-term trends in forest policy, forest legislation, and forestry activities are divided into the German colonial period (1884–1915), the mandate period and the modern period (1960–). The main publications and archival records concerning Namibian woody vegetation are reviewed and analysed.

The terminology has been unified. Ovamboland, Okavango and Bushman are replaced by the modern terms Ovambo, Kavango and San. The term forest has also been used in cases where the vegetation could be defined as shrubland, e.g. forest management not woodland or shrubland management. The botanical and common names are taken mainly from the National list of indigenous trees (Breitenbach 1990) and from the National list of introduced trees (Breitenbach 1989).

References in the bibliography include archival sources, forestry and other professional literature, periodicals, newspapers, databases and herbaria relevant to the subject.

A great tree stood by itself, away from other trees. It was the Omumborombonga tree and it held a secret.

(Namibian folktale, Asare 1990)

Joensuu, 7 November 1991

Antti Erkkilä      Harri Siiskonen
Fig. 1.
General map of Namibia
PART I

THE REPUBLIC OF NAMIBIA
Fig. 2.
Map of Africa
1. Physical and socioeconomic environment

Namibia is located in the southwestern corner of Africa. It is bounded in the north by Angola, Zambia and Zimbabwe, in the east by Botswana, in the south and southeast by the Republic of South Africa, and in the west by the Atlantic Ocean.\(^1\)

The territory of Namibia covers an area of 82.4 million ha, including Walvis Bay (112 400 ha), which is still administered as a part of the Republic of South Africa. Namibia is almost three and a half times the size of the United Kingdom and two and a half times the size of Finland.\(^2\)

Namibia covers nearly 3 per cent of the total land area of Africa and contains about 0.2 per cent of the whole population of Africa.

The country can be divided into three distinct regions: the Namib Desert, the Central Highland and the Mega Kalahari. The two last-mentioned regions are parts of the Central Plateau (Fig. 3).

The Namib Desert comprises the western marginal area between the escarpment and the coast, stretching along the entire coastline and rising rapidly eastwards. It is 80 to 120 km in width and constitutes about 15 per cent of the total area of Namibia.\(^3\)

The Central Highland lies east of the Namib Desert. Its altitude varies between 1 000 and 2 000 metres. The highest mountain in Namibia is the Brandberg (2 579 m) in Damaraland. The lower lying extensions of the semi-arid Mega Kalahari occupy the eastern and northeastern parts of the country.\(^4\)

The Mega Kalahari, an area of 2 500 million ha in central southern Africa, is covered by unconsolidated Kalahari sand. The origin of the Kalahari sand is unclear, but it is widely agreed that aeolian processes have dominated the environmental history of the Mega Kalahari. During the Quaternary period, in the area of fixed dunes, the climate must have been drier than today, allowing aeolian processes to operate. In addition, winds may have differed from those of today in terms of prevailing direction and strength.
The Mega Kalahari must be distinguished from the smaller area known as the Kalahari Desert. In Namibia the Kalahari Desert covers the southeastern part of the country.\textsuperscript{5}

There are only a few rivers in Namibia. Most of them are periodical, flowing sporadically after intensive rains. Namibia's perennial rivers lie on her southern and northern borders: the Orange River in the south and the Kunene, Kavango, Kwando–Linyanti–Chobe and Zambezi Rivers in the north.\textsuperscript{6}

\begin{center}
\textbf{Fig. 3.} \textbf{Geographical features of Namibia}
\end{center}

\textit{Modified from Wellington 1967, 3; Mthoko et al. 1990, p. 89.}

\section*{Climate}

Namibia has a dry climate with extremely variable and unpredictable rainfall.\textsuperscript{7} The average annual rainfall increases from less than 20 mm on the coast towards the northeast where Katima Mulilo receives more than 700 mm. The potential average annual evaporation varies between 3 700 mm in the central-southern area to 2 600 mm in the north. It is estimated that about 80 per cent of the total rainfall evaporates shortly after precipitation.\textsuperscript{8}
Fig. 4. Average annual rainfall

Source: Department of Water Affairs, SWA 1989a.

Fig. 5. Number of frost days per annum

Source: Le Roux & Esterhuysen 1967, p. 43.
The first rains can be expected in the northern parts of the country in October or November and in the drier southern areas, two months later. The rainfall peaks in January–February in the northern areas and in March in the southern regions. In the coastal desert the morning fog supports various desert-adapted plants and animals.

Hot and dry easterly winds blow over the country during the late autumn and early winter.

The temperature is influenced by the cold Benguela Current and the altitude of the Central Plateau. The warmest and coldest months differ in different regions. In the north October and November are the hottest months with an average daily maximum temperature of 34–36 °C. In the central region the warmest month is December and in the south January. The coldest month is July in most parts of the country, except on the coast where the lowest temperatures can be expected in August. The average daily minimum for the coldest month varies from less than 2 °C to more than 10 °C. The absolute maximum and minimum temperatures recorded in Namibia are 48 °C and −10 °C.

The occurrence of frost increases towards the Central Plateau, from north to south and, of course, everywhere at high altitudes. The probability of a temperature below freezing is highest in the Auas Mountains northwest of Windhoek.

Soils

The pedology of Namibia is characterized by lithosolic (Central Highland), arenosolic (Mega Kalahari) and weakly developed soil types (Namib Desert). Weakly developed soils are brown to greyish and may or may not contain a B-horizon. These soils often contain free lime, and gypsum may occur in areas where the rainfall is less than 300 mm. Lithosols are shallow soils with weak profile differentiation, which contain coarse fragments and solid rock at depths of 30 cm and less; topography is the dominant soil-forming factor. Arenosols have low water-retention capacity and low reserves of weatherable minerals. Their colour is red on upland sites and dune ridges, yellow on level areas and grey on bottomland sites. The parent material is aeolian sand or sands derived from aeolian deposits, which make these soils very sensitive to wind erosion.
Vegetation

Giess (1971) subdivides the vegetation of Namibia, primarily on the basis of rainfall, into three regions: deserts, savannas and woodlands. He distinguished 15 vegetation types, of which two are classified as woodlands, eight as savannas and five as deserts (Fig. 6).

The deserts in Namibia are the Namib Desert and the Etosha Pan. Woody vegetation – small trees and shrubs (e.g. *Welwitschia mirabilis*, *Acacia reficiens*) – occurs in the Namib Desert only along the river beds. The Etosha Pan in the northern part of the country is fairly barren, but some *Acacia nebrownii* are found on its less brackish fringes. Deserts cover 16 per cent of Namibia.10

Savannas cover 64 per cent of the territory of Namibia. A certain vegetation type, Mopane Savanna, is widespread in northwestern Namibia.11 The dominant tree species is *Colophospermum mopane* (mopane; family Caesalpiniaceae), a 7–10 m tall deciduous tree with a stunted shape. In many areas mopane makes up a spaced woodland with a shrubby understorey.12 Its southern boundary of distribution follows the 5°C isotherm of mean daily minimum temperature for the coldest month, July.13 This explains why mopane does not exist either in the eastern part of Ovamboland or in Kavango. Close to the southern boundary of its distribution, frost damage is frequent. Towards the western limits of its distribution, scattered shrubby individuals of mopane occur associated with *Welwitschia mirabilis* in the predominantly dry river beds of the Namib Desert.14

The height of the mopane trees decreases from north to south and west, where the weather is cooler and drier.15 The more alkaline the soil, the poorer the growth of the trees seems to be.16 Soils under mopane tend to have poor permeability and high susceptibility to erosion.17

Woodlands cover one fifth of the territory of Namibia. One of the dominant species in this region is *Baikiaea plurijuga* (Zambezi teak or mukusi; family Caesalpiniaceae). Zambezi teak is extremely resistant to termites and decay. This semievergreen, thornless, 8–18 m tall tree is entirely confined to areas of the deep Kalahari sand.
Baikiaea plurijuga produces excellent and very valuable timber for furniture, parquet and carvings. Unfortunately, this species grows slowly and is very difficult to regenerate. It is sensitive to fire and does not regenerate easily in frequently burnt areas. Today B. plurijuga communities in southern Africa are in serious danger due to commercial logging, agricultural expansion and forest fires.\textsuperscript{18}

The most important commercial tree species in Namibia, however, is *Pterocarpus angolensis* (wild teak, Transvaal teak, mukwa, dolf or kiaat; family Fabaceae). It grows on Kalahari sand in the northern part of the country (see Fig. 7 page 29). *P. angolensis* can be worked easily and is therefore also preferred among curio makers. Even though it is not as sensitive to fire as Baikiaea plurijuga, periodic fires keep it in the sapling stage for several years.
Trees growing along the Kuiseb River in the Namib Desert.

*Welwitchia mirabilis*, which is botanically grouped into gymnosperms (conifers and their allies), is endemic to the Namib Desert. It has only two leathery leaves, which grow from their base replacing the part dying from the tip. This female plant is estimated to be more than 1500 years old.
Acacia erioloba (camel thorn) is one of the major tree species in Namibia.

Hyphaene petersiana (real fan palm) is a conspicuous tree species in central Owambo.
Colophospermum mopane (mopane) is the dominant tree species in western Owambo.

Owambo market under marula (Sclerocarya birrea subsp. caffra) tree.
Agroforestry in Owambo, marula (*Sclerocarya birrea* subsp. *caffra*) trees growing in a millet field.

Harvesting mahangu millet (*Pennisetum glaucum*) in Owambo.
Population

The earliest people in southern Africa and in Namibia were hunter–gatherers. The occurrence of groundwater and the seasonal distribution of rainfall have directly influenced the pattern of human settlement. About 60 per cent of the population live in the northern part of the country where the annual rainfall is higher than 400 mm per annum. 19

The available long-term population figures are based on estimates and cannot be relied upon with any degree of accuracy. The first population estimates were presented in the earliest travel accounts written in the 1850s. The first official estimate of Namibia’s population is from 1921 and the most recent ones are from 1990. However, current estimates place the present population at 1.5–1.7 million. The current projections forecast a total population of about 2 million by the year 2000. 20

The average population density in Namibia is only 1.5–1.6 inhabitants per km², while the African continent has an average population density of 18 inhabitants per km². Windhoek, the capital, is the largest urban centre, with about 115 000 inhabitants. The nine next largest towns are (estimates from 1988): Swakopmund (15 500 inhabitants), Rehoboth (15 000), Rundu (15 000), Keetmanshoop (14 000), Tsumeb (13 500), Otjiwarongo (11 000), Grootfontein (9 000), Okahandja (8 000) and Mariental (6 500). 21

The majority of the white population, approximately 80 000, reside in the central and southern regions. 22 Although English is the official language of the country, several other languages are spoken in Namibia, e.g. Oshiwambo, Herero, Nama, Bushman, Afrikaans and German. 23
Fig. 8. Population distribution

Modified from Claassen & Page 1978, Fig. 3.1.; FNDC 1989, p. 46.

Fig. 9. Population growth in Namibia 1921-1988

**Table 1.**
Annual growth rate of the population, crude birth rate, crude death rate and life expectancy for Owanbo, Katutura (African township in Windhoek), Namibia and neighbouring countries

<table>
<thead>
<tr>
<th></th>
<th>Rate of increase (% p.a.)</th>
<th>Crude birth rate</th>
<th>Crude death rate</th>
<th>Life expectancy (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owanbo region</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- rural north(^a)</td>
<td>4.0</td>
<td>50</td>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td>- peri-urban north(^b)</td>
<td>3.8</td>
<td>48</td>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td>Katutura</td>
<td>4.2</td>
<td>47</td>
<td>9</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5</td>
<td>33</td>
<td>8</td>
</tr>
<tr>
<td>Namibia</td>
<td>3.1</td>
<td>44</td>
<td>10</td>
<td>56</td>
</tr>
<tr>
<td>Zambia</td>
<td>3.9</td>
<td>51</td>
<td>14</td>
<td>54</td>
</tr>
<tr>
<td>Botswana</td>
<td>3.5</td>
<td>47</td>
<td>11</td>
<td>59</td>
</tr>
<tr>
<td>Angola</td>
<td>2.8</td>
<td>47</td>
<td>20</td>
<td>45</td>
</tr>
<tr>
<td>Lesotho</td>
<td>2.8</td>
<td>41</td>
<td>12</td>
<td>56</td>
</tr>
<tr>
<td>Kenya</td>
<td>4.1</td>
<td>54</td>
<td>22</td>
<td>59</td>
</tr>
</tbody>
</table>

\(^a\) Rural locations: Tsandi, Engela and Onyaana
\(^b\) Peri-urban locations: Oshakati/Oluno
\(^c\) Number of births per thousand population
\(^d\) Number of deaths per thousand population

Source: Cogill & Kiugu
1990, p. 106.

**History**

Before colonization there existed various forms of subsistence in the Namibian territory. Economic activity was conditioned by the harsh ecological factors and the available technology.

In the Namib Desert only a few isolated communities have been able to survive. These communities lived off the bounty of the sea and from game as well as from the plant life occurring along the few periodic rivers. In the southern part of Namibia the economy was based on raising of small stock and hunting. In the better-watered central part of the territory, cattle raising predominated. In the north, agriculture and cattle raising were the main sources of livelihood.\(^24\)

Communities with different forms of production did not live in isolation from each other. Trade played an important role in promoting interdependence among neighbouring communities and in bringing together different modes of production.\(^25\)
The Europeans became acquainted with the coast of Namibia at the end of the fifteenth century through the Portuguese explorers Diogo Cão and Bartholomeu Dias; but owing to the inhospitality of the land, contacts were restricted to a few anchorage places on the coast. It was only at the end of the eighteenth century and in the beginning of the nineteenth century that European explorers, missionaries, hunters and traders became interested in the interior of the Namibian territory.  

The intrusion of the European colonial powers into Namibia started in 1878 when the British annexed Walvis Bay on behalf of the Cape Colony. The German colonial period started in 1884 when Chancellor Bismarck proclaimed the Territory a German protectorate. The boundaries of the Territory, which became known as German South West Africa, were laid down in agreements concluded in 1886 with Portugal and in 1890 with Great Britain. The Caprivi Strip was connected with South West Africa on the basis of an agreement signed on 1 July 1890 between Great Britain and Germany.

German colonial rule in the Namibian territory ended in 1915. In 1915–1920 the Territory was under the military rule of the Union of South Africa. In 1920 the League of Nations proclaimed South West Africa to be a "C" mandated territory and the Union of South Africa as the mandatory. Supervisory power over South Africa was transferred to the Permanent Mandates Commission of the League of Nations.

When the League of Nations was dissolved in 1946, its supervisory authority for the Territory was inherited by the United Nations. In 1946 the South African Government requested the UN General Assembly’s permission to incorporate South West Africa into the Union of South Africa. South Africa’s request was rejected. Accordingly, South Africa refused UN requests to place South West Africa under a trusteeship agreement, arguing that the United Nations was not the automatic successor to the responsibilities of the League of Nations.

In the late 1950s, African nationalist movements such as SWAPO (South West Africa People’s Organisation) and SWANU (South West Africa National Union) were formed to resist South African domination. The decision of the International Court of Justice of 1966, when it refused to consider the question of South West Africa’s legal status, had
important political consequences. African nations immediately put the question before the UN General Assembly. In October 1966, the UN terminated South Africa’s mandate and established a Council for Namibia to govern the country. In 1971, after the Security Council had asked the International Court for an opinion, the court reversed the 1966 decision, ruling that South Africa’s occupation of Namibia was illegal.  

When the International Court failed to rule against South Africa in 1966, SWAPO began its armed struggle against South African occupation. Until late 1987 South Africa continued the implementation of its “internal independence settlement”; and the People’s Liberation Army of Namibia (PLAN), the military wing of SWAPO, continued its liberation struggle. In 1988 South Africa was forced to go to the negotiating table because it had lost its military advantage and because Namibia’s occupation had become a financial burden. Another important element was the new agreement between the two superpowers to work towards defusing regional conflicts around the world.  

This provided the framework for the independence process that was started on 1 April 1989 under the supervision of UNTAG forces (United Nations Transition Assistance Group). This process was led by the UN Secretary-General’s Special Representative for Namibia, Mr. Martti Ahtisaari, and culminated in the first free elections in November of the same year. SWAPO was the winner of the Constituent Assembly elections.  

A new epoch in the history of Namibia began on 21 March 1990 when the birth of the new, independent nation was recognised.
Economy

The structure of Namibia’s economy is dualistic. Economic activities range from subsistence economy to the export-oriented modern industrialised sector.

Since the First World War the commercial sector has been based on an export-oriented mining and agriculture. In recent years these sectors have accounted for about 40 per cent of the GDP and about 90 per cent of the total exports. The subsistence sector, on which about half of the population are dependent, produces only about 3 per cent of GDP.33

Namibia’s economy has always been very open, the emphasis being on primary production for export, while the bulk of processed goods required for domestic market have been imported. Under South Africa’s administration, Namibia remained, in economic terms, virtually a fifth province with only limited development of manufacturing activities. In this connection only the two most important productive sectors of the economy, mining and agriculture, are considered.34

Namibia is one of Africa’s major mining countries, especially with regard to uranium, diamonds, refined lead and zinc concentrates. In the 1980s the mining industry provided over 75 per cent of the total exports by value. In 1989 the total value of exports was R2 700 million, of which 76 per cent was provided from mining.35

The mining industry is almost totally export-oriented, which has made it particularly dependent on world market prices. In 1988 the industry employed 13 100 workers, including about 3 000 South Africans and other expatriates.36

Fig. 10. Gross domestic product at current prices, 1920–1989

Source: Department/Ministry of Finance 1988, p. 13; 1990, p. 11.
Most of Namibia's mines are operated by the subsidiaries of overseas-based multinational mining groups, or South African companies and parastatals.37

Agriculture consists of two sectors: the market-oriented European sector and the African subsistence sector. Although agriculture makes up only about 10 per cent of GDP, some 70 per cent of the total population are directly or indirectly dependent on farming.38

The commercial sector produces about 80 per cent of the total agricultural yield, but this was severely affected by the drought of 1978–1985.39 This sector is concentrated firmly on livestock farming, which contributes more than 80 per cent to the gross value of agricultural production. The most important products have been: pelts of karakul sheep (Swakara), meat, wool and dairy products. The commercially oriented crop farming is concentrated in the Grootfontein–Otavi–Tsumeb triangle. The main product has been maize, which is produced for the local market.40

During the South African administration, African agriculture and animal husbandry were undermined by expropriation of land and by the channelling of funds and expertise only to the white farmers. Marketing of meat and animals outside the African "homelands" was prevented by the Red Line cordon fence between the white farmland and the former African "homelands".41 For example, in the Ovamboland district, which until the 1960s was self-sufficient in food, production of the staple crop, mahangu millet (Pennisetum glaucum), has declined and the district is dependent on the import of food.42

In 1989 Namibia imported 80 per cent of its vegetables, 73 per cent of the white maize, 47 per cent of the yellow maize and 85 per cent of the wheat needed to feed the population. All agricultural machinery and production inputs are imported, mainly from the Republic of South Africa.43

Namibia's economically active population numbers about 500,000. In 1988 employment in the formal sector was about 185,000. Unemployment and underemployment have become one of the most serious economic and social problems in Namibian society.44 Prof. F. J. Tjia, a former president of the University of Windhoek, has observed that the urban unemployment rate was 20 per cent (excluding informal sector involvement) we would be talking about 50,000 people unemployed in the urban areas. If reference is made to all people outside formal employment in urban
settlements as being 'un(der)employed', the latter category could easily be about 80 000–90 000 in the urban areas and 150 000–175 000 countrywide.\textsuperscript{45}

According to the Ministry of Finance, independence has brought forward various new and interesting prospects to Namibia's economy.

First of all the fact [that] the country was now recognised as a sovereign entity, has increased the hopes for material foreign capital inflows and for opening up new markets for Namibia's exports. Secondly, the fact that the pre-independence trade sanctions had now been lifted has re-opened markets that were closed for some time in sectors that had been affected by this. Thirdly, because the Namibian government was now in command and control of its offshore fishing zone, the country is about to expand its economy with the fishing activities foreseen in that zone.\textsuperscript{46}

\textbf{Government}

The government of the Republic of Namibia is formed in terms of the Namibian Constitution, which was unanimously adopted by the 72-member Constituent Assembly on 9 February 1990. The Constitution lays down the division of powers between the legislature, the executive and the independent judiciary.

The bicameral legislature consists of the 72-member National Assembly, elected for a term of five years, and the National Council, which consists of two members from each geographical region. These members will be selected from amongst their members by the Regional Council for each region. The National Council reviews bills passed by the National Assembly and recommends legislation on matters of regional concern.\textsuperscript{47}

The first free elections took place in Namibia in November 1989. The result of the Constituent Assembly/National Assembly election, in which 97 per cent of the registered electorate voted, was certified as free and fair and accepted by all the contending parties.

The executive branch of government is headed by the president, who is assisted by the Cabinet. The president is elected by direct popular vote for a term of five years.\textsuperscript{48} However, the first president of independent Namibia His
Fuewood sold in Katutura, Windhoek.

Open three-stone fireplaces are the predominant way of cooking in many Namibian households.
Wood, millet stalks and grass are the most important building materials in Owambo.

Owambo homestead surrounded by a palisade wall. *Colophospermum mopane* is the most popular tree species used in constructions.
Excellency President Sam Nujoma was elected by the Constituent Assembly. Hage Geingob was appointed to be the first Prime Minister.

Since the latest arrangements made in the beginning of 1991, the Cabinet is composed of seventeen ministers, who in turn head their respective ministries. Forestry affairs are the responsibility of the Ministry of Agriculture, Water and Rural Development and the Ministry of Wildlife, Conservation and Tourism.49

The Judiciary of Namibia is independent and subject only to the Constitution and the law. A Supreme Court, a High Court and a number of Magistrate and Lower Courts share the judicial power.50

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3 Forestry in Namibia

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Fig. 11. Constituent Assembly election 1989

Source: Pütz et al. 1990, pp. 52-53.
Fig. 12.
Map of northern Namibia
PART II

THE NORTHERN PART OF NAMIBIA
2. Owambo

Owambo is located in the northern part of Namibia. It is bordered by Angola in the north, Kavango in the east, Kaokoland in the west and the commercial farming districts of Outjo and Tsumeb in the south. It covers about 5.2 million ha.

Owambo is a broad plain, about 1 100 m above sea level. The central area is slightly concave, sloping very gently southward. During the high floods, water drains from the delta (Cuvelai catchment, 3.7 million ha) south of Evale in Angola into Lake Oponono and via the Ekuma channel to the Etosha Pan. In many places the gradient is so flat that some floodwater may be redistributed northwards.

The floodwater courses, *oshanas*, vary in width from a few metres to over a kilometre and in depth from less than half a metre to more than 5 metres. Some *oshanas* are interconnected but the larger ones are usually separated by slightly elevated terraces or sand dunes. The most important *oshana* is called Cuvelai.

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Fig. 13. Cuvelai River Basin

Modified from Stengel 1963a, p. 378; Claassen & Page 1978, p. 5.
The southeastern part of Owambo is characterized by W–E oriented sand dunes and shallow water courses, in this region called omiramba (sing. omuramba). The elevation between the dunes and the omiramba decreases from 10 metres in the south to 1–2 metres in the north. In other parts of Owambo the orientation of sand dunes is more variable.

North of the Etosha Pan extends the Ombuga Grassland, a flat plain about 50 km wide with numerous pans (seasonally flooded depressions). Most of the time the pans are dry, receiving water only from local runoff or from floodwater during the rainy season. The size of the pans varies from a few tens of metres to a few kilometres; usually their depth is less than half a metre.

**Climate**

The weather records of Owambo are mainly from the central area. Thus for the rest of Owambo one has to rely on large extrapolations.

The rainfall increases from 350 mm in the southwest to 550 mm in the northeast. Usually most rains fall between November and April with the peak in February. However, there is great variation in the amount and timing of the rainfall. In Ondangwa during 1959–1973 the annual rainfall varied from 200 mm to 1 039 mm with a mean of 495 mm.\(^52\)

Drought, a long period of low rainfall, is common in Owambo. It is highly predictable that drought will occur frequently, and thus it cannot be considered ‘abnormal’.

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**Fig. 14.** Average monthly rainfall, and maximum and minimum temperatures in Ondangwa

**Rainfall 1902–1975, temperatures 1944–1975**

*Source: Page 1980, pp. 7–9.*
The climate of Owanbo is continental with great variation in temperature between day and night. In winter, the night temperatures drop to 7 °C with day temperatures rising to 27 °C or higher. October, November and December are the hottest months. Although frosts are rare in Owanbo, the risk of frost increases towards the southwest. During the hot season the soil temperature may rise above 36 °C, thus causing severe stress for plants.53

Water resources

In Owanbo there are three natural surface water resources: 1) oshanas filled by the floods or efundjas, 2) the Kunene River and 3) local precipitation accumulated in pans and oshanas.

The efundja in Owanbo is caused by the good and widespread rains in Angola.54 Thus heavy local rains are not prerequisite for high flooding in Owanbo, although some oshanas may ‘come down’. The floods occur about two years out of every three; however, 2–3 years may pass without any significant flooding.55 According to Stengel, at Okatana from 1941 to 1961 only 1 exceptional flood occurred, 12 floodings varied in extent, and 7 years passed without any flooding.56

The Kunene River is the only perennial surface water resource in Owanbo. It forms the border between Namibia and Angola in northwestern Owanbo. In the beginning of the 1960s construction of the canal from the Kunene River to Okatana in Owanbo was started (Fig. 15).57 There was a plan to irrigate about 8 000 ha on both sides of the canal and serve 430 000 ha of fenced pasture.58

Today water is supplied from the Kunene River by pipelines and canals to the major centres of Owanbo.59 However, many people living in rural areas still rely on the floodwater from small dams. Owing to high evaporation, these water resources seldom last throughout the dry season. The pans and oshanas filled by the precipitation dry up rapidly from March onwards.60
The groundwater resources in Owambo are high in salinity and thus are often unusable for irrigation or for human consumption. Saline groundwater comes close to the surface almost everywhere in Owambo but especially in the south towards the Etosha Pan. The rural population in the Cuvelai floodplain gets its water from 2–3 m deep hand-dug wells along the middle slopes of the oshanas. This fresh water aquifer is isolated from the highly saline groundwater by an impermeable layer.\(^61\)

**Soils**

Geologically, the soils of Owambo belong to the Kalahari Group (arenosols). The sand and underlying deposits vary in depth but can even be more than 300 metres. Rocks do not occur but precipitated calcareous concretes, ‘white stones’, are found in some sites. The soils are poor in humus and plant nutrients. The soil reaction varies from neutral to strongly alkaline, which together with high evaporation causes the danger of salinization. The soils are also sensitive to erosion.\(^62\)
Vegetation

The western part of Owambo belongs to the Mopane Savanna. The dominant tree species is Colophospermum mopane. Its butterfly-shaped leaves fold together during hot and dry weather; thus the exposure to the direct sunshine is minimized. However, the grass in well-developed mopane stands is usually sparse. This may be due to the very dense and shallow lateral root system of the trees. The poorly developed understorey and the absence of fires favour the regeneration of mopane. In the most densely populated central part of Owambo, the Mopane Savanna has been extensively converted to agricultural fields and in the western part to grazing land.

Other tree species occurring in the Mopane Savanna are, e.g., Acacia spp., Adansonia digitata (baobab), Combretum spp., Commiphora spp., Diospyros mespiliformis (African ebony) and Terminalia sericea. Hyphaene petersiana (real fan palm or makalani palm) is a conspicuous species in central Owambo.

Giess (1971) classified the eastern part of Owambo as Tree Savanna and Woodland. Especially in the north, fine stands of Baikiaea plurijuga, Burkea africana, Pterocarpus angolensis and Ricinodendron rautenii occur. Other species include e.g. Acacia erioloba, Combretum spp., Guibourtia coleosperma and Terminalia sericea.

Draft Shrub Savanna Fringe occurs in the south-central area of Owambo, close to the Etosha Pan. Halophytic vegetation dominates. In places Acacia nebrovii forms more or less thick stands.
Pipeline near Ruacana, Owambo.
**Population**

According to current estimates, the population of Namibia is 1.3–1.7 million, of whom about 600 000 live in Ovamboland. The population density in Ovamboland is rather high, 11.5 inhabitants/km², compared to the national average of 1.5–1.6 inhabitants/km².  

The Cuvelai floodplain is the most densely populated area in Ovamboland. The population density was, according to Jensen's observations, at its greatest close to 100 inhabitants/km². The eastern, western and southern parts of Ovamboland are sparsely populated partly due to the lack of groundwater. The largest urban centres are Oshakati (according to the 1988 estimate, 4 500 inhabitants) and Ondangwa (1 500 inhabitants).  

According to the UNICEF survey of 1990, the population growth in Namibia was highest in the peri-urban locations in Ovamboland (4.2 per cent per annum, see Table 1 page 31). The fertility rate was also higher in Ovamboland than the national average of 5.9 births. In Ovamboland the corresponding figures were 6.4 for rural areas and 7.3 in peri-urban areas.

**Economy**

The higher rainfall in Ovamboland permits far greater intensity of land use than in central and southern parts of Namibia. The basic unit of social and economic structure is the homestead or *egumbo*.

The land is held in communal ownership and is administered by the king in the Ondonga area or headmen elsewhere. The king or headman distributes cultivation rights to individuals for their whole lifespan for the price of a few head of cattle or a corresponding amount of money. The land outside the fields is communal and open to everyone for grazing and for cutting of trees.

Rural land use is based on a combination of agriculture and livestock herding. In fertile areas the average size of the fields cultivated by a homestead is two to three hectares. The most important crops are millet, sorghum, beans and ground-nuts.
In this subsistence economy, crop yields are low. Agriculture is very little mechanised and most cultivation is done with hoes, oxen and donkeys. The only fertilizer used is limited application of manure from cattle yards. The central part of Ovambo is approaching the limit of its human carrying capacity through dryland farming, and in parts of this area the limit has been exceeded. 72

No exact figures exist concerning the number of livestock in Ovambo. The Namibia Stock Census of December 1990 estimated that the area had about 360 000 cattle, 4 000 horses and 120 000 donkeys, and 360 000 goats and 12 000 sheep. 73 The number of cattle owned by a family has been increasing; at the end of the 1970s the number was 7.6 head but in the mid-1980s it was 9.5 head per family. In many areas there are clear signs of severe overgrazing. 74

The productivity of livestock herding is low, due mainly to nutritional stress and to disease and cultural aspects. According to Loxton et al., only 0.5 per cent of the cattle are sold annually and 4.5 per cent are slaughtered, essentially at festive occasions. 75 According to Morrow, agricultural development work, for instance extension work and developing of market outlets, has been neglected in Ovambo. 76

The lack of markets for the most common rural products has been one of the main hindrances for the development of handicraft industries. The only local items sold commercially to a certain extent are meat and forest products (fuelwood, poles and baskets) and locally produced alcoholic beverages.

The proportion of industrial production in the Ovambo economy has been minimal. A modern abattoir has been built at Eloolo by the First National Development Corporation (FNDC), which also runs a canning unit. This factory operates only part of the year. A modern dairy has been established in Oshakati, but in practice it has concentrated on bottling imported juices. 77 A sawmill was operating in Oshakati from 1964 to 1978. 78

Since the beginning of this century an important element in the Ovambo economy has been migrant labour. In the mid-1980s approximately 70 000 Ovambo people were working as migrant labourers in mines, on white farms and in the public sector in central and southern parts of Namibia. 79
3. Kavango

Kavango, the northeastern district of Namibia, covers about 4.6 million ha and occupies almost one third of Namibia’s border with Angola. Kavango is generally very flat, sloping gently to the north. The variation in altitude is only 190 m.\(^8^0\) The highest point is in the southwest and the lowest in the northeast. The average altitude is 1 100 m.\(^8^1\)

The main physiographic regions are:

1) The perennial Kavango River and its floodplain. The width of the floodplain varies from a few metres to a few kilometres. The floods begin in December with the peak in March/April. In the flood stage the Kavango River, which is one of the largest rivers in southern Africa, may rise as much as 4.6 m. It drains through the southern part of Angola, turns to the east when it reaches the Namibian border and to the southeast near the West Caprivi border and then forms its delta in Botswana.\(^8^2\)

2) The river terraces, which lie 6–7 m above the river bed, are extremely fertile. The width of these terraces ranges from a few metres to several hundred metres.\(^8^3\)

3) The aeolian sand plateau, Kalahari sandveld, which is intervened by omiramba or drainage channels and parallel low dune system.\(^8^4\) In general, the omiramba are orientated W–E; but some of the drainage channels, such as the large Omatako Omuramba, are orientated N–S. In the southwestern part of Kavango where no omiramba occur, water flows into the pans.\(^8^5\) Kalahari sandveld dominates most of Kavango.

Climate

Rainfall increases slightly from southwest to northeast. The average annual rainfall is 500–600 mm. The first rains are expected in September or October and the last ones in May. However, 80 per cent of the rain falls between December and March, when the maximum rainfall in 24 hours can be 100–120 mm.\(^8^6\)

The long-term average monthly temperature varies from 16 °C in June–July to 25–26 °C in October–January. The corresponding maximum and minimum temperatures are 35 °C and 7 °C. There is a slight possibility of a few night frosts in June. The absolute minimum temperature measured in Rundu is −4 °C and the absolute maximum is 41 °C.
Water resources

The Kavango River is the only permanent source of water. The sandy soils of Kavango are so well drained that almost no superficial drainage exists. Even the largest omuramba, Omatako, drains hardly any water to the Kavango River. The omiramba contain water only temporarily, after heavy rains.87

The groundwater resources in Kavango are fairly abundant and reliable. Most of the boreholes are concentrated within a zone 30 km from the Kavango River. Many rural communities live too far from the perennial Kavango River and the boreholes, and these communities have to rely on hand-dug wells sunk close to omiramba. The water quality of these wells is often poor, due to contamination and sedimentation.88

Soils

Kavango is covered by aeolian Kalahari sand (arenosols), which has a low water-retention capacity and is sensitive to wind erosion. In these soils the silt and clay content varies little. Alluvial and colluvial soils are found locally along the major omiramba and the Kavango River. Where there are no deep sands, underlying calcareous deposits are prominent.89
Vegetation

The vegetation in Kavango can generally be described as Tree Savanna and Woodland, and Riverine Woodland along the Kavango River. The last-mentioned type is strongly influenced by human settlement.  

Because the climatic and soil conditions in Kavango are very even, the variations in vegetation are caused mainly by soil depth and topography. The dominant tree species on the crests of the dunes is *Baikiaea plurijuga*; moving downwards, the next dominant is *Guibourtia coleosperma*; the third dominant is *Pterocarpus angolensis*; and the next ones in order are *Ricinodendron rautanenii, Burkea africana, Terminalia sericea*, and *Acacia erioloba*. The last dominants of the catena (in bottomlands and depressions) are *Combretum imberbe* and *Spirostachys africana*. Tree density decreases from the top of the dune towards the plateau level.  

The characteristic tree species in the Riverine Woodland of the Kavango River are *Phoenix reclinata* (wild date palm), *Salix mucronata* (African willow), *Acacia nigrescens* and *A. hebeclada* subsp. *chobiensis*.  

*Kavango River at Nkurenkuru.*
Population

In 1987 the estimated population of Kavango was 128,000 inhabitants. The town of Rundu, which is the largest urban centre in northern Namibia, has a population of about 15,000. About 78 per cent of the population are concentrated within a ten-kilometre strip along the southern bank of the Kavango River.  

Since the 1960s the average annual population growth has been over 6 per cent. An important reason for the rapid population growth has been migration from Angola. In the 1960s the Portuguese Government in Angola introduced a poll tax that caused migration from the northern bank of the Kavango River to the Namibian side. Approximately 30,000–40,000 refugees of the war in Angola have settled in Kavango since the mid-1970s and have been absorbed into the population.  

Economy

Land ownership in Kavango is communal. Agriculture, concentrated on a 3 km strip along the river banks, and livestock (primarily cattle) herding predominate the economy. Mahangu millet is the main crop. It is grown both for the farmers’ own consumption and for informal sales within the region. Millet has little if any market outside the northern communal area.  

According to the December 1990 estimates, the area had about 100,000 cattle and 30,000 goats. Most of the livestock are grazed within a ten- to twenty-kilometres trip along the banks of the Kavango River and are marketed within Kavango district.  

Like in the Owambo economy, the role of manufacturing industry in Kavango has remained minimal.
In the absence of wood, alternative material must be sought for construction purposes; in this case tins were used.

A Himba homestead built of poles, dung and mud.
Harri Siiskonen

Transportation of building poles (*Terminalia sericea*) near Okankolo, eastern Owambo.

Wood chip production in the Tsumeb Bush Project.
4. East Caprivi

Caprivi forms a narrow strip about 400 km long in the northeastern part of Namibia. It borders on Angola and Zambia in the north, Zimbabwe in the east, Botswana in the south and Kavango in the west. The territory is divided into eastern and western areas. The border between East and West Caprivi is a straight line from north to south a few kilometres west of the Kwando River.

East Caprivi covers an area of about 1.2 million ha. The landscape is generally very flat and slopes slightly towards the south and east. The average altitude is 930 m.97

Three main physiographic regions, according to elevation, soils and duration of inundation, can be defined: 1) an elevated upland region in the northwest, 2) a lower lying southern and southeastern region and 3) a marsh and swamp region.98

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**Fig. 17.**
**Physiographic regions in East Caprivi**

*Source: Breitenbach 1968.*
Climate

The climate of East Caprivi is subtropical with mild dry winters (April to August) and hot wet summers (September to March). The first rains are expected to fall in October; the peak of rainfall, according to the long-term records, is in January. The average annual rainfall is slightly above 700 mm. Heavy storms and downpours may last as long as ten days.  

Temperature records for East Caprivi are available for a much shorter period than the rainfall data. The highest temperatures occur in September and October and the lowest in June and July. Frost is not common but may sometimes occur in June and July.  

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**Fig. 18.**
Average monthly rainfall, and maximum and minimum temperatures in Katima Mulilo

**Rainfall**

**Water resources**

In East Caprivi there are two main drainage systems: the Kwando–Linyanti–Chobe and Zambezi Rivers.\(^{101}\)

The first one is called Cuando in Angola and in the Namibian side first Kwando and then Mashi. When it turns eastward along the Namibian–Botswanan border, it is called Linyanti until Lake Liambezi and after that Chobe.

The Kwando River has a continuous main channel with a floodplain about 2 km wide. The Linyanti River meanders over an 10–30 km wide floodplain made up of a mosaic of river channels, islands and lakes. Lake Liambezi drains eastward into the Chobe River, which flows into the Zambezi.\(^{102}\)

The water level in the Zambezi River may vary as much as eight metres between October (lowest) and April (highest).\(^{103}\) If the flooding level rises as high as 4–5 m at Katima Mulilo, the Chobe River starts to flow westward. During the exceptionally high floods, Lake Liambezi is filled up through several channels. The floodplain between the Zambezi and Chobe Rivers covers approximately 350 000 ha or almost one third of East Caprivi.\(^{104}\)

Although there are about 200 boreholes in East Caprivi, most of the rural communities have to rely on surface water and wells 2–3 metres deep. Most of the rivers and swamps in East Caprivi are infested by bilharzia, and the situation is worst in the Kwando River.\(^{105}\)

**Soils**

The soils of East Caprivi derive from Kalahari sand and can be classified into three types:\(^{106}\)

1) Aeolian red and yellow sands (fersiallitic soils) cover the moderately elevated northwestern region along the Angolan border, between Katima Mulilo and Kongola. These are well-weathered soils with low water-retention capacity.

2) Loamy soils occupy floodplains and river zones (alluvial and other weakly developed soils of low-lying areas, alluvium enriched with organic material).

3) Shallow sands, which cover an impervious calcrete stratum (alluvial and other weakly developed soils of low-lying areas, dark alluvial sand and loam). These soils exist between the floodplains and the elevated northwestern region.
Vegetation

East Caprivi can be divided according to the vegetation into three major regions: 1) wooded area, 2) aquatic plant communities of rivers, lakes, marshes and swamps and 3) cultivated areas. According to Breitenbach, the corresponding coverages are 60 %, 36 % and 4 %.\textsuperscript{107}

The wooded area in the northwest is dominated mainly by *Baikiaea plurijuga*. The lower lying southern and southeastern region is characterized by wide distribution of *Colophospermum mopane* and the complete absence of *B. plurijuga*. In the flooding western and southern parts there are a few islands, river banks and flood terraces where some stands of *Phoenix reclinata* and *Piliostigma thonningii* occur.\textsuperscript{108}

*Terminalia sericea* is a pioneer species, which forms dense thickets, especially on deep sand. *Acacia erioloba* and *Burkea africana* invade areas destroyed by fire, overgrazing or shifting cultivation and are thus indicators of soil erosion. Other common tree species in East Caprivi include, e.g. *Adansonia digitata*, *Combretum spp.*, *Erythrophleum africanum*, *Parinari curatellifolia*, *Pterocarpus angolensis*, *P. lucens subsp. antunesii* and *Strychnos pungens*.\textsuperscript{109}

Population

The population of East Caprivi is about 60 000 inhabitants. Approximately 50 per cent of the population lives – temporarily or permanently – in the regional centre, Katima Mulilo. Other areas of settlement concentration are along the main waterways and in the vicinities of the main roads. The best characterized recent change in the distribution of the population has been the rapid growth of Katima Mulilo and its surroundings, and also the relative decrease in population of the rural villages.\textsuperscript{110}

In the east, people are accustomed to moving according to the seasonal flooding. Compared to many other parts of Namibia, migration outside East Caprivi has been very low. During the mid-seventies people were forced to move away from areas close to the Angolan border. As a result, the number of settlements along the Katima–Kongola road (the so-called Golden Highway) increased.\textsuperscript{111}
Economy

Most of the rural population is directly involved in subsistence farming. Some farmers held rights to large areas, even about 200 hectares of arable land, which is exceptional high figure compared to any other communal area. The average area cultivated by farmers in 1990–91 was 5.5 hectares. The crops cultivated included maize, millet (*mahangu*), sorghum and beans. 112

Another important sector of agriculture is cattle raising. According to a survey from 1980, the total herd size was estimated to be approximately 40,000. Ten years later the cattle population had increased to about 100,000, which is clearly more than the grazing capacity in the region. 113

Fishing is another important means of livelihood in East Caprivi. According to a survey conducted in 1980, about 700 people owned modern fish-nets and *mikolos* (dugout canoes), and fishing was practised for domestic and commercial use. 114

It is obvious that fishing could have a great potential in East Caprivi. Probably only a fraction of this potential is now being realized. Lake Liambezi, which has a surface area of about 26,000 ha of which 10,000 ha is occasionally open water, could play an important role in the future development of fishing. 115

East Caprivi is regarded as having the highest agricultural potential in Namibia, and therefore attracts local and foreign investors. For example, the Lonrho Group is planning to establish a 6,000–10,000 ha sugar-cane plantation on the north side of Lake Liambezi. 116

Some of the new agricultural development projects may, however, be controversial from the standpoint of forestry and nature conservation.
5. West Caprivi

West Caprivi is a narrow strip of land in northwestern Namibia between Kavango and East Caprivi. It covers a fairly flat area of about 0.5 million ha. The characteristic feature of the landscape is east-west rolling sand dunes. For a long time West Caprivi was rather inaccessible due to the absence of roads, occurrence of the tsetse fly and later because of military rule in this area.

The characteristic tree species in West Caprivi include, e.g. *Baikiaea plurijuga, Guibourtia coleosperma, Pterocarpus angolensis* and *Sclerocarya birrea.* The pedology of the region is dominated by Kalahari sand (arenosolic soil types). West Caprivi was proclaimed a game reserve in 1968. As a result, the local inhabitants, about 6 000 San people, were evicted from the area. Today the needs of the farmers in the neighbouring areas and the evicted San people as well as refugees in neighbouring countries make the West Caprivi the subject of considerable controversy. No doubt this area and its socioeconomic problems need special attention from the Namibian government.
PART III

FORESTS
6. Forest policy

German colonial period

Establishment of the colonial economy in the Namibian territory (German South West Africa), considerably increased the demand for wood products. In addition to its use on farms, wood was also needed for construction of the Swakopmund–Windhoek Railway and in the Otavi copper mine.

The indigenous forest resources could not fill the requirements for wood products, and even in the surroundings of Windhoek there was a shortage of fuelwood. The Territory was forced to import large amounts of timber and other forest industry products from Germany (80 per cent of the total timber importation) and the Cape Colony (Fig. 19).

Forestry received considerable political emphasis in German South West Africa. Forest policy and economy as well as the environmental role of woody vegetation were subjects of lively debate in the first decade of the twentieth century.

Forstkandidat E. Düttman thrashed out a solution for timber importation in 1899. According to Düttman, it would have been important to improve forest management in the central and southern parts of Namibia and to start trials with exotic tree species near Grootfontein, Tsumeb, Otjo and Otjiwarongo.¹²⁰

Fig. 19. Imports of timber and other forest industry products 1897–1908

Botanist **Kurt Dinter** emphasized the importance of nature conservation, especially the protection of river banks. Nor did he forget the economical importance of forests. Like Düttmann, Dinter also stressed the necessity of timber production for local consumption. The best sites for artificial regeneration were considered to be the high rainfall areas of Otavi and Tsumeb.

Dinter arrived in the Namibian territory in 1897 to collect plant specimens in the central and southern parts of the Territory. He was soon employed by the *Deutsche Kolonialgesellschaft* and in 1900 was appointed Government Botanist by the German South West Africa Administration. As a natural scientist, he proposed the establishment of forest research stations and trials of indigenous and exotic tree species. He suggested obtaining forest management and plantation establishment expertise from Germany and its colonies, such as the Cameroons, to South West Africa.

Thanks to Dinter, the first forest station and the tree species trials were established in Brakwater in 1900. Two years later, however, the forest station was removed to Okahandja and Dinter was appointed director of Okahandja Forest Station (see page 86).

Dinter was supported by **von Wiedeburg**, who in 1901 recommended that large-scale afforestation programmes be started, which would have alleviated South West Africa’s harsh climate as well as improving soil fertility. Von Wiedeburg thought that an increase in local wood production would have provided good income possibilities for European settlers. The most favourable sites for forest plantations would have been near mines and railway lines, where the demand for timber was highest. The most recommendable species, according to Wiedeburg, would have been certain deep-rooted exotic tree species.

The new topic discussed by Wiedeburg was establishment of a forestry administration. Its responsibilities should have been at least nature conservation, forest statistics, tree plantations and forest utilization.

The first forestry officer in German South West Africa was Dr. **Gerber**, who was appointed Chief Forestry Officer (*Forstassessor*) in November 1901. Gerber criticized Wiedeburg heavily for favouring exotic tree species. According to Gerber, the only way to establish plantations of exotic tree species would be enrichment planting – seedlings would
survive only under the shade of indigenous shelterwood. In spite of his objections to exotic species, however, he introduced some date palms (*Phoenix dactylifera*) into Ukuib.\textsuperscript{125}

As his first duty Gerber started to organize forestry administration. He proposed in 1903 that four forest districts be set up: Windhoek, Okahandja, Otavi and Keetmanshoop.

Each district was intended to have a forest station with adequate personnel and facilities, e.g. seed store and nursery. Forest stations would have been centres of forest research and extension. The biggest forest station was planned to be in Okahandja, with a production capacity of 5 million seedlings per annum. The headquarters of forestry administration were planned to be located in Windhoek.\textsuperscript{126}

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\textbf{Fig. 20.} Forest districts proposed by Gerber in 1903
Below is presented Gerber’s proposal for forestry administration in German South West Africa. The proposal was presented in 1903 and the plan was that it would to come into force on 1 April 1905.\textsuperscript{127}

Windhoek district
- 1 chief forestry officer (\textit{Vortragender Rat})/district forestry officer (\textit{Bezirksforstamtmann})
- 1 forest secretary (\textit{Forstsekretär})
- 1 nursery manager (\textit{Forstgartenverwalter}) based in Ukuib
- 1 forest technician (\textit{ Förster}) based in Brakwater

Okahandja district
- 1 district forestry officer (\textit{Bezirksforstamtmann})
- 1 forest secretary (\textit{Forstsekretär})
- 1 nursery manager (\textit{Forstgartenverwalter}) based in Okahandja
- 1 district forest technician (\textit{Revierförster}) based in Waterberg
- 3 forest technicians (\textit{ Förster})

Otavi district
- 1 district forestry officer (\textit{Bezirksforstamtmann})
- 2 district forest technicians (\textit{Revierförster}) based in Outjo and Grootfontein
- 1 forest technician (\textit{ Förster})

Keetmanshoop district
- 1 district forestry officer (\textit{Bezirksforstamtmann})
- 1 forest technician (\textit{ Förster})

Governor Leutwein was also interested in forestry matters. He was especially worried about the diminishing of fuelwood resources in the areas settled by Europeans.\textsuperscript{128}

The forest policy practised in German South West Africa was evaluated in 1908 by a high ministry official, \textit{Regierungsrat von Eschstruth}, from the Colonial Office (\textit{Reichskolonialamt}) in Berlin. Eschstruth criticized the poor results of artificial regeneration and the great expense. His proposal to local forest authorities was to obtain forestry expertise from the Cape Colony.\textsuperscript{129}
Oberförster C. Pogge, who followed Gerber as Chief Forestry Officer (Forstassessor), emphasized, however, that South African expertise in plantation forestry could not be transferred as such to the Namibian territory, because the ecological conditions were so different. Pogge pointed out that it would be possible to cut planting expenses if the government encouraged farmers to plant trees.¹³⁰

Fig. 21. Forestry administration proposed by Gerber in 1903, copy of the original document

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Mandate period

When the colonial master changed in South West Africa after the First World War, the debate on forest policy ceased. The German forest legislation remained in force until 1925 when it was replaced by the new ordinance. The aim of the new legislation was, however, not to make any major changes in the currently practised forest policy but merely to update certain provisions (see pages 74–75).

The First World War had increased the timber price in South West Africa, which in turn increased the utilization of indigenous tree species. Like other sectors of forest industry, joinery shops also changed from imported oak and mahogany to local tree species. When the war was over, importation of timber and other forest industry products was resumed and the utilization of local forest resources was minimized. The exception, however, was the mine in Tsumeb. Otavi Minen und Eisenbahnen Gesellschaft continued to use large quantities of wood for energy, mine props and lagging, because the German colonial authorities had granted it unlimited cutting permission on its property.  

In the mid-1920s the Executive Council of South West Africa invited the South African forestry expert Johan Diedrik Möhr Keet to make proposals for future forestry development. The terms of reference for the evaluation mission were prepared by the Executive Council. For example, Keet was asked to appraise the following issues: 1) forest legislation, especially cutting permits and broadcast burning, 2) nature conservation, 3) pasture management on watershed areas, including fencing of pasture grounds, 4) possibilities for the local municipalities and private enterprises to produce their own energy wood and timber in order to save indigenous woodlands, and 5) extension work among local farmers, e.g. distribution of seedlings.

In 1926 Keet made an evaluation mission to the southern and central parts of South West Africa. The northernmost place he visited was Tsumeb. He recommended continuing the forest policy and silvicultural systems adopted during the German colonial period. An example could also be taken from achievements in the Cape Colony.

Keet made a proposal, e.g. concerning administration, afforestation, selection of species and sand-dune stabilization.
His proposal for forestry administration was the appointment of one administrative officer (District Forest Officer) and one field forestry officer to be stationed in Walvis Bay and one or more district forestry officers to undertake the work at experimental plantations and nurseries. Afforestation trials were to be implemented in different areas in the central and southern parts of Namibia. The species trials were to be based on both indigenous and exotic species. Sand-dune stabilization touched, in particular, Walvis Bay and the railway line between Swakopmund and Walvis Bay. Very few of the recommendations were carried out in South West Africa, due mainly to poor forestry administration and lack of personnel.

The forest policy started to change gradually in the 1930s from nature conservation towards forest exploitation. As during the First World War, the Great Depression again increased the demand for local timber and other forest industry products. To improve the employment situation, it was also proposed that exploitation of forest resources be started in the northern part of the country, outside the Police Zone.

The first cutting permit in Kavango was granted in 1933 to Mr. E.A. Zwiebel from Windhoek. The permit allowed him to cut only a few trees for the purpose of examination. Later the same year he received a proper cutting permit for 1 000 timber trees within a defined area in Kavango. Several more small cutting permits were given to other entrepreneurs and missionaries.

The cutting permits were usually granted by the magistrate in Grootfontein and by the Native Commissioners of Okavango or Ovamboland. These officials were not very familiar with forestry issues and did not have effective measures for supervising logging.

In spite of increased interest in the exploitation of forest resources after the Second World War, nature conservation was not totally forgotten. The Technical Adviser Mr. J.D.M. Keet wrote in 1948: *The need and urgency [is] for the adoption of measures to arrest erosion of the soil by wind and water, to protect and ameliorate the veld, to conserve and improve the water supplies and to encourage tree-planting – urban and rural.*

The lack of forestry administration hindered the practice of systematic forest policy. The administrative burden was worsened in the beginning of the 1950s by a heavy increase in
applications for cutting permits. The situation was eased, however, in 1957 when Mr. **P.J. Le Roux** was appointed Regional Forestry Officer for South West Africa. Le Roux worked in Grootfontein under the Territorial Director of Agriculture. This administrative arrangement continued until the reorganisation of the government in 1969.

**Recent trends**

In 1968 South Africa started the policy of ethnic fragmentation in Namibia, which was based on the recommendations of the Odendaal commission. South West Africa now became virtually a “fifth province” of the Republic of South Africa.

Consequently forestry was now administered by the South African Government. The Regional Forestry Officer in Grootfontein – sent from the South African forest service – was no longer responsible to the local authorities in Windhoek but rather to the Secretary of Forestry in Pretoria. His duties included:

...reclamation of driftsands, conservation of mountain catchments, issue of permits for mining timber, the maintenance of a tree nursery at Grootfontein, extension services including advice on bantu forest management, and in respect of practical forestry – the preparation of fire protection plans, exploitation and regeneration plans based on growing-stock enumerations for Owambo and Kavango and the Bushman Reserve, all for application by the Department of Bantu Administration and Development.

The organisational reform prevented cooperation between regional forest authorities. For example, the two foresters stationed in Owambo and Kavango were responsible to the local agricultural directors acting under the authorities in Windhoek. The promulgation of the Representative Authorities Proclamation in 1980 made the situation even worse. Forestry was now split under different second-tier (ethnic administration) and first-tier agricultural branches of the government. One must also remember that intensification of the liberation struggle and hostilities prevented forestry activities in large areas of northern Namibia, especially during 1975–1989.

The independent Namibia has started to organise a new forestry administration. Now, for the first time, Namibia has the possibility to carry out a successful national forest policy.
7. Forest legislation

German colonial period

African societies in South West Africa have had, and to some extent still have, their own systems for controlling the utilization of natural resources. For instance, the cutting of trees in Owambo was not allowed without the permission of the local king (omukwaniiltwa) or his councillors. The following discussion, however, concerns only forest legislation prescribed by the colonial governments.

The first forest provisions in South West Africa – felling permits – were issued in the mid-1870s by the Special Commissioner W.C. Palgrave, the representative of the Cape Colony based in Walvis Bay.145

In 1888 the Deutsche Kolonialgesellschaft für Südwestafrika, a concession company, gave an order concerning the burning of vegetation. The aim of this order was to decrease deliberately lighted field fires.146 Fire was commonly used, e.g. among San communities to increase the efficiency of hunting.147 Another ordinance from 1894 (Verordnung des Kaiserlichen Landeshauptmanns für das Südwestafrikanische Schutzgebiet, betreffend die Wald- und Feldbrände) simply made the burning of vegetation a criminal offence with a maximum punishment of three months imprisonment. It was, however, possible to apply for special permits from divisional magistrates.148

Already in the 1890s there were threatening signs of environmental degradation in the areas settled by Europeans, which aroused the attention of the colonial administration. The Territorial Commander, Landeshauptmann Heinrich Göring was asked by the German Colonial Office to pay attention to the protection of woody vegetation.149 The European population, altogether about 2 000 inhabitants, was settled mainly near Windhoek, Okahandja, Karibib, Omaruru and Otjiwarongo.150

The first ordinance on forest reserves (Forstschutzbezirk) in South West Africa was given in 1894 (Verordnung des Kaiserlichen Landeshauptmanns für das südwestafrikanische Schutzgebiet, betreffend den Schutz der Holzbestände im Bezirk Windhoek). The total area of the Windhoek
Forstschutzbezirk was about 60,000 ha. In this forest reserve, collection of dry wood was allowed for domestic use but cutting of living trees and shrubs was forbidden. Similar ordinances were also prescribed for other areas settled by Europeans.

The first ordinance covering the whole area settled by Europeans, later called the Police Zone, came into force in 1900 (Verordnung betreffend den Schutz der Holzbestände im südwestafrikanischen Schutzgebiete). Landowners were now allowed to fell trees and shrubs as well as to strip off the bark for domestic use. Permits for commercial fellings were granted by magistrates or by the police. The ordinance required that necessary measures be taken for regeneration. Whether this provision was followed is, however, questionable.

The private landowners and companies – especially the Otavi Minen und Eisenbahnen Gesellschaft – were accused of devastating the forest resources. The result was that in 1910 small amendments were introduced to the forest legislation.

The last forest ordinance during the German colonial period was given in 1914 (Verordnung des Kaiserlichen Gouverneurs von Deutsch-Südwestafrika betreffend den Holz- und Feldschutz). This ordinance was stricter with regard to the demand for regeneration in large-scale logging operations than the ordinance of 1900 had been. However, it allowed more freedom to manage and utilize the forests on private farms. The provisions were applied only in the Police Zone, not, e.g., in Ovambo, Kavango or Caprivi.

During the German colonial period (1884–1915) all economic activities, including forestry, were concentrated almost entirely on the Police Zone. Forest legislation was no exception. The colonial administration wanted first and foremost to control the utilization of forest resources in districts settled by Europeans, not in other parts of the country.

**Mandate period**

In 1915 the colonial master in South West Africa changed. The forest legislation enacted during the German colonial period remained in force until 1925 when it was replaced by the new proclamation (The Preservation of Trees Proclamation, No. 23 of 1925), which superseded the one prescribed in 1914.
1. No person shall, unless he has previously obtained a permit thereto, cut, injure or destroy, or strip off the bark from, any tree, indigenous to South West Africa, of any age.

2. Notwithstanding anything in this Proclamation contained any owner or lawful occupier of land shall, subject always to the terms and conditions under which he owns or occupies the land, be entitled to cut, or strip off the bark from, any tree growing on such land, if he shall require the wood or bark of such tree for his own agricultural, industrial or domestic purposes; but the provisions of this section shall not be deemed to authorize the cutting of any tree for the purpose of selling or bartering the wood or bark in an unwrought condition or cut into poles or firewood.

The proclamation emphasized the importance of reforestation:

The Magistrate or other officer issuing such permit as aforesaid may attach to such permit such conditions relating to afforestation as he may deem fit and shall endorse thereon such further particulars as may be prescribed by regulation.

The new forest proclamation was criticized by Mr. J.D.M. Keet, who worked as forestry officer at the Union Forestry Department of South Africa. According to him, there was no enforcement of the law against illegal cuttings or burning of vegetation. Furthermore, the proclamation did not mention Rehoboth district, the area of the country containing the best stands of camel thorn (Acacia erioloba). Keet argued that in Rehoboth living trees were illegally cut down and sold as “dry wood”.

He further pointed out that artificial regeneration was not feasible in an arid or semi-arid climate. Therefore interpretation of the proclamation of 1925 should, in connection with cutting permits, accept coppicing as an appropriate method of regeneration. As a consequence of this criticism, the Proclamation of 1925 was revised by The Preservation of Trees Amendment Proclamation No. 13 of 1937.

In 1948 Keet was nominated as temporary forestry adviser (Technical Adviser) for one year. His duties included, e.g. drafting forest legislation. The new forest ordinance came into force in 1952 (The Preservation of Trees and Forests Ordinance, No. 37 of 1952) and was applied to the whole territory, including Walvis Bay, Rehoboth district and the so-called native reserves, except for Caprivi.
Between 1921 and 1929 the Caprivi Strip was administered as part of the Bechuanaland Protectorate (Botswana); between 1 September 1929 and 1939 it was administered as part of South West Africa. In 1939 East Caprivi was taken under the administration of the Union of South Africa. West Caprivi, however, remained under the administration of South West Africa.  

The objectives of the new forest legislation were:

To make better provision for the protection, preservation and utilization of trees and forest produce and the regulation of veld burning, to regulate trade in forest produce, to control the exportation and importation thereof, to combat diseases and pests in timber and to provide for matters incidental thereto.  

According to the forest ordinance of 1952, the obligation of reforestation was no longer in force as it had been in the ordinances of 1925 and 1914. The main explanation for relinquishing this claim was the lack of seedlings at the end of the 1940s.

The totally new element in the forest legislation was the enumeration of 23 protected tree species (see Table 2 page 79). It shall not be lawful for any person to cut, injure, take, remove or destroy any reserved tree growing or occurring on such land or to allow, aid or abet another person to do so, except upon the authority of a licence, permit or other document issued in terms of this section by the Administrator or by a person duly authorised thereto by him and subject to the conditions stated therein. In practice, permits were issued by the magistrates or the native commissioners. The cutting of wood for household use was, however, still allowed for landowners.

Another new aspect of the ordinance was the order to clear fire belts between ‘common boundaries’. In this context procedures were also defined for fire control. Forest officers and police were empowered to control timber import in order to prevent the spread of diseases and pests.

The forest legislation was last reformed in 1968 (Forest Act, No. 72 of 1968). This legislation mentions commercial plantations for timber production for the first time and gives orders on grading and manufacture of forest products as well as on the timber trade and logging. For instance, it was now forbidden to sell timber products for less than the government-regulated price. The commercial aspect of forestry is also emphasized by the establishment of a Forestry Council.
Its purpose was to promote forest industries (including plantation establishment) and forest research.

The new forest legislation defined the establishment of nature reserves and protected forest areas more specifically than the earlier ordinances and proclamations had. The provisions against burning of vegetation were also tightened. The maximum imprisonment for violation of this act was lengthened from six months to two years.

**Independent Namibia**

The forest legislation prescribed during the German colonial period put more emphasis on forest conservation than the mandate legislation had. German colonial authorities were sincerely concerned about the environmental degradation and deforestation in the Police Zone.

The mandate administration recognized the merits of the German forest and environmental policy; The Secretary for SWA wrote to the Magistrate Gobabis, in January 1921: *I am further to say the Administrator holds the view that as the timber in this country has been preserved in such an exemplary manner in the past the administration would be ill advised to modify or relax the regulations which have secured such good results.* 163

The forest legislation prescribed during the mandate period followed the principles of the earlier legislation until 1968, when the commercial aspects were brought up. The Forest Act of 1968 is also in force in the independent Namibia until the new forest legislation presently being drafted has passed the hearing in the Namibian parliament.

Most of Namibian forest resources are located in the northern part of the country. During the colonial period they were and still are chiefly controlled by the local headmen, in spite of the legislation prescribed in Windhoek. Therefore, when planning the future forestry activities in the northern part of Namibia one has to keep in mind, in addition to the formal legislation, that the traditional system of land tenure may overstep the government authority. Although traditional leaders have no jurisdiction to allocate land, in practice all applications are directed through them. 164
Protected tree species

In African communities many tree species were protected long before European occupation. For example, in Owambo all fruit trees were guarded and contravention was severely punished. Marula (*Sclerocarya birrea* subsp. *caffra*) was among the most valued tree species, mainly because the fruits could be made into alcoholic drink. All marula trees, regardless of where they grew, were the property of the king.  

Felling of real fan palm (*Hyphaene petersiana*) was also avoided. The upper part of the stem could be tapped to make palm wine, the core of the young trunk used as a vegetable and the liquid of the young fruit taken like coconut milk. In addition, the leaf fibres offer raw material for basketry.  

Leadwood (*Combretum imberbe*) or, in the very old Namibian legends, the *Omumborombonga* tree has been respected as an ancestral tree. According to the stories told from generation to generation, human beings, cattle, sheep and various animals originated from this tree.  

The Native Commissioner of Ovamboland reported in 1931: *Fruit trees, of which there are several varieties in Ovamboland, are, generally speaking, protected in all the tribal areas. In fact certain species are very jealously guarded and many trees even have special names and there are definite laws in regard to their ownership. This is unfortunately not the case with fruit trees which happen to be growing long distances away from the tribal areas in the bush. These, as well as the other non fruit bearing species, are at times unnecessarily destroyed by unscrupulous native trekkers, hunting parties, fire, etc. and the object in view to endeavour to formulate a stricter policy which will require natives and the missionaries to co-operate more closely in their preservation.*  

Keet, forestry officer at the Union Forestry Department of South Africa, was the first to name a few tree species which should be protected, e.g. *Acacia albida, A. erioloba, A. tortilis, Adansonia digitata, Euclidean pseudebenus, Ficus spp., Hyphaene petersinana, Kirkia acuminata, Lonchocarpus capassa* and *Spirostachys africana.*  

The list of protected tree species (Table 2) was first included in the forest legislation of 1952 (*The Preservation of Trees and Forests Ordinance, No. 37 of 1952*). The list was officially revised in 1975 (*The Proclamation of the SWA
<table>
<thead>
<tr>
<th>Botanical name</th>
<th>Common name*</th>
<th>Protected tree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1952</td>
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<tr>
<td>Acacia albida</td>
<td>Ana Tree</td>
<td>X</td>
</tr>
<tr>
<td>A. erioloba</td>
<td>Camel Thorn</td>
<td>X</td>
</tr>
<tr>
<td>A. haematoxyylon</td>
<td>Grey Camel Thorn</td>
<td>X</td>
</tr>
<tr>
<td>A. montis-usti</td>
<td>Brandberg Thorn</td>
<td>X</td>
</tr>
<tr>
<td>A. robynsiana</td>
<td>Whip-stick Thorn</td>
<td>X</td>
</tr>
<tr>
<td>A. sieberiana</td>
<td>Paperbark Thorn</td>
<td>X</td>
</tr>
<tr>
<td>Acanthosicyos horridus</td>
<td>Nara</td>
<td>X</td>
</tr>
<tr>
<td>Adansonia digitata</td>
<td>Baobab</td>
<td>X</td>
</tr>
<tr>
<td>Albizia anthelmintica</td>
<td>Worm-bark</td>
<td>X</td>
</tr>
<tr>
<td>Baikiaea plurijuga</td>
<td>Zambezi Teak</td>
<td>X</td>
</tr>
<tr>
<td>Berchemia discolor</td>
<td>Brown Ivory</td>
<td>X</td>
</tr>
<tr>
<td>Boscia albitrunca</td>
<td>Shepherd's Tree</td>
<td>X</td>
</tr>
<tr>
<td>Burkea africana</td>
<td>Red Syringa</td>
<td>X</td>
</tr>
<tr>
<td>Cassine transvaalensis</td>
<td>Transvaal Saffron</td>
<td>X</td>
</tr>
<tr>
<td>Colophospermum mopane</td>
<td>Mopane</td>
<td>X</td>
</tr>
<tr>
<td>Combretum imberbe</td>
<td>Leadwood</td>
<td>X</td>
</tr>
<tr>
<td>Entandrophagma spicatum</td>
<td>Owambo Mahogany</td>
<td>X</td>
</tr>
<tr>
<td>Erythrina decora</td>
<td>Namib Coral Tree</td>
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<tr>
<td>Euclea pseudoebenus</td>
<td>Ebony Tree</td>
<td>X</td>
</tr>
<tr>
<td>Ficus cordata</td>
<td>Namaqua Fig</td>
<td>X</td>
</tr>
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<td>F. sycomorus</td>
<td>Cluster Fig</td>
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</tr>
<tr>
<td>F. thornigii</td>
<td>Common Wild Fig</td>
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<tr>
<td>Guibouricia coleosperma</td>
<td>Copalwood</td>
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<td>Gyrocarpus americanus</td>
<td>Propeller Tree</td>
<td>X</td>
</tr>
<tr>
<td>Kirkia acuminata</td>
<td>White Syringa</td>
<td>X</td>
</tr>
<tr>
<td>Lannea discolor</td>
<td>Live-Long</td>
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</tr>
<tr>
<td>Lonchocarpus capassa</td>
<td>Apple-leaf</td>
<td>X</td>
</tr>
<tr>
<td>L. nelsii</td>
<td>Kalahari Apple-leaf</td>
<td>X</td>
</tr>
<tr>
<td>Maerua schinzii</td>
<td>Ringwood Tree</td>
<td>X</td>
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<tr>
<td>Ochna pulchra</td>
<td>Peeling Plane</td>
<td>X</td>
</tr>
<tr>
<td>Olea europaea subsp. africana</td>
<td>Wild Olive</td>
<td>X</td>
</tr>
<tr>
<td>Ozoroa crassinervia</td>
<td>Namibian Resin Tree</td>
<td>X</td>
</tr>
<tr>
<td>Pappea capensis</td>
<td>Jacket-plum</td>
<td>X</td>
</tr>
<tr>
<td>Parkinsonia africana</td>
<td>Wild Green-hair Tree</td>
<td>X</td>
</tr>
<tr>
<td>Peltophorum africunum</td>
<td>Weeping Wattle</td>
<td>X</td>
</tr>
<tr>
<td>Pterocarpus angolensis</td>
<td>Wild Teak</td>
<td>X</td>
</tr>
<tr>
<td>Rhus lancea</td>
<td>Karree</td>
<td>X</td>
</tr>
<tr>
<td>R. pendulina</td>
<td>White Karree</td>
<td>X</td>
</tr>
<tr>
<td>Ricinodendron rautanenii</td>
<td>Manketti Tree</td>
<td>X</td>
</tr>
<tr>
<td>Salix capensis</td>
<td>Vaal Willow</td>
<td>X</td>
</tr>
<tr>
<td>Schotia afr var. angustifolia</td>
<td>Small-leaved</td>
<td>X</td>
</tr>
<tr>
<td>Sclerocarya birrea subsp. caffra</td>
<td>Marula</td>
<td>X</td>
</tr>
<tr>
<td>Securidaca longepedunculata</td>
<td>Violet Tree</td>
<td>X</td>
</tr>
<tr>
<td>Spirostachys africana</td>
<td>Tamboti</td>
<td>X</td>
</tr>
<tr>
<td>Sterculia africana</td>
<td>African Star-chestnut</td>
<td>X</td>
</tr>
<tr>
<td>S. quinqueloba</td>
<td>Large-leaved</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Star-chestnut</td>
<td>X</td>
</tr>
<tr>
<td>Strychnos cocculoides</td>
<td>Corky Monkey</td>
<td>X</td>
</tr>
<tr>
<td>S. pungens</td>
<td>Orange</td>
<td>X</td>
</tr>
<tr>
<td>S. spinosa</td>
<td>Monkey Orange</td>
<td>X</td>
</tr>
<tr>
<td>Tamarix usneoides</td>
<td>Wilc Tamarisk</td>
<td>X</td>
</tr>
</tbody>
</table>

**Table 2. Protected tree species in Namibia since 1952**

Sources:


4) Information received from the Forestry Section, Groofontein, 1990.
Administration, No. 486). The list applied presently (1990) by forestry officers in Grootfontein is a bit longer than that in the proclamation of 1975.

One has to remember, however, that forest legislation did not apply to East Caprivi. Therefore Breitenbach (1968) recommended the protection of 56 local species in East Caprivi. His purpose was to eliminate the clearing of land for new villages and cultivations. By protected or ‘reserved trees’ he meant that ...the damage to and the felling, destruction or removal of any such tree without prior permission shall be prohibited and punishable.\textsuperscript{170}
8. Early explorers’ observations on the woody vegetation

The earliest explorations into the interior of Namibia were made at the end of the eighteenth century but the earliest travel accounts are only from the nineteenth century. An Englishman, Francis Galton (a cousin of Charles Darwin), and a Swede, Charles John Andersson, made a joint expedition to the central and northern parts of Namibia in 1850–51.

The two explorers wrote accounts of their observations: The narrative of an explorer in tropical South Africa (Galton 1853) and Lake Ngami or explorations and discovery during four years of wanderings in the wilds of South-Western Africa (Andersson 1987). Both of these men had studied natural sciences, the former zoology and the latter chemistry and medicine. Their accounts contain valuable information on the relationship between man and the environment. For instance, Galton describes their arrival from central Namibia (Hereroland) into Owambo (Ovamboland) with a Ndonga trading caravan in 1851.

We crossed the flat in four hours, keeping close by its easternmost margin; to the west it widened out, and stretched to the far horizon. Four hours from the north border of the flat we passed a magnificent tree. It was the parent of all Damaras. The caravan stopped awhile, and the savages danced round and round it in great delight. We slept without water. In the morning we had some delays with the oxen, but travelled from early day-break, passing an empty well at eleven, and another a little later. We pushed through thick thorns the whole time, and had begun to disbelieve in Ondonga, when quite a sudden the bushes ceased: we emerged out of them, and the charming corncountry of the Ovambo lay yellow and broad as a sea before us. Fine dense timber-trees, and innumerable palms of all sizes, were scattered everywhere over the country. 171

Andersson’s later publications The Okavango River in 1861 and The lion and elephant in 1873, which was published after his death (1867), include many observations related to vegetation and animal life. Of the early travel accounts worthy of mention are also T.G. Een’s (1872) Minnen från en
flerårig vistelse i Sydvestra Afrika and Thomas Baines’ (1864) Explorations in South West Africa.

A proper pearl among these early travel accounts is Deutsch-Südwest-Afrika, written by a Swiss botanist Hans Schinz (1891). This book was the result of a two-year expedition in 1885–1887 through Namibia and the northwestern part of Botswana. The author’s interest in botany and anthropology predominates but economic and social themes also recur. During his stay in Ovambo he estimated, for example, the wood consumption of an average homestead (see page 152). In his travel account Schinz mentioned about 75 indigenous plant species.

Especially informative are Schinz’s (1887–1890) four articles on vegetation, Beiträge zur Kenntnis der Flora von Deutsch-Südwest-Afrika und der angrenzenden Gebiete, in which 208 plant species are described. Schinz discovered and named many new tree species, e.g. Acacia arenaria, A. fleckii, Combretum hereroense and Ricinodendron rautanenii. He collected a considerable number of plant specimens and also induced the Finnish missionary Martti Rautanen to collect plant specimens. The first set of specimens Rautanen collected were sent to the Botanical Museum of the University of Zürich and their duplicates to the Botanical Museum of the University of Helsinki.
9. Forestry activities during the German colonial period

Review of publications and archival sources

The most distinguished forestry expert in German South West Africa was botanist Kurt Dinter, who arrived in Lüderitz in July 1897 and started to collect plant specimens in the central and southern parts of the country. In May 1900 he was appointed to a forestry post at Brakwater Forest Station and soon after was also nominated to be Government Botanist. He acted as head of the Okahandja Forest Station from 1901 to 1914.172

One of Dinter’s most distinguished publications—Deutsch-Südwest-Afrika: Flora; Forst- und landwirtschaftliche Fragmente—which is composed of three parts, was published in 1909. The first part presents the results of Dinter’s botanical observations along the Swakopmund–Windhoek Railway. In the second part he describes over 300 plant species from the central and southern parts of the country. In the last part Dinter discusses the state of forestry in the Police Zone.

Based on the achievements of international forestry and on his own experiments at Okahandja Forest Station, Dinter makes several recommendations concerning species selection, nursery management and plantation establishment. He was especially enthusiastic about Eucalyptus spp. and Casuarina spp. as well as other exotic tree species. Dinter did not forget to make detailed estimates of the cost of establishing a plantation. To reduce high irrigation costs he suggested intercropping trees with agricultural crops. On the whole, he was very optimistic about the future of forestry in the Namibian territory.

The other work of Dinter (1912b) that is worth mentioning from the forestry point of view is Die vegetabilische Veldkost Deutsch-Südwest-Afrikas. This is an important ethnobotanical study that deals with edible wild plants occurring in the Namibian territory. It was illustrated with photographs of various tree species.
After the First World War, Dinter continued his research work in Germany. In 1921 *Botanische Reisen in Deutsch-Südwest-Afrika* was published, which was a detailed report of Dinter’s expeditions and work as Government Botanist in South West Africa. This book provides very detailed information on the occurrence of a large number of tree species and is therefore very valuable for studying long-term changes in the woody vegetation.¹⁷³

Another notable scholar during the German colonial period was Dr. Leonard Lindinger. His work *Reisestudien auf Teneriffe über einige Pflanzen der Kanarischen Inseln und Bemerkungen über die etwaige Einbürgerung dieser Pflanzen in Deutsch-Südwestafrika* was published in 1911. In this volume Lindinger discusses the introduction of trees and other plants from the Canary Islands to South West Africa. His study is one example of the Germans’ efforts to look for suitable exotic tree species for the Namibian territory.

The only article written by the German South West African forestry officer, Chief Forestry Officer Pogge, was *Nutzholzbäume Deutsch-Südwestafrikas* (1910). Oberförster Pogge deals with management of the indigenous forest resources – their protection and utilization. He described in detail fourteen locally and commercially important tree species occurring in the central and southern parts of the territory. In particular, he emphasized the commercialization of timber and other forest products, such as resins.

Archival sources are another type of information that can be used for studying forestry activities during the German colonial period. The original archives of the German Imperial Government in Windhoek (*Kaiserliches Gouvernement in Windhoek*) are located at the National Archives of Namibia in Windhoek, but microfilms are also available in Koblenz, Germany and at the University of Joensuu, Finland. Forestry matters can be found under the heading (M) – forestry, hunting and fishing (*Forstwirtschaft, Jagd, Fischerei*).

The most useful archival records are the annual reports of the forest stations, written by the chief of the station (*Gärtner*) to the Imperial Government in Windhoek. Other good sources of information are research and travel reports by several forestry experts and authorities.

Missionaries were also active in correspondence, taking notes and keeping minutes of meetings. They observed the utilization of local forests, collected plant specimens for
scientists (e.g. Finnish missionary Martti Rautanen for the Swiss botanist Hans Schinz) and kept records of forestry activities, such as logging and tree planting. Most of the missionary sources concerning the northern part of Namibia are located in the Archives of the Finnish Evangelical Lutheran Mission in Helsinki, Finland; the files concerning the central and southern parts of Namibia are located in the Archives of the United Evangelical Mission in Wuppertal-Barmen, Germany. Microfilm copies of these materials are available in Namibia at the National Archives, Windhoek, and the parts produced by the Finnish missionaries are in the Auala Elcin Library in Oniipa.

All of the above-mentioned archival sources have their limitations. When using them, one has to keep in mind the background of the writer and to whom he is reporting. The reports hardly fulfill modern scientific criteria.

The archival sources used in the present study are almost entirely from the archives of the Imperial Government in Windhoek. The analysis below is based on different reports, memoranda and letters.

**Establishment of Forest Research Stations**

The Germans recognized very early that the forest research conducted in other parts of the world was not applicable to the Namibian territory. Even the nearest research sites in the Cape Colony had different climate and soils. Therefore it was necessary to start experiments *in situ* before beginning large-scale plantation forestry.

The first step towards organized forest research was the clearing in 1894 of a small area close to Windhoek for experimental purposes. The seedlings planted were various European species of conifers, birches, maples and limetrees.¹⁷⁴

**Brakwater Forest Station**

The first tangible proposal to establish a forest research station was presented by the Government Botanist Kurt Dinter, who applied for land in the Windhoek district, to be used for experimental purposes. Permission to establish the
Brakwater Forest Station was granted in 1900 by the Imperial Government in Windhoek.  

Trials with the following species were being carried out in 1901: Acacia saligna, Ailanthus altissima, Allocasuarina verticillata, Cupressus guadalupensis, C. sempervirens, Eucalyptus globulus, E. robusta, Morus alba, Pinus halepensis, P. pinea, P. radiata, Robinia pseudoacacia, Schinus molle and Tecoma stans. 

**Ukuib Forest Station**

At the same time Dr. Gerber, the first forestry officer in German South West Africa, proceeded with the establishment of a date palm plantation. In 1901 one hundred hectares were reserved for that purpose in Ukuib, on the bank of the Swakop River. Half of the area was to be planted with root suckers imported from Algeria and the other half with plants propagated by seeds. The first root suckers were ordered already in 1901.

**Okahandja Forest Station**

Gerber questioned botanist Dinter’s competence in forestry matters and argued that Brakwater was not a suitable site for the forest station. Consequently, a new forest station was established at Okahandja in the budget year 1901–02. Okahandja was given the status of central nursery in South West Africa. The best nursery expert in the territory, Kurt Dinter, was called to be the director of the new station right from the beginning.

In Okahandja 21 hectares were reserved for the forest station – 6 hectares for the nursery and the rest for experiments. The production capacity was planned to be ten million seedlings per annum. The irrigation capacity in the nursery was designed to be 20,000 litres per hour. The location of the forest station was ideal, next to the Okahandja Railway Station.

In 1910 there were in operation ten forest stations or forest nurseries, with a total personnel of 70 labourers and 11 professionals (Table 3 and Fig. 22).

In addition, during the first decade of the twentieth century there were two other government nurseries temporarily
<table>
<thead>
<tr>
<th>Forest station or nursery</th>
<th>White personnel</th>
<th>African personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windhoek Government Forest Station</td>
<td>1 head gardener</td>
<td>11 workers</td>
</tr>
<tr>
<td>Windhoek Forest Station</td>
<td>2 gardeners</td>
<td></td>
</tr>
<tr>
<td>Windhoek Fruit Tree Nursery</td>
<td>1 gardener</td>
<td>5 workers</td>
</tr>
<tr>
<td>Brakwater Forest Station</td>
<td>1 gardener</td>
<td>5 workers</td>
</tr>
<tr>
<td>Okahandja Forest Station</td>
<td>1 botanist</td>
<td>15 workers</td>
</tr>
<tr>
<td>Osona Forest Station</td>
<td>1 gardener</td>
<td></td>
</tr>
<tr>
<td>Ukuib Forest Station</td>
<td>1 forester</td>
<td>17 workers</td>
</tr>
<tr>
<td>Grootfontein Forest Station</td>
<td>1 gardener</td>
<td>12 workers</td>
</tr>
<tr>
<td>Gibeon Forest Station</td>
<td>1 gardener</td>
<td>3 workers</td>
</tr>
<tr>
<td>Gobabis Forest Station</td>
<td>1 gardener</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11</strong></td>
<td><strong>70</strong></td>
</tr>
</tbody>
</table>

Table 3. Forest stations and their personnel in 1910

Source: ZBU Nr. 24, A.VI.a.3.Bd.24, pp. 119–131, NAW.

in operation: Neudam near Windhoek (1904–1908) and Keetmanshoop on the banks of the Aub River (1903–1907). The former was closed because of difficulties in supplying irrigation water and due to frequent severe frost during the winters. All forest stations were established in the Police Zone.

The farmers in the Police Zone were encouraged in different ways to plant trees. For example, in 1908–09 Grootfontein Forest Station delivered to settlers 2 500 seedlings free of charge. Not only forest trees were grown, however. In Grootfontein eight hectares were reserved for fruit trees, grapevines and tea plantations. Four hectares were set aside for agricultural purposes and only four hectares for forest trees. This was a clear indication that the role of forest stations was to support the settlement policy of the German colonial government.

**Number of seedlings produced**

It is very difficult to estimate the total number of seedlings produced at the government nurseries but even harder to say how many seedlings were actually planted. Probably half of the seedling production was delivered free of charge or sold, mainly to farmers. One can imagine that many of those seedlings died during transportation and right after planting.

In “normal” years each nursery (Windhoek, Okahandja and Grootfontein) would produce between 50 000 and 100 000 seedlings, which was far less than the original plan of
millions of seedlings.\textsuperscript{184} Bad years for nursery production were the years of the Herero and Nama uprising (1904–1907). In Okahandja and Osona, for example, fences were knocked down and animals allowed to play havoc in the nursery.\textsuperscript{185}

Still in 1907–08 seedling production in the Okahandja central nursery remained rather modest, only about 40 000 plants (mainly different species of \textit{Eucalyptus} and \textit{Casuarina}). About 27 000 seedlings were delivered for planting in Otjitua and Osona; 6 000 plants were sold to farmers, and only 5 000 seedlings were used in experiments. The rest, 2 000 seedlings, were given to the colonial administration to be planted near administrative buildings.\textsuperscript{186}
Der Rechtsanwalt Dr. Forkel hat auf seiner Farm Leverbreck circa 500 Weinstöcke und gegen 1100 Bäumchen ausgepflanzt, die er sich aus dem Regierungsgarten in Gibeon mit ziemlichen Kosten aufwand hat schaffen lassen. Die Fracht allein betrug 184.- Mark.

Unter Bezugnahme auf die Bekanntmachung von 10. Juni 1909, wonach ein Freund des Landes zur Förderung der Aufforstung 1000.- Mark gestiftet hat, bittet das Bezirksamt Herrn Dr. Forkel aus diesem Fonds einen Beitrag zur Deckung seiner Unkosten zuwenden zu wollen.

I. V.

Fig. 23. Example of the promotion of tree planting by offering rewards, copy of the original documents

Source: ZBU Nr. 1173, M.1.g.1.Bd.1., pp. 8–10, NAW.

NURSERY MANAGEMENT

Seed stock was acquired from various sources in Europe, Australia, South America and Asia. The largest quantities, however, were imported from the Union of South Africa and from Germany. Only a small amount of seed was collected locally in the Namibian territory.\(^{187}\)

Seeds were usually germinated in separate open-topped wooden boxes or in split-plate canisters. Dinter recommended using wooden boxes the size of a beer case. A gravel layer of three centimetres was spread over the bottom of each germination box to improve drainage. The proper filling was a 15 cm deep mixture of humus (2/3) and sand (1/3).\(^{188}\)
A few weeks after germination the seedlings were transplanted into planting boxes (similar to germination boxes) or tins (the most common size was 10–15 cm in height and 10 cm in diameter). In planting boxes the roots were pruned fortnightly by cutting the seedling rows with a sharp knife. Dinter\textsuperscript{189} recommended using tins, but in an article in \textit{Windhoek Nachrichten}\textsuperscript{190} farmers were advised to use planting boxes (Table 4). Some 20–30 seedlings could be raised in one box, which would reduce considerably the cost of production and ease the transportation of seedlings. The article recommended the use of tins only for ornamental and shade trees.

Bare-rooted seedlings (e.g. \textit{Casuarina} spp. in Okahandja) were also tried, but their survival after planting proved unsatisfactory.\textsuperscript{191}

Only a small amount of planting stock was propagated vegetatively. The use of cuttings was restricted to fruit trees. The use of root suckers for raising date palms was widely discussed, but in practice the plants were propagated mainly from seeds.

![Fig. 24. Seeds obtainable from the Forest Department of the Union of South Africa, copy of the original announcement of 1 March 1912](source: ZBU Nr. 1174, M.I.f.I.Bd.I., p.12, NAW.)
<table>
<thead>
<tr>
<th>Species</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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</thead>
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<td>Acacia spp.</td>
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<td>Casuarina spp.</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Eucalyptus citriodora</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Eucalyptus globulus</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Eucalyptus spp.</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Prosopis glandulosa</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robinia pseudoacacia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schinus molle</td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Table 4. Proposed time of sowing at the farm tree nurseries**

Modified from ZBU Nr. 1169, M.1.a.1.Bd.1, pp. 127–128, NAW.

**Plantation establishment**

The most common method of artificial regeneration was planting. Dinter recommended the following method for establishing *Eucalyptus* spp. and *Casuarina* spp. plantations. After the vegetation has been cleared, irrigation channels should be dug 1.8 m or 1.5 m apart. Spacing for *Eucalyptus* should be 1.8 m × 1.8 m and for *Casuarina* 1.5 m × 1.5 m. Plantations should be watered twice a week during the first three weeks and after that watering should be reduced gradually until the rains start. Depending on the site, plants may need to be watered for two years after establishment. According to Dinter, the seedlings should reach 5–6 m height and the roots be in contact with the groundwater two years after planting.192

The most favourable sites for *Eucalyptus* spp. and *Casuarina* spp. were, according to Dinter, the banks of periodic rivers in the central part of the country. Good growing conditions were also found between Otavi and Grootfontein.193

Suitable planting sites for date palm (*Phoenix dactylifera*) would be the linear oases (dry river beds) in the Namib plain and the low mountains nearby. The reserves of groundwater would enable the irrigation of plantations, which had to be continued weekly even after the roots had reached the groundwater. The arid climate would be favourable for fructification. Spacing of 5 × 6 metres and intercropping with cereals were recommended.194
Direct sowing

The most suitable species for direct sowing were known to be Acacia and Casuarina spp. During the German colonial period, however, only a few small-scale trials were carried out – with poor results. Direct sowing was said to be successful on river banks in the central part of the country only if the rainfall was sufficient.\textsuperscript{195}

Intercropping

To reduce the high cost of plantation establishment, the German forest authorities started experiments on integrating forestry and agriculture. For example, the establishment of a date palm plantation involved the construction of an expensive irrigation system. In Ukuib date palms were intercropped with maize, and Agave sp. In Grootfontein trials were conducted with Eucalyptus spp. and maize, whereas in Okahandja an agroforestry trial was established with three tree species and two agricultural crops, maize and sorghum. In Grootfontein the maize yield varied from 1 250 to 1 500 kg/ha, which was one fifth of what Dinter\textsuperscript{196} had expected.\textsuperscript{197}

Species trials

At the end of the nineteenth century the European settlers needed increasing quantities of timber and other forest industry products in addition to fuelwood and fencing poles. In this context can be mentioned, e.g. timber for construction of the Swakopmund–Windhoek Railway and for the Otavi copper mine. To reduce timber import and at the same time save the indigenous forest resources, large-scale plantation forestry was thought to be feasible in the so-called Police Zone.

The planting of individual trees was started already at the end of the nineteenth century, but more systematic forestry and forest research was concentrated in the period 1900–1915. More than 200 tree species were raised in nurseries and planted in experimental plots or delivered to farmers. Species trials progressed fairly well but were stopped rapidly when the First World War broke out. The new South African mandate administration was not very interested in forestry in
Four-year-old Casuarina sp. and Eucalyptus sp. at Okahandja Forest Station. (From: Dinter 1909a)
Namibia. Research facilities and trials were neglected and no systematic data were collected.

Most of the afforestation trials were carried out with exotic species, but some indigenous species were also planted. At first, it was hoped that fast-growing deciduous trees, e.g. *Ailanthus altissima*, *Melia azedarach*, *Morus alba* and *Robinia pseudoacacia* would produce the timber the country needed so much. It soon became clear, however, that these species would not fulfill the expectations. All the above-mentioned species burst into leaf at the end of August or beginning of September and received frost damage. *Melia azedarach* and *Morus alba* thrived somewhat better but did not produce quality timber. The latter, on the other hand, was thought to be suitable for culturing silk worms. Pines and cypresses were also tested but were not able to stand the harsh Namibian climate.

After ten years of experience the conclusion was that indigenous species were too slow growing to be planted for wood production. Only exotic species from climatic conditions similar to Namibia would be suitable for large-scale plantation forestry. The two genera suitable for timber production were *Eucalyptus* and *Casuarina*.

In 1909, according to the Government Botanist and head of the Okahandja Forest Station, Kurt Dinter, the right tree species and sites for Namibian plantation forestry were found.198

Many trials were made with date palm (*Phoenix dactylifera*). The preliminary results were variable and hardly any dates were produced before the outbreak of the First World War. *Schinus molle* (pepper tree) survived better than any other exotic tree species and was very popular as hedge. The other important ornamental trees were *Acacia saligna*, *Cupressus macrocarpa*, *C. sempervirens* and *Melia azedarach*.

Below are reviewed the most important species trials we were able to glean from the records of the German colonial administration.
Acacia

The genus *Acacia* includes about 800 species that grow in arid regions of Australia, Africa, India, and the Americas. Many *Acacia* species are trees or shrubs growing under severe conditions and most provide forage for domestic and wild animals. They are able to fix atmospheric nitrogen to be utilized by plants and thus also fertilize the soil.

Trials with *Acacia* spp. were started in Okahandja in the mid-1890s. In 1904 various *Acacia* species were planted on the banks of the Neudam dam. The next year about 1.5 ha of *Acacia* spp. and other tree species were planted in the Brakwater floodplain. In 1905 in Brakwater one hectare of *A. erioloba* was also established under indigenous shelterwood. In 1910 half a hectare was planted with *A. erioloba* in Ukuib and in 1913–14 about 3 ha were planted with several other indigenous tree species in Grootfontein (e.g. *A. karroo, Kirkia acuminata*). In 1906 *A. mearnsii* was planted with *Morus* sp. among old *A. albida* trees on an area of two hectares in Ukuib.

**Acacia albida**

This species, which is one of the largest *Acacia*, is widely distributed throughout Africa. In Namibia it is found in the western part of the country on the river banks from Kuiseb to Kunene. *A. albida* is one of the most valuable plants for many African farmers: it provides shelter and forage during the dry season and drops its foliage before food crops are planted. In certain conditions, however, the times at which the trees lose their leaves can vary; and it may also bear leaves all year round. Stock and game animals pick up the large nutritious pods as soon as they fall to the ground.

*Acacia albida* was one of the indigenous tree species experimented with during the German colonial period. It is known with certainty to have been planted at least in Brakwater in 1904 and 1905.
Cattle under the shade of Acacia albida trees in Ruacana, Owambo.
**Acacia cyclops**

This species, a large shrub or small tree 3 to 5 m in height, was introduced from Australia. According to preliminary results, it grew well in all kinds of soils and produced good timber. Seedlings were raised in several nurseries during 1904–1914.

**Acacia erioloba**

Camel thorn is one of the main tree species in Namibia. Depending on the habitat, it varies from a small, very spiny shrub to a tree up to 16 m in height with a wide spreading crown. It produces excellent fuelwood and termite-resistant wood for construction purposes; in addition, the pods are excellent fodder for livestock. The widely-used common name, camel thorn, is a mistranslation from the Afrikaans *kameeldoring*, meaning ‘giraffethorn’. The previous scientific name applied to it was *A. giraffae*.

Different methods of plantation establishment were tried. For example, in Ukuib 700 seedlings were raised in containers and planted out in March 1910. One year after planting, survival was good and the height of some seedlings reached one metre. In Grootfontein in 1913–14 *A. erioloba* was planted with other indigenous tree species on an area of 3 ha.

In 1905 in Brakwater the shelterwood method was used. One hectare of natural *A. erioloba* forest was cleared and about 4 500 seed patches of 40 cm × 40 cm were prepared. Seeds germinated well and the start was promising.

In 1913–14 an agroforestry trial was established in Okahandja. Three tree species—*A. erioloba*, *A. tortilis* subsp. *heteracantha* and *Ziziphus mucronata*—and two agricultural crops—maize and sorghum—were used. The trial was a failure; germination was poor because of insufficient rainfall.

**Acacia mearnsii**

Black wattle was introduced from Australia and planted widely, especially in the Natal province of South Africa. It is the principal source of the world’s supply of tanbark, which is used by the leather industry. This handsome *Acacia* species yields excellent fuelwood and charcoal. The dry climate of Namibia has not been favourable for this species, but in South Africa it has spread out of control.
In 1894 trials were started in Okahandja and Omaruru, followed later by trials in Brakwater, Grootfontein, Keetmanshoop, Ojitua, Neudam and Windhoek. In Ukuib in 1906 *A. mearnsii* was planted with *Morus* sp. among old *A. albida* trees on an area of two hectares.

**Acacia saligna**

In the 1840s Port Jackson willow or blue-leaved wattle was introduced from Australia to South Africa in an attempt to stabilize the shifting sand dunes. From there, seeds were imported to Namibia. This bushy shrub grows rapidly and tolerates drought.

Trials were carried out at least in Gibeon, Grootfontein, Keetmanshoop and Windhoek in 1905–1909. The survival was poor because of scale insects and other pests. Many of the old trees were replaced by new plants; the stems were utilized but branches were given to the African population in exchange for empty cans, which were used in nurseries for raising seedlings.

**Acacia tortilis**  
subsp. *heteracantha*

Umbrella thorn is a native tree and one of the most widespread *Acacia* species in Africa. Two of the six recognized subspecies of *A. tortilis* occur in Namibia. The most common subspecies, *heteracantha*, is found in the central, northern and western parts of the country. The leaves and pods make very good fodder. Seedlings were produced in several nurseries during 1906–1914.

**Casuarina**  
(including *Allocasuarina*)

There are approximately 80 *Casuarina* species. Most of them are native to Australia but their natural range of distribution is from tropical India to Polynesia. Most species produce good fuelwood, are fast-growing and can adapt to poor, even salty, soils. *Casuarina* species have the ability to fix atmospheric nitrogen. The foliage – long “needles” – and shape resemble a conifer, which may cause mistakes in identification. Some
species, such as *C. equisetifolia* and *C. cunninghamiana*, are difficult to distinguish from each other.

The first *Casuarina* spp. were sown in Windhoek nursery in 1892. Later, seedlings were raised at least in Brakwater, Gibeon, Grootfontein, Keetmanshoop, Okahandja, Osona and Ukuib. Planting sites were selected close to rivers so that the seedlings could be irrigated.

It can be estimated that about 30–60 ha of *Casuarina* spp. were established in South West Africa during 1892–1914. Plantations were situated fairly close to the nurseries.

Animal dung was used to enhance growth, at least in Okahandja. It was applied at planting and placed in a hole close to the seedling. Serious damage at the nurseries and plantations was caused by locusts and termites. Many seedlings also died during periods of drought when irrigation was not possible. Therefore, in Okahandja, Dinter decided to give up producing seedlings of *Casuarina* species and concentrate instead on *Eucalyptus* spp.

Species experimented with were *Allocasuarina verticillata*, *A. torulosa*, *Casuarina cunninghamiana*, *C. equisetifolia* and *C. glauca*.

**Eucalyptus**

There are more than 600 species in the genus *Eucalyptus*. Most of them are endemic to Australia and Tasmania. *Eucalyptus* species have been widely planted for energy, timber and pulp outside their areas of natural distribution. In South West Africa Germans made experiments with 28 different species of this genus.

The Colonial Department of the German Foreign Office first sent *Eucalyptus* seed to South West Africa in 1894. The first seedlings were produced in Okahandja, Omaruru and Keetmanshoop. Later, *Eucalyptus* species were also grown in the nurseries of Gibeon, Grootfontein, Ukuib and Windhoek.

It is very difficult to estimate the total area of plantation, although it can be assumed that approximately 20–40 ha were planted with *Eucalyptus* spp. during 1894–1914. Among the plantation sites were Brakwater, Neudam, Otjitua, Osona and Okahandja. In 1908 six different *Eucalyptus* species were intercropped with maize on an irrigated area of 1.5 ha. The preliminary results were promising.
In 1914 the Rhenish Missionary Society applied for a permit to cut 20 *Acacia albida* trees on their Otjimbingwe Farm. The purpose was to clear land for a *Eucalyptus* sp. plantation. At first it was planned to start with an area of 5–6 ha and later extent the plantation area to 50–60 ha. This was an example of many exaggerated plans which were never carried out.

**Eucalyptus camaldulensis**

Red gum is the most planted *Eucalyptus* sp. in South West Africa. During the German colonial period it was raised and planted in many areas in the Police Zone, e.g. in Windhoek, Neudam and Brakwater as well as in Keetmanshoop, Osona and Okahandja. Already from the very beginning it showed good growth. There were also plans to intercrop *E. camaldulensis* with sorghum.

**Eucalyptus globulus**

Trials with *Eucalyptus globulus* (blue gum) were carried out in several parts of South West Africa. According to reports from the Okahandja Forest Station in 1904, germination of seeds and early growth of *E. globulus* were the best for any *Eucalyptus* spp. It was said to have shoot growth of up to 3 m in 15 months. Hybrids between *E. globulus* and *E. ficifolia* were claimed to be even more vigourous.

Seedlings grown in Okahandja were planted in Windhoek, Neudam and Brakwater. In 1908 part of the *E. globulus* plantation in Okahandja died of frost and was replaced by *E. camaldulensis*.

**Melia azedarach**

Syringa, which is native to Asia, is a medium-sized deciduous tree that has been widely planted in many countries as an ornamental and for fuelwood. The tree is often confused with the closely related *Azadirachta indica* (neem).

*Melia azedarach* was among the tree species first introduced to Namibia. The seedlings were frost sensitive; old trees resisted frost but were not suitable for timber. It has now become naturalized, e.g. in the Grootfontein district along a tributary of the Omatako *Omuramba* (Fig. 25).
**Morus alba**

White mulberry is a medium-sized deciduous tree, native to Asia and widely planted in temperate, sub-tropical and tropical regions. It is grown principally for rearing silk worms on its leaves, especially in China, India and Pakistan.

Trials with *Morus alba* were started successfully in Omaruru in 1895. Later it was also grown in most government nurseries. *Morus alba* was thought to be tolerant to frost, drought and termites. This was actually proved, e.g. in Okahandja nursery where many seedlings survived during the Herero and Nama uprising (1904–1907) without irrigation or protection against grazing animals. But when the forest station was again brought into use, the trees were too big to be transplanted.

Plants were propagated from seeds or from cuttings. For example, in Okahandja in 1906 about 15 000 plants were raised from cuttings.

Various methods of plantation establishment were tried. In Ukuib two hectares of scattered *Acacia albida* were planted with *A. mearnsii* and *Morus alba* (shelterwood method).

![Distribution map of Melia azedarach and Prosopis spp.](image)

*Fig. 25. Distribution of Melia azedarach and Prosopis spp.*

Phoenix dactylifera

The real date palm is a large dioecious (male and female flowers on different individuals) feather palm. The date palm, which has been cultivated for at least 6 000 years, originated in Mesopotamia or Egypt. The first fruit yield can be expected 5 years after planting.

Phoenix dactylifera was introduced to Namibia by the early missionaries. Germans were hoping to establish date palm plantations over thousands of hectares and export the dates at a good profit. Suitable sites were thought to be the river valleys containing underground moisture. It was argued that Swakop and other rivers northwards had as good growing conditions as the best Algerian oases.

Before South West Africa could export a large amount of dates, the plantations first had to be established. One forest station, Ukuib, was built up in 1901–1902 to study and promote the planting of date palms. The area had been chosen for its arid climate.

Plant production was started with 5-year-old root suckers imported from Algeria through Hamburg (Table 5). The shipment contained 67 root suckers, each weighing about 20 kg. In addition, the Botanische Zentralstelle in Berlin acquired seeds from various locations in Africa and Asia.

At first the results were not promising. Very few of the Algerian root suckers rooted; and in fact, propagation by seeds became the only method of production. Young seedlings were attacked by locusts, hares and cattle; and during the Herero and Nama uprising (1904–1907) the plantations were totally abandoned. In 1913 the area of date palm plantation in Ukuib was about 27 ha or 7 300 trees. It is hard to find any similar contemporary plantations in southern Africa.

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1901–02</td>
<td>100 ha reserved for plantations</td>
</tr>
<tr>
<td>1903–04</td>
<td>15 ha planted with 6 000 seedlings</td>
</tr>
<tr>
<td>1904–07</td>
<td>the Herero and Nama uprising</td>
</tr>
<tr>
<td>1907</td>
<td>total plantation area 13 ha</td>
</tr>
<tr>
<td>1908</td>
<td>6 ha planted with 1 500 seedlings</td>
</tr>
<tr>
<td>1909</td>
<td>20 ha planted with 9 000 seedlings</td>
</tr>
<tr>
<td>1910</td>
<td>16 ha planted with 5 300 seedlings</td>
</tr>
<tr>
<td></td>
<td>8 ha prepared for planting</td>
</tr>
<tr>
<td>1913</td>
<td>total plantation area 27 ha,</td>
</tr>
<tr>
<td></td>
<td>altogether 7 300 date palms</td>
</tr>
</tbody>
</table>
After the First World War it was found that date palms in Ukuib were seriously infested by scale insects. All trees were burnt, and thus this unique plantation was destroyed.  

During 1901–1914 experiments with date palms were also carried out in Brakwater (at least 6.5 ha), Grootfontein (at least 3.5 ha), Otjitua, Okahandja, Ukuib, Keetmanshoop, Windhoek and Gobabis. In addition to the government nurseries, date palm seedlings were also raised at the mission station of the Rhenish Missionary Society in Omaruru. It is not known whether any dates were produced during the German colonial period.

**Prospis glandulosa**

Mesquite was imported from the southwestern part of the United States of America. This deep-rooted shrub or tree has been widely planted in many arid zones of the world, especially for fuelwood and forage. It was also commonly planted in German South West Africa. Contemporary reports refer to this species as *Prosopis juliflora* but modern taxonomists call it *P. glandulosa*.  

Mesquite has nitrogen-fixing root nodules, which support its growth in unfertile soils. It is also said to improve soil by nutrient “pumping”.

In Namibia *Prosopis* spp. have naturalised and spread over considerable areas, especially to the regions around Windhoek, Okahandja, Rehoboth and along the Swakop River (Fig. 25 page 101 and Fig. 26). In the white settlement area mesquite has been hated as a nuisance and there have been many campaigns to get rid of it.

![Graph showing density of Prosopis spp. along the Swakop River related to the locations of old wells.](image)

*Fig. 26. Density of Prosopis spp. along the Swakop River related to the locations of old wells.*

*Source: Brown et al. 1985, p. 27.*
The first mesquites were sown in Windhoek nursery in 1905. Later they were also raised in several other nurseries, e.g. Gibeon, Grootfontein, Okahandja and Ukuib. *Prosopis glandulosa* was regarded as a good hedge species but was not valued as a timber producer. It was planted, e.g. in Brakwater (at least two hectares in 1906), Gibeon, Gobabis and Ojitua. It was fairly tolerant to termites and locusts but was damaged by frost, e.g. in Brakwater.

**Robinia pseudoacacia**

Black locust is a fast-growing deciduous tree, which can reach a height of 18–25 m. It is native to the southeastern and central parts of the United States and is now grown in most temperate and Mediterranean zones of the world. Because of its nitrogen-fixing ability, it is especially effective in improving unfertile, eroded soils.

In the beginning of the twentieth century black locust was regarded as one of the most suitable tree species for South West Africa. For instance, in Okahandja nursery during the Herero and Nama uprising (1904–1907) many seedlings survived without any care. It was also raised in the nurseries of Grootfontein, Keetmanshoop, Neudam, Osona, Ukuib and Windhoek.

**Schinus molle**

The pepper tree was introduced from South America. It was favoured as a beautiful, quick-growing hedge tree. But most important of all, unlike most exotic tree species, it survived both drought conditions and winter cold.

*Schinus molle* was first grown in Keetmanshoop and later in other nurseries. For example, in 1908 Windhoek nursery produced 23,000 containerized seedlings. According to Keet, pepper tree was the most planted tree species in South West Africa.
List of propagated woody species

In Table 6 are presented woody species propagated at government nurseries during the German colonial period. The list is based on the annual reports of the forest stations. It is fairly complete, although several species of minor importance may still be missing. Woody species propagated outside the government nurseries are not included.

If we analyse the list below, we discover that 23 out of the total of 201 species, subspecies and varieties are indigenous to Namibia. The following genera are gymnosperms (conifers and their allies): Araucaria, Callitris, Calocedrus, Cedrus, Chamaecyparis, Cryptomeria, Cupressus, Ginkgo, Juniperus, Pinus, Platycladus, Taxus and Thuja – a total of 29 species. The list represents various trees and shrubs of which many are important timber and pulp, energy, forage, soil conservation and ornamental species. Many of them are also known as producers of fruits, fibres, gums, tannin, honey, etc.

| Acacia albida* | Ana Tree |
| Acacia cyclops | Red Eye |
| Acacia decurrens | Green Wattle |
| Acacia erioloba* | Camel Thorn |
| Acacia hebeclada* | Candle Thorn |
| Acacia karroo* | Sweet Thorn |
| Acacia mearnsii | Black Wattle |
| Acacia pycnantha | Golden Wattle |
| Acacia saligna | Port Jackson Willow |
| A. tortilis subsp. heteracantha* | Umbrella Thorn |
| Acanthosicyos horridus* | Nara |
| Acer negundo | Ash-leaved Maple |
| Aesculus hippocastanum | Common Horse-chestnut |
| Agave americana | Century Plant |
| A. sisalana | Sisal |
| Ailanthus altissima | Tree-of-Heaven |
| Allocasuarina torulosa | Forest Oak |
| A. verticillata | Drooping She-oak |
| Anacardium occidentale | Cashew |
| Annona reticulata | Bullocks Heart |
| Araucaria angustifolia | Parana Pine |
| Arecastrum romanzooffianum | Queen Palm |
| Artocarpus heterophyllus | Jack-fruit Tree |
| Asclepias fruticosus | Milkbush |
| Atriplex lindleyi subsp. inflata | Baldoo |
| A. semibaccata | Creeping Saltbush |
| Bixa orellana | Annatto |

Table 6.
Woody species propagated in
German South
West Africa in
1900–1914

* = indigenous to Namibia
Bombax ceiba  Red Cotton Tree
Burkea africana*  Red Syringa
Caesalpinia bonduc  Bonduc
C. japonica  Jaketsu-Ibara
C. sappan  Sappanwood
C. tinctoria  Tara
Callitris endlicheri  Black Cypress Pine
Calocedrus decurrens  Incense Cedar
Calophyllum inophyllum  Alexandrian Laurel
Calotropis gigantea  Wara
Carya tomentosa  Hickory
Cassia fistula  Golden Shower
Castanea sativa  Sweet Chestnut
Casuarina cunninghamiana  Beefwood
C. equisetifolia  Swamp She-oak
C. glauca  Indian Bean
Catalpa bignonioides  Northern Catalpa
C. speciosa  Cigarbox Cedar
Cedrela fissilis  Atlas Cedar
Cedrus atlantica  Deodar
C. deodara  Cedar-of-Lebanon
C. libani  Tinwa
Cephalostachyum perigracile  Carob
Ceratonia tiliqua  Weeping Cypress
Chamaecyparis funebris  Lawson Cypress
C. lawsoniana  European Fan Palm
Chamaerops humilis  Camphor Tree
Cinnamomum camphora  Carnauba Palm
Copernicia prunifera  Smoke Tree
Cordia decandra  English Hawthorn
Cotinus coggyria  Japanese Cedar
Crataegus laevigata  Mexican Cypress
Cryptomeria japonica  Black Cypress
Cupressus guadalupensis  Common Cypress
C. lusitanica  Churchyard Cypress
C. macrocarpa  Quince
C. sempervirens var. horizontalis  Tree Lucerne
C. sempervirens var. sempervirens  Sisso
Cydonia oblonga  Flamboyant
Cytisus proliferus  Kei-apple
Dalbergia sissoo  Oil Palm
Delonix regia  Black Ear
Dovyalis caffra  Loquat
Elaeis guineensis  Black Peppermint
Enterolobium contortisiliquum  White Flowering Gum
Eriobotrya japonica  Red Gum
Eucalyptus amygdalina  Lemon-scented Gum
E. calophylla  Sugar Gum
E. camaldulensis  Yate
E. cirriodora  Mountain Grey Gum
E. cladocalyx  Karri
E. cornuta  Red Flowering Gum
E. diversicolor  Blue Gum
E. ficifolia  Yorrell
E. globulus  Saligna Gum
E. gracilis
E. grandis
<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. incrassata</td>
<td>Ridge-fruit Mallee</td>
</tr>
<tr>
<td>E. leucoxylon</td>
<td>Yellow Gum</td>
</tr>
<tr>
<td>E. longifolia</td>
<td>Woollybutt</td>
</tr>
<tr>
<td>E. loxophleba</td>
<td>York Gum</td>
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<tr>
<td>E. maculata</td>
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<tr>
<td>E. marginata</td>
<td>Jarrah</td>
</tr>
<tr>
<td>E. occidentalis</td>
<td>Swamp Yate</td>
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<tr>
<td>E. populnea</td>
<td>Poplar Box</td>
</tr>
<tr>
<td>E. resinifera</td>
<td>Red Mahogany Gum</td>
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<td>E. robusta</td>
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<td>E. salmonophloia</td>
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<td>E. salubris</td>
<td>Gimlet</td>
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<td>E. siderophloia</td>
<td>Ironbark</td>
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<td>E. viminalis</td>
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<tr>
<td>Euclea pseudebenus*</td>
<td>Ebony Tree</td>
</tr>
<tr>
<td>Ficus sycomorus*</td>
<td>Cluster Fig</td>
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<tr>
<td>Fraxinus americana</td>
<td>American Ash</td>
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<td>F. pennsylvanica</td>
<td>Green Ash</td>
</tr>
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<td>Furcraea foetida</td>
<td>Mauritius Hemp</td>
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<td>Ginkgo biloba</td>
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<td>Gleditsia triacanthos</td>
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<td>Australian Silky Oak</td>
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<tr>
<td>Hevea brasiliensis</td>
<td>Para Rubber</td>
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<tr>
<td>Hyphaene petersiana*</td>
<td>Real Fan Palm</td>
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<tr>
<td>Ilex paraguariensis</td>
<td>Maté Tree</td>
</tr>
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<td>Juglans ailantifolia</td>
<td>Japanese Walnut</td>
</tr>
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<td>J. cinerea</td>
<td>Butternut</td>
</tr>
<tr>
<td>J. nigra</td>
<td>Black Walnut</td>
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<td>Juniperus communts</td>
<td>Common Juniper</td>
</tr>
<tr>
<td>J. flaccida</td>
<td>Mexican Juniper</td>
</tr>
<tr>
<td>J. virginiana</td>
<td>Red Cedar</td>
</tr>
<tr>
<td>Kigelia africana*</td>
<td>Sausage Tree</td>
</tr>
<tr>
<td>Kirkia acuminata*</td>
<td>White Syringa</td>
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<td>Ziziphus mucronata*</td>
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**Total 201**
10. Forestry activities during the mandate period

**Review of publications and archival sources**

German interest in the Namibian territory continued after the First World War, despite the change of colonial master. Dinter returned to Namibia as a private person from March 1922 to March 1925. The result of this expedition was *Sukkulentenforschung in Südwestafrika* (1923) and *Sukkulentenforschung in Südwestafrika II* (1928). His other journeys to Namibia took him to the Lüderitz region (1929) and to Kavango (1933–1935).

After the severe drought of 1928–1933, the *Stuttgart Technische Hochschule* in Germany decided to start a dendrochronological research project in order to obtain information on long-term variability in rainfall. The leader of the project, Professor Heinrich Walter, travelled to Namibia for data collection in 1935 and the next year published the preliminary results in an article *Die Periodizität von Trocken- und Regenzeiten in Deutsch-Südwestafrika auf Grund von Jahresringmessungen an Bäumen*.

The main output from this project was, however, the doctoral dissertation of Walter Huss (1944) *Jahresringuntersuchungen an Acacia giraffae und Copaifera coleosperma und ihre Auswertung für die Frage einer Klimaänderung in Deutsch-Südwestafrika*. The main hypothesis of this dissertation was that there is a correlation between rainfall and the growth of *Acacia erioloba* (syn. *Acacia giraffae*) and *Guibourtiacoleosperma* (syn. *Copaifera coleosperma*). By measuring the width of growth rings, Huss was able to draw a graph of tree growth back to the year 1677 (Fig. 27). He first hypothesized that good rains occur every 10 years and very rich ones every 20 years. Based on the collected data, however, this hypothesis could not be proved. Yet it was obvious that dry and rainy periods have alternated in Namibia for at least 250 years. Extremely interesting is
the significant decrease in the growth rate of *Acacia erioloba* since the beginning of the twentieth century. Whether this has also meant an unfavourable period for farming would be interesting to determine.

Heinrich Walter made his next expedition to Namibia in 1937–1938. The result of this journey was three volumes of *Die Farmwirtschaft in Deutsch-Südwestafrika : Ihre biologischen Grundlagen* (Walter 1940a,b,c). Walter dealt extensively with the potential and problems of agriculture and forestry in Namibia. He described, e.g. the adaptation of exotic tree species, applied methods of artificial regeneration and the utilization of various indigenous tree species. Because of the insufficient rainfall, he was not very optimistic about possibilities for large-scale plantation forestry in Namibia.

Walter was in Namibia for the third time in 1952–1953. The result of this stay was *Grundlagen der Weidewirtschaft in Südwestafrika*, in which he discussed in detail the ecological background of bush encroachment and salt tolerance of woody plants. He also studied the nutrient content of various indigenous and exotic fodder species (e.g. *Acacia* and *Prosopis* spp.).

The new South African mandate administration did not show any particular interest in forestry. The silence on forest policy was broken in 1926 when Mr. J.D.M. Keet from the Union Forestry Department of South Africa was asked to evaluate forestry in South West Africa.

Keet left Pretoria on the 9th of September 1926, heading first to Mariental and from there to Windhoek, Gobabis,
Okahandja, Grootfontein, Tsumeb, Otjiwarongo, Waterberg, Swakopmund and Walvis Bay. He was already back in Pretoria on the 11th of October 1926. The title of his report was **Afforestation and conservation in South West Africa.**

Keet noted that, with respect to fuel and fencing, the extremely slow-growing but very common camel thorn (*Acacia eriolba*) had the greatest commercial value in the country. This resource was, however, diminishing due to felling and mortality. Utilization of other economically important species, such as dolf (*Pterocarpus angolensis*) and tamboti (*Spirostachys africana*), had not yet started. Erosion was not a serious problem in the areas surveyed.

Keet discussed extensively, e.g. the possibilities for plantation forestry in South West Africa. He reviewed the results obtained for artificial regeneration of exotic tree species at 30 different locations. The species that had done best had been *Eucalyptus camaldulensis* (the most widely planted eucalyptus), *E. cladocalyx*, *Melia azedarach*, *Morus alba*, *Prosopis* spp. and *Schinus molle* (the most commonly planted tree species). Other common exotic tree species were *Casuarina cunninghamiana* and *C. glauca*.

Keet warned about establishing large plantations of exotic tree species with rapid transpiration, such as *Eucalyptus*, close to river courses, because such plantations might lower the water table. The conditions in Tsumeb would be suitable for growing, e.g. *Eucalyptus cladocalyx*, *E. camaldulensis* and *E. albens* for mine props. Keet also dealt with the selection of species. He recommended several trees and shrubs, both indigenous and exotic, to be tried in South West Africa. He grouped the species according to use and region.

The South African forestry expert and former Director of Forestry Mr. Keet was invited to Namibia again in 1945. He now worked both as the Controller of Timber in South Africa as well as Technical Adviser to the Department of Agriculture, Division of Soil Conservation and Extension. This time he visited Namibia on August 5–20, 1946. He spent most of his time in Grootfontein and Outjo districts. Due to lack of time, neither Owambo nor Kavango was visited.

The administration of the mandated territory wanted to know whether it was feasible to establish forest industries that would utilize the indigenous forests of the Ovamboland and Grootfontein districts. Therefore the report **Exploitation of indigenous timber, and allied questions in South West Africa**
emphasizes the commercial aspect of forestry more than the earlier report of 1927 did. For instance, in this later report was presented for the first time a cost estimate for timber production.

According to Keet, the most important tree species in the region (excluding Kavango and Owambo) from the standpoint of commercial utilization were *Commiphora* sp., *Kirkia acuminata*, *Pterocarpus angolensis*, *Ricinodendron rautanenii*, *Sclerocarya birrea*, *Spirostachys africana* and *Terminalia prunioides.* A more complete list of the important indigenous tree species was included in the appendix of the report. Owambo and Kavango were mentioned in the report to have much better timber resources, but they were outside the economic transportation radius. Other issues discussed were, e.g. afforestation, soil erosion, bush encroachment and forest legislation.

Keet also advised the South African government on protection and exploitation of the forests in East Caprivi (the administrative setup is explained on page 76). The short survey, which was part of a longer tour to the Copperbelt and Barotseland in Northern Rhodesia (Zambia), was carried out in October 1946. According to the report *Caprivi Zipfel: forestry and allied questions*, the average yield of saw timber was about 17 m³/ha in *Baikiaea plurijuga* forests and about 10 m³/ha in other heavily wooded forest areas. Due to the difficult transportation conditions, Keet was somewhat sceptical about commercial timber exploitation in East Caprivi.

Keet worked one year (1948) in South West Africa as forestry adviser, especially tackling questions of afforestation and soil conservation. In this post he prepared several reports and memoranda.

In June 1948 Keet was able at last to make a survey in Kavango. His report on Kavango forests, *Forests of the Okavango Native Territory*, was published in revised form in 1950. This was the first publication on forestry and forest resources that dealt with the northernmost part of Namibia. According to his estimate, the area of ‘forest and useful woodland’ in Owambo, Kavango and Caprivi would be 6.5 million hectares. The total volume of saw timber would be 147 million m³ or 23 m³/ha. However, only 12.5 per cent of this volume was made up of suitable species or had the required dimensions. This reduced the volume of utilizable timber to 18 million m³ or 3 m³/ha; the annual growth would be 0.07 m³/ha.
The natural regeneration of timber species in Kavango was reported to be satisfactory. One sample plot was measured at Kwatakwata on the Kavango River. The result was 13000 seedlings and shoots of *Baikiaea plurijuga* plus an uncounted number of other tree species. Plants between 15 cm and 1.8 m in height were counted, groups of root sucker were taken as one plant or at most two.  

Keet reviewed the state of forest utilization and estimated the economic value of the forests. According to him, the exploitation of Kavango forests had been very limited. *Pterocarpus angolensis* was used mainly by missionaries for building material, by the Africans for canoes and paddles and occasionally also by the Native Labour Recruiting Association. *Terminalia sericea*, however, was used in large quantities for building huts, palisade enclosures and cattle pens.  

Keet’s interest on Namibia’s forests and forestry continued after the above-mentioned four missions. At the request of the Secretary of Forestry of the Republic of South Africa he prepared a review of forestry development in Namibia from the German colonial period up to the 1970s. The unpublished manuscript *Review of Development of Forestry in South West Africa*, which was completed in 1973, is based on his earlier reports and observations as well as on the relevant literature. Keet is at his best when analysing the four first decades of the mandate period. His review of the German colonial period and the period after 1960 remains very superficial.

For analysing the forestry activities during the mandate period, we have used the holdings of the National Archives of Namibia and documents dated prior to 31 December 1955. The files used were the *Archives of the Secretary for South West Africa 1920–1959*, *South West Africa Administration (SWAA)*, and the *Archives of the Native Commissioner Ovamboland (NAO)*. It would also be useful to study the documents dating from 1 January 1956 at the National Archives of Namibia. For that purpose, however, one must apply for a special permit. Additional documents dealing with forestry matters in Namibia are also located at the Central Archives Depot, Pretoria and at the Cape Archives Depot, Cape Town. Nor should one forget the files of the Forestry Officer in Grootfontein, the documents held by various companies (e.g. the Tsumeb Corporation Ltd. and Loxton, Venn & Associates) or the missionary archives.
One of the best archival sources is the report of Dr. E.K. Marsh, *Report on the availability of indigenous timbers for mine props in South West Africa with suggestions for measures to be taken to ensure future supplies* 221 Marsh, who was Chief Forest Research Officer in the Department of Forestry of South Africa, visited Namibia between the 1st and 13th of May 1954. His main object was to investigate whether the Tsumeb Corporation could continue logging without causing harm to the grazing capacity. The conclusion was that the cutting of tamboti had caused a serious bush encroachment problem (more details on pages 169–171).

The company was advised to look for other solutions to replace the logging of tamboti (*Spirostachys africana*) for mine props. Marsh also recommended improving wood production in the plantations, diversifying the utilization of indigenous forests, improving the mining process to save wood and substituting for local wood by importing.

Marsh was well aware of the potential value of tamboti. *It is thus certain that tamboti trees constitute an asset which will appreciate in value enormously in years to come and any farmer who can afford to do so will be well-advised to reserve his trees for their future value.* 222

**DETERIORATION OF FOREST STATIONS**

The South African mandate administration was unwilling to invest in forestry. This led to the decline of the forest stations that had been established during the German colonial period. Keet’s report of 1926 on the condition of Okahandja Forest Station was crushing. The research plots were left unthinned and unpruned, and the nursery had fallen into disrepair. *Prosopis* spp. and carob (*Ceratonia siliqua*) had spread out over a large area by natural regeneration. 223

In 1926 on the river bank in Okahandja, Keet noticed two small plantations, one government and one municipal. Trees had been planted there with an elaborate irrigation system in about 1914. In these very favourable conditions *Eucalyptus camaldulensis* trees had grown up to 30 metres in height (average about 24 m); the diameter at breast height (dbh) was up to 80 cm (average about 50 cm). In addition, a few *E. cladocalyx* trees were fairly large. Other tree species on
these plantations were, e.g. Casuarina cunninghamiana (height up to 21 m), Delonix regia, Eucalyptus robusta, E. sideroxylon, Hyphaene sp., Morus alba, Phoenix dactylifera, P. reclinata, Prosopis sp., Quercus suber and Schinus molle.224

Keet revisited Okahandja in 1948, but the situation had not improved since 1926. The experiments were neglected but some of the planted trees were still alive. The height of some individual trees was as much as 30 metres and the dbh about 80 cm; the dbh of the biggest Eucalyptus sp. was 131 cm.225

For future management of Okahandja plantations Keet recommended a systematic thinning scheme and 12-year rotation. The coppiced second rotation would be excellent for laths, spars and building poles; but oversize logs would only be good enough for fuelwood, so there was no point in growing trees larger than required for gate and roof beams.226

**Forest Nurseries**

From the beginning of the mandate period until the 1950s the only nursery in operation in South West Africa was the Okahandja Railway Nursery, which was established after the First World War on the new site. It provided seedlings mainly for the Railway Administration, but a small amount of surplus production was also sold to the mandate administration.227 Most of the seedlings were imported from South Africa.228

Keet recommended starting tree nurseries on the government experimental farms. The nursery on Neudam Farm was planned to produce 50 000 seedlings per annum for the central and southern regions and another nursery on Omatjene Farm 100 000 seedlings per annum for the northern areas. The experimental farms would be good nursery sites from the standpoints of demonstration, education and publicity.229 This shows clearly that forestry on the white farmland was not an independent sector but rather supported the policy of settlement. Nevertheless, implementation of Keet’s proposal was postponed.
ROLE OF THE MINING INDUSTRY

Since the early 1900s the mining industry has been the most productive sector in the economy of Namibia. In 1989 the mining sector made up 29 per cent of the Gross Domestic Product and 76 per cent of the total exports by value. The mining industry was started in 1906 with the reopening of the rich copper mine in Tsumeb. Diamonds were found two years later in the Namib Desert near Lüderitz.

The rich copper deposit in the Grootfontein–Otavi–Tsumeb triangle was utilized by the Africans decades before the arrival of Europeans. In the Namibian territory the smiths of the Ondonga community in Owambo specialized in copper handling and in trade with copper artifacts. However, the Ondonga people did not extract the copper ore themselves but bought it from the San community living near Otavi. The missionary Hahn estimated that the San mined fifty to sixty tonnes of copper ore annually from a secret mine near Otavi.

Wood consumption

In the early 1900s the mines used a rather limited amount of wood. Later, however, the situation changed. The mines were much deeper and required a lot of props and lagging. In addition, wood was also used as fuel.

The German colonial administration had granted a cutting permit to the mining company in Tsumeb (Otavi Minen und Eisenbahnen Gesellschaft). This permit allowed the company to cut an unlimited number of trees from its large domain. The new mandate administration became concerned about this virtually unlimited permit, and the authorities tried to force the company to use coal or oil instead of wood for energy. The magistrate of Grootfontein decided in 1920 that after 30th June 1922 no unlimited cutting permit would be granted.

In 1926 South African forestry expert J.D.M. Keet visited the Otavi Mines at Tsumeb and the Abenab Mines northwest of Grootfontein. At that time the Otavi Mines used about 2,700 m³ of tamboti (Spirostachys africana) annually for mine props. In addition to props, some mines also used fairly large quantities of wood (tamboti and other tree species) for producing steam power. Later the Abenab Mines and the Tsumeb Mines started to use coal imported from South Africa for their energy requirements.
Smiths at work in Uukwanyama, Owambo. (From: Paul 1933)
Eucalyptus plantations

Tree planting activities started in Tsumeb in 1930 with the establishment of a *Eucalyptus camaldulensis* plantation. About 3 000 seedlings were planted per hectare and irrigated frequently with water pumped from the mine. No thinnings were being done when Keet visited the site in 1946.235

In 15–16 years the trees had grown up to 20 metres in height and 25 cm in diameter. The timber was reported to have good quality for mine uses, but drought had left only a few trees alive. According to Keet, the stand should have been thinned in the 5th or 6th year after planting. Keet proposed trying line planting: 60-metre wide zones should be cleared in the forest and planted with *Eucalyptus* spp. in 8–9 rows; 6-metre wide strips should be left untouched to provide a natural food source for termites.236

Marsh estimated in 1954 that in the vicinity of Tsumeb there were approximately five tamboti trees (*Spirostachys africana*) per hectare. One third of the trees fulfilled the size requirement of the mine (minimum diameter at the top of pole 20 cm over bark, maximum diameter at base 35 cm over bark and minimum length of the pole 1.7 m). At best, only 50 per cent of the trees of suitable size were sound enough for mine props. He assumed that 50 per cent of the trees could be logged without any silvicultural harm. It was supposed that one tree would produce two poles. In the end, from an average farm of 5 000 hectares the company could get about 4 000 poles instead of the 20 000 estimated by the Tsumeb Corporation.237

In the mid-1950s in Tsumeb about 22 per cent of the ore was mined by the so-called square-set method, which required 18 times as much timber as other methods. The annual consumption was 135 000 poles (about 13 000 m³)238 or 29 pieces per 100 tons of ore mined. The consumption was expected to increase up to 183 000 pieces in the near future. For this amount of wood the company would have to log at least 115 000 ha annually. At this rate, however, the forest would be destroyed. If a more ecologically sustained logging method was used, the minimum forest area needed would have been about 230 000 hectares per annum. According to Marsh, it was evident that less than 10 per cent of the next seven years' wood consumption would be supplied within a 100 km radius of Tsumeb.239
The Tsumeb Corporation tried to solve the threatened shortage of poles by establishing a new tree plantation. According to Marsh, 65 000 seedlings of *Eucalyptus camaldulensis* had already been planted in 1954 near Lake Otkoko, first 6 000 and later 3 400 seedlings/ha. The mining company was hoping to produce 130 000 poles in seven years after establishment of the plantation, i.e. almost the amount needed annually. Marsh estimated that at best only 20 per cent of the target could be reached. The spacing of seedlings was too dense and the growth prediction far too optimistic, even with irrigation.\(^\text{240}\)

Marsh estimated that to produce 180 000 poles annually using 10-year rotation and wide spacing (e.g. 1 300 seedlings/ha), at least 700 ha would be needed instead of the 116 ha estimated by the Tsumeb Corporation. However, it was estimated that Lake Otkoko would supply irrigation water for only 500 ha. Marsh suggested trying *Eucalyptus grandis*, which was a common mining timber in South Africa, in Tsumeb instead of *E. camaldulensis*.

**COMMERCIAL FELLINGS**

The European settlers and companies in Namibia have from the very beginning cut a considerable number of trees and shrubs for fuel, mine props and cattle pasture plus a minor quantity for building materials. Most of the timber and other forest industry products have, however, been imported. According to Keet, in 1926 the quantity cut by the European sector was about 42 000 m\(^3\), of which some six per cent was used for mine props by the Tsumeb Corporation.\(^\text{241}\) The use of props in Tsumeb had increased up to about 13 000 m\(^3\) in 1954.\(^\text{242}\) According to Hose, in 1987 the company purchased 2 000 tons of wood chips per month for energy (about 27 000 m\(^3\) per annum).\(^\text{243}\)

Up to mid-September 1972, according to the Regional Forest Officer in Grootfontein, the quantity of *Pterocarpus angolensis* cut from Kavango, Owambo and Bushmanland amounted to 28 000 m\(^3\).\(^\text{244}\) One can compare this figure to the information from 1990 which states that concessions allowed annual cutting of 8 850 m\(^3\) – including East Caprivi\(^\text{245}\) (Table 7 page 122). To get a better picture of the total drain
Pit sawing in Kavango.

Loading logs of wild teak (Pterocarpus angolensis) in Kavango. The distance to the main road is about 30 km and from there 75 km to the sawmill in Rundu. The average diameter of the logs in the photograph is about 60 cm.

Sawn timber (Pterocarpus angolensis) at the Rundu saw mill.
from Namibia’s forests, one should study the documents mentioned on page 113. We were not able to use those papers in this study, and therefore the logging activities since 1956 have remained rather obscure.

**Wood industries**

During the First World War a furniture factory was established in Omaruru. The demand for ‘Omaruru furniture’ collapsed soon after the recovery of the world economy and the drop in prices of imported timber. When the great depression hit Namibia, attention was again turned toward indigenous forest resources, especially those in Kavango and Ovambo. In the beginning of the 1930s permits were granted to private enterprises allowing them to cut small amounts of *Guibourtia coleosperma*, *Pterocarpus angolensis* and *Spirostachys africana* (tamboti) in Kavango. Because of the poor road conditions, these areas still remained for the most part outside the economic transportation radius.

The increased demand for indigenous timber encouraged the establishment of sawmills. The pioneer in this field was a private person who first established his sawmill in Otavi in the mid-1940s and later moved it to a farm 65 km southwest of Otavi. This sawmill utilized mainly *Kirkia acuminata* (white syringa). However, the venture soon failed. In 1948 one mission station in Kavango was reported to have a horizontal frame saw of low capacity.

Contrary to many other parts of Africa, pit sawing was not known in the northern part of Namibia before the 1950s. According to Breitenbach, in the mid-1960s eight sawyers operated in East Caprivi west and south of Katima Mulilo. They each sawed about 20–30 *Pterocarpus angolensis* logs per annum; average timber size was 0.3–0.6 m³. The production of sawn planks was very small, probably less than 100 m³ per annum. The wastage was excessive, e.g. the non-durable sapwood was usually not used. However, the local demand for timber for door and window frames and other carpentry products was fully met.

In 1990 three sawmills were operating in northern Namibia. A bush-sawmill was first erected by the South African authorities in 1978 at Lutala, about 30 km from Katima Mulilo, and ten years later moved to Katima Mulilo. The
sawmill in Rundu was first run by the government in 1978–1985 and later privatized. Since 1990 it has been operated by MKU Enterprises, which also has a furniture factory in Okahandja. The Industrial Development Cooperation (IDC) owns a sawmill in Bushmanland, which utilizes *Pterocarpus angolensis* from Bushmanland and Hereroland. In Ovambo, sawing was carried out in Oshakati in 1964–1978. The Bantu Investment Corporation also used to operate a furniture factory there. In 1990 the logging concession was held by Central African Timber from Johannesburg.²⁵¹

The sawmills are exploiting *Pterocarpus angolensis* and *Baikiaea plurijuga* almost exclusively. Both of these are highly valued timber trees with properties fairly similar to those of the world famous high grade timbers, e.g. *Tectona grandis* (Indian teak). In 1990 concessions were given for a total of 8 850 m³ in the northern part of Namibia (Table 7). In recent years the marketing of *B. plurijuga* has faced serious difficulties and, in practice, e.g. the state-owned sawmill in Katima Mulilo has concentrated on utilizing only *P. angolensis* (annual timber use 1988: about 300 m³; 1989 and 1990 about 600 m³).²⁵²

### Table 7.
Volume of commercial fellings up to mid-September 1972 and cutting permits granted in 1990


<table>
<thead>
<tr>
<th>Region</th>
<th>Commercial fellings, m³ up to 9/1972</th>
<th>Cutting permits, m³ 1990</th>
</tr>
</thead>
<tbody>
<tr>
<td>East-Caprivi</td>
<td>?</td>
<td>3 000</td>
</tr>
<tr>
<td>Kavango</td>
<td>10 000</td>
<td>3 000</td>
</tr>
<tr>
<td>Ovambo</td>
<td>2 000</td>
<td>2 000</td>
</tr>
<tr>
<td>Bushmanland/Hereroland</td>
<td>16 000</td>
<td>850</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>28 000</strong></td>
<td><strong>8 850</strong></td>
</tr>
</tbody>
</table>

122
11. Forestry activities since the 1960s

Review of forestry and forest research

The most important forest research in the 1960s and 1970s was the mapping of forests in East Caprivi, Kavango, Owanbo and Bushmanland. These studies give a rough idea of forest areas and the volumes of saw logs. The Long-term plan of forestry development in the Eastern Caprivi Zipfel by Breitenbach (1968) is the most comprehensive and detailed forestry study done in Namibia. This study includes a forest management plan for East Caprivi. Geldenhuys (1975; 1977a) prepared forest management plans for Kavango and East Caprivi, but these plans remained incomplete.

In the latter part of the 1980s forestry personnel in Grootfontein made rough forest inventories in Bushmanland, Hereroland and in restricted areas of Kavango. These inventories give estimates of the volume of Pterocarpus angolensis saw logs (Hilbert 1986a; 1986c; 1987a).

The information available in 1990 on Namibian timber resources is summarized in Table 8. Except for farming areas, only commercial timber species are included in the calculations. The local use of wood for construction, agricultural purposes and for energy have not been taken into account. The figures presented are outdated and should not be used for any national forestry plan. To build up sustainable forestry in Namibia, there is a need for a national forest (woody biomass) inventory.

Vegetation maps and botany

Botany is closely related to forestry. The most extensive botanical study done in Namibia is Prodromus einer Flora von Südwestafrika by Merxmüller (1966–1972). The other comprehensive works are, e.g. Preliminary vegetation map by Giess (1971) and The common names and a few uses of the better known indigenous plants of South West Africa by
Table 8. Commercial timber resources in Namibia

<table>
<thead>
<tr>
<th>Forest area</th>
<th>Saw logs total m$^2$</th>
<th>Allowable cut per annum m$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kavango</td>
<td>2 400 000</td>
<td>2 600 000</td>
</tr>
<tr>
<td>Owambo</td>
<td>900 000</td>
<td>?</td>
</tr>
<tr>
<td>East Caprivi</td>
<td>700 000</td>
<td>1 100 000</td>
</tr>
<tr>
<td>West Caprivi</td>
<td>500 000</td>
<td>*</td>
</tr>
<tr>
<td>Bushmanland</td>
<td>400 000</td>
<td>60 000</td>
</tr>
<tr>
<td>Hereroland</td>
<td>100 000</td>
<td>6 000</td>
</tr>
<tr>
<td>Farming area</td>
<td>8 000 000</td>
<td>?</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13 000 000</strong></td>
<td></td>
</tr>
</tbody>
</table>

* nature conservation area

Le Roux (1971). The latter consists of a list of 300 plant species with about 2 000 vernacular names, in one or more of 29 languages.

Another vegetation map covering the whole of Namibia is The Vegetation of Africa by White (1983). It is the remarkable result of UNESCO’s long-term programme for synthesizing information on African natural resources. It includes maps at a scale of 1:5 000 000, which are based on the physiognomy (all aspects of the structure of vegetation) and floristic composition of the vegetation.

A useful source book concerning the vegetation of the most northern part of Namibia is Carta Fitogeográfica de Angola (Barbosa 1970). Actually, White (1983) used Barbosa’s work in compiling the UNESCO vegetation map. A.O.C. Technical Services (1967) produced a preliminary vegetation map for Owambo. Correia and Bredenkamp (1987) and Page (1979; 1980) have classified the vegetation of Kavango. All available vegetation maps of northern Namibia are very superficial and not detailed enough for the future development of forestry.

Some very useful publications from the standpoint of rural forestry are, e.g. The Ethnobotany of the Kwayama Owambos by Rodin (1985) and Subsistence ecology of the Kung Bushman by Lee (1965). The first includes a very useful summary of species by categories of utilization, e.g. carved wood, fibres, construction materials, fuel, foods and medicines. The latter
is the study of a San community and its environment, with special emphasis on the manketti tree (*Ricinodendron rautanenii*) and its utilization. The third important ethnobotanical study is *The Food Plants of the !Khu Bushmen of north-eastern South West Africa* by Maguire (1978). In this study are listed 71 plants used for food or water by the San people.

A considerable amount of ecological research has been done since 1963 in Gobabeb, the field station of the Desert Ecological Research Unit of Namibia (DERUN), which is located on the Kuiseb River in the central Namib Desert. Perhaps the best introduction to the area is *The Kuiseb environment: the development of a monitoring baseline* by Huntley (1985a). For other botanical publications concerning Namibia, see the *Bibliography of South West African Botany* by Giess (1990).

**Satellite remote sensing**

The first Landsat satellite was launched by NASA in 1972. So far, five Landsat satellites have been launched. Each satellite is intended to provide repeated ground coverage of 185 km × 185 km of each area of the Earth's surface every 16th day. Landsat Multi-Spectral Scanner (MSS) records reflected energy in four spectral wavelengths from the ground within a resolution of about 80 m. The orbit of the satellite is 705 km above the Earth's surface.

Using Landsat MSS satellite images, FAO has conducted a survey of potential land suitability in the northwestern part of Namibia (Travaglia and Schade 1981). The selected area covered 22 million ha. Eleven Landsat MSS images taken between 30th July 1972 and 15th September 1973 were used. These images were analysed and interpreted visually. The maps produced cover climate, geology, drainage, land use, land systems and soil associations, infrastructure and vegetation. The vegetation is divided into five major regions: 1) Coastal Desert, 2) Steppe Grassland between the Namib Desert and the Kalahari Sandveld, 3) Kalahari Thornveld, 4) Mixed Savanna surrounding the Etosha Pan and 5) Mopane Savanna.

The meteorological NOAA satellites acquire data from any part of the Earth's surface every 12 hours. The scanner in
the satellite sweeps out a continuous 3,000 km wide swath of the Earth's surface with a ground resolution of 1.1 km. The data acquired by the Advanced Very-High-Resolution Radiometer (AVHRR) carried by the NOAA satellite have been used successfully to map woody biomass resources in the SADCC region, excluding Namibia.\(^{255}\)

A similar study, financed by the World Bank and covering all of Africa south of the Sahara, is now in progress and will be published in 1991. The rough estimates of standing stock and mean annual increment in 16 different biomass classes will be given. The spatial resolution used is 8 km. This study will include Namibia.\(^{256}\)

In Namibia the image-processing facility was implemented at the end of the 1980s in the Department of Agriculture and Nature Conservation (later, the Ministry of Agriculture, Water and Rural Development). The 29 Landsat MSS and 29 Landsat TM scenes were acquired from the end of the wet season 1989. The data processing of these scenes has focused on mapping of bush encroachment and grazing capacity in the commercial farming areas.\(^{257}\)

**Forest ecology**


Rutherford's (1975) study of the vegetation structure, the biomass production and phenology is one of the most detailed studies carried out in Namibia. In particular, he concentrated on seasonal changes in the vegetation during the period September 1970 – August 1971. The dominant tree species in the study area were *Burkea africana*, *Combretum psidioides* subsp. *dinteri*, *Ochna pulchra*, *Securidaca longepedunculata* and *Terminalia sericea*. 
Regeneration

Afforestation and reforestation activities, including research, in Namibia since the 1960s have been minimal. Even the established plantations and research trials have been more or less abandoned, and data collection has been neglected. However, there have been several plans to establish large plantations. One tree-planting exercise was recently initiated in Hamoye, Kavango.

In the 1970s a few *Eucalyptus* spp. plantations were established in the northern part of Namibia, covering about 100 ha altogether. In the beginning of the 1970s Le Roux (1974) studied the salt tolerance of various tree species at Walvis Bay. Similar research was started in 1990 at the Agricultural Experiment Farm of Rössing Foundation in Okashana, Owambo.

In February 1989 Grootfontein’s forestry personnel established an alley crop trial of *Leucaena leucocephala* (14 provenances) and *Glicidium sepium* (12 provenances). The site is on Imbenau Farm near Grootfontein. According to the initial plan, the agricultural crops will include, e.g. *mahangu* millet, sunflower and maize.

From the mid-1980s onwards observations on coppicing of *Pterocarpus angolensis* have been made in Bushmanland, Hereroland and Kavango. According to these observations, trees seem to coppice fairly well in the absence of fires. In the 1960s a *Colophospermum mopane* management project was started in Ombalantu, Owambo. The purpose of this project was to produce poles from coppiced shoots. Unfortunately, no reports have been written on these activities. Management of the *C. mopane* stands will be one of the urgent challenges for the newly organized Directorate of Forestry.

Timber properties

Banks and Kromhout (1966) studied the timber properties of *Burkea africana* and made comparisons between Namibia and South Africa. Malan (1974) made similar studies with *Kirkia acuminata*. More unpublished information on the properties of Namibian timbers probably exists in the files of research institutes and wood industries.
A planted *Pterocarpus angolensis* trunk ("cutting") sprouting at the front of the MKU sawmill in Rundu.
Bush encroachment and biomass harvesting

Bush encroachment on grazing land is a serious problem in the central part of Namibia. Several methods of controlling bush encroachment, including goats, have been used. Aerial spraying of herbicides has proved to be effective but not economically advisable.

In the beginning of the 1980s the First National Development Corporation (FNDC) started to look for economically viable methods of biomass harvesting and utilization. The research was conducted partly in Tsumeb, Namibia (Tsumeb Corporation Ltd) and partly in South Africa (Council for Scientific and Industrial Research).

Forest inventories, mapping and management plans

East Caprivi

Breitenbach (1968) made a preliminary forest inventory for East Caprivi. For this inventory he divided the wooded area – 690 000 ha or 60 per cent of the total area of the territory – into 15 forest types. The cultivated areas made up 4 per cent and marshes, swamps and rivers 36 per cent. For mapping, he used aerial photographs (1:50 000) from 1965.

Fifteen one-acre (1 acre = 0.4047 ha) square sample plots were laid out over seven forest types. Within each sample plot all trees above four inches (10.16 cm) diameter at breast height (dbh) were enumerated by species, dbh (over bark) and bole length. Two species, Baikiaea plurijuga and Pterocarpus angolensis, were considered to produce good quality timber for industry. The diameter limits over bark for mature trees was set at 40 cm (16 inches) for B. plurijuga and 50 cm (20 inches) for P. angolensis.

Breitenbach estimated that the total volume of growing stock (dbh>10 cm) in East Caprivi was 3 900 000 m³, of which one third consisted of Pterocarpus angolensis and Baikiaea plurijuga (Table 9). The mean volume of growing stock was 6 m³/ha, varying in forests from 7 to 21 m³/ha, in woodlands from 2 to 11 m³/ha and in wooded savannas from 0.7 to 2 m³/ha.
The volume of mature *Pterocarpus angolensis* and *Baikiaea plurijuga* trees was 700 000 m³. However, in the case of *B. plurijuga* 400 000 m³ and in the case of *P. angolensis* 3 500 m³ was not commercially exploitable because of poor quality stems, low tree density and for ecological reasons. Thus only about 297 000 m³ was estimated to be available for commercial utilization.

<table>
<thead>
<tr>
<th></th>
<th>Baikiaea</th>
<th>Pterocarpus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mature</td>
<td>575 000 m³</td>
<td>128 000 m³</td>
<td>703 000 m³</td>
</tr>
<tr>
<td>Immature</td>
<td>275 000 m³</td>
<td>163 000 m³</td>
<td>438 000 m³</td>
</tr>
<tr>
<td>Total</td>
<td>850 000 m³</td>
<td>291 000 m³</td>
<td>1 141 000 m³</td>
</tr>
</tbody>
</table>

Dbh limits for mature trees: *Baikiaea* 40 cm; *Pterocarpus* 50 cm.
Minimum dbh for immature trees: 10 cm.

Breitenbach prepared a forest management plan for 226 000 ha, which is one third of the total wooded area in East Caprivi or 19 per cent of the whole territory. The volume of growing stock in the area was estimated to be 1.9 million m³.

The area was proposed to be divided into six management areas or forest reserves; four production and protection areas in the *Baikiaea plurijuga*-dominated upland region and two soil conservation areas in the *Colophospermum mopane*-dominated low land region.

Five silvicultural management classes were introduced: 1) *Baikiaea* production, 2) *Baikiaea* improvement, 3) *Pterocarpus* production, 4) *Pterocarpus* improvement and 5) protection.

The proposed rotation was 120 years for *Baikiaea plurijuga* and 90 years for *Pterocarpus angolensis*. The allowable cut in 1975 for the management area was planned to be about 6 000 m³/a, of which 17 per cent would be *Baikiaea plurijuga* and 83 per cent would be *Pterocarpus angolensis*.

For establishing *Baikiaea plurijuga* plantations, Breitenbach recommended intercropping with maize, millet or groundnut (the so-called *taungya* method). He advised that *Pterocarpus angolensis* be established with 18- to 30-month-old nursery-grown stumps (a cutting which has a fairly long root and a very short shoot).
The forest management plan included the establishment of a forest service organization, a comprehensive system of fire protection with firebreaks, watch-towers and telecommunication, and a list of 56 tree species to be protected (see page 80).

Breitenbach's (1968) forest management plan was never put into effect, and later the document was no longer available in Namibia. Nine years later Geldenhuys (1977a) prepared a tentative forest management plan for Nakabunze forest, which covered 36 000 ha.

Geldenhuys (1977a) carried out a line-plot survey using circular plots with a 30 m radius (0.283 ha). The total volume of saw logs in Nakabunze forest was estimated to be about 230 000 m³.

For management purposes the Nakabunze was divided into ten forest types according to species composition. These types were grouped into three management classes:

1) *Pterocarpus* improvement, 2) *Baikiaea* improvement and 3) *Pterocarpus–Baikiaea–Guibourtia* improvement. In addition to the volume estimations, emphasis was also put on the natural regeneration of *Pterocarpus angolensis* and *Baikiaea plurijuga* as well as elephant damage to *P. angolensis*.

<table>
<thead>
<tr>
<th>Species</th>
<th>minimum D₁₃</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Baikiaea plurijuga</em></td>
<td>55 cm</td>
<td>159 000 m³</td>
</tr>
<tr>
<td><em>Pterocarpus angolensis</em></td>
<td>45 cm</td>
<td>18 000 m³</td>
</tr>
<tr>
<td><em>Guibourtia coleosperma</em></td>
<td>60 cm</td>
<td>8 000 m³</td>
</tr>
<tr>
<td><em>Burkea africana</em></td>
<td>35 cm</td>
<td>13 000 m³</td>
</tr>
<tr>
<td>Other tree species</td>
<td>30–60 cm</td>
<td>35 000 m³</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>233 000 m³</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Table 10. Volume of saw logs in Nakabunze forest, East Caprivi**

Source: Geldenhuys 1977a.

**Kavango**

Geldenhuys (1975) prepared a preliminary forest management plan for Kavango. For forest mapping he used aerial photographs (1:75 000) and topographic maps (1:250 000). Initially, four forest types were defined over an area of 2.4 million ha, which is about half the size of Kavango. After the field survey five forest types were defined, which consisted of 14 different species groups.
Altogether 194 cluster points were selected for data collection. Each cluster consisted of four circular sample plots, each with a radius of 30 m (0.283 ha). All trees with dbh > 10 cm were enumerated by species and dbh. Volume of saw logs was estimated for four main species.

The total volume of saw logs on an area of 820 000 ha was estimated to be about 2.6 million m³ (Table 11). The very large trees (60+ cm dbh) were usually *Guibourtia coleosperma*

<table>
<thead>
<tr>
<th>Species</th>
<th>minimum $D_{L3}$</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Baikiaea plurijuga</em></td>
<td>45 cm</td>
<td>640 000 m³</td>
</tr>
<tr>
<td><em>Pterocarpus angolensis</em></td>
<td>45 cm</td>
<td>370 000 m³</td>
</tr>
<tr>
<td><em>Guibourtia coleosperma</em></td>
<td>45 cm</td>
<td>960 000 m³</td>
</tr>
<tr>
<td><em>Burkea africana</em></td>
<td>35 cm</td>
<td>650 000 m³</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>2 620 000 m³</strong></td>
</tr>
</tbody>
</table>

*Table 11. Volume of saw logs in Kavango*

*Source: Geldenhuys, 1975.*

Shop for wood carvings in Kavango.
or *Baikiaea plurijuga*, but seldom *Pterocarpus angolensis*. The average volumes of saw logs in the 14 forest types were: *Baikiaea plurijuga* 0.8 m³/ha, *Pterocarpus angolensis* 0.5 m³/ha, *Guibourtia coleosperma* 1.1 m³/ha and *Burkea africana* 0.8 m³/ha.

Hilbert (1986c) made a forest inventory for 10 000 ha in Kavango. The area is called Myl 30 and it is utilized by wood carvers. A systematic line plot inventory was carried out using 0.5 ha sample plots (total 128 plots). All *Pterocarpus angolensis* trees over 10 cm dbh were measured and the vitality was classified; the volumes were not estimated. According to Hilbert, 300 trees can be harvested each year. The maximum number of wood carvers in the area would be fifteen, which means 20 trees/permit-holder/a.

**Bushmanland**

Preliminary forest inventories have also been carried out in Bushmanland (Hilbert 1986a). The results are combined into a forest map (1:75 000) dated 1970. According to the map, the forest area was 390 000 ha, which is one fifth of the area of Bushmanland. The area was divided into four forest types.

In 1986 a new survey was carried out (Hilbert 1986a), which consisted of 147 sample plots, each 0.5 ha in size. Only *Pterocarpus angolensis* trees with dbh >10 cm were measured. Based on these two surveys, Hilbert estimated that the total exploitable volume of *Pterocarpus angolensis* and *Baikiaea plurijuga* would be about 60 000 m³ or 0.2 m³/ha and the exploitation potential would be about 600 m³/a. It was proposed that about 90 000 ha of the total forest area be reserved for nature conservation.

**Hereroland**

In Hereroland a preliminary survey of growing stock and distribution of *Pterocarpus angolensis* was carried out in 1987 (Hilbert 1987a). The field data consisted of 116 sample plots, each 0.5 ha. The forest area was estimated to be 100 000 ha and the exploitable volume of *Pterocarpus angolensis* 6 000 m³ or 0.06 m³/ha. If the rotation is 50 years, the exploitable volume will be 120 m³/a.
Owambo

Forest mapping has also been done for the eastern part of Owambo. The map (1:75 000), which is dated 1970, is similar to those for Kavango and Bushmanland. Aerial photographs were from 1964, topographic maps (1:250 000) from 1967, and the field work was done in 1969. The mapped area is divided into four different forest types.

Tree plantations and nurseries

Species and provenance trials

A fairly large provenance trial was established in 1973–1974 in Onuno, Owambo (17°56'S, 15°59'E) \(^{266}\) and in Rundu, Kavango (17°55'S, 19°46'E).\(^ {267}\) The experiment consists of 25 different provenances of *Eucalyptus camaldulensis* and 18 provenances of *E. tereticornis*. The trials were measured at the time of planting and again after 3 months, 12 months and 44 months.\(^ {268}\) In 1974 provenance trials of *Eucalyptus citriodora* were established in Kavango and Owambo.\(^ {269}\)

In the 1970s *Eucalyptus camaldulensis* was planted also in Onankali, Owambo (18°12'S, 16°18'E)\(^ {270}\), in Kavango\(^ {271}\) and near Katima Mulilo, East-Caprivi (17°32'S, 24°16'E).\(^ {272}\)

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![Diagram showing the distribution of plantations in Angola and Botswana](image)

**Fig. 28.**

*Eucalyptus spp. plantations in Namibia*
In 1990 the total plantation area was less than 100 ha. However, there have been several plans to start large-scale plantation programmes. In the 1970s approximately 25 000 ha in Ovamboland and 35 000 ha in Kavango were reported to be reserved for forest plantations.

**Government nurseries**

There were three government tree nurseries in operation in 1990. Two of them, one in Katima Mulilo, East Caprivi and one in Ondangwa, Ovamboland are rather modest units producing a few thousand seedlings of ornamental and fruit tree species annually. The main forest nursery was established in the beginning of the 1970s in Groostontuin. The production at this nursery has been about 25 000 seedlings per annum, which consist of 250 different indigenous and exotic tree species. One third of the production is sold.

**Rural Development Centre – Ovamboland**

The Rural Development Centre (RDC) project was started in Ongwediva, Ovamboland in March 1988. The project includes a Short Course Training Centre, a fish hatchery, an appropriate technology workshop and a plant nursery. This project is executed by the Western Development Company (Pty) Ltd.

The seedlings produced consist of fruit, ornamental and timber tree species. So far several thousand seedlings of *Eucalyptus camaldulensis* and *Casuarina* species have been produced. In 1990 seedlings were sold within the local community for 1R/each.

**DAPP-nursery – Ovamboland**

DAPP (Development Aid from People to People) is a NGO headquarter in Denmark with subsidiaries in Angola, Guinea Bissau, Mozambique, Namibia, Zambia and Zimbabwe.

In April 1990 DAPP started to build up a tree nursery in Ombalantu district, Ovamboland. The nursery is planned to produce 100 000 seedlings annually. In October 1990 about 40 000 black polythene bags were filled with nursery soil and
Eucalyptus spp. plantation in Onuno, Owambo.

Eucalyptus spp. trees in Kavango, 50 km from Rundu towards Grootfontein. The plantation was established in the 1970s and destroyed in 1982 when the safety zones on both sides of the road were cut.
sown with seed of 22 different tree species. In addition, 20 000 pots were sown with seed of guava and papaya. About 15 000–25 000 seeds of *Eucalyptus camaldulensis* were sown in seed beds.

According to the DAPP project leader, the seedlings were planned to be sold to local community for R2 for a fruit tree seedling and R1 for other seedlings. An advertising campaign on the local radio station was started in October 1990. Although the project is not oriented to large-scale reforestation, the project site provides good possibilities for demonstration woodlots.

**Hamoye nursery project – Kavango**

In 1988 the Department of Agriculture and Nature Conservation started a nursery project in Hamoye, which is about 45 km south of Rundu in Kavango.\(^{275}\) The aim of this project was to establish a *Eucalyptus* spp. plantation of 5 000 ha for timber production. The nursery was planned to produce 700 000 seedlings per annum. The plan included the establishment of a clone bank for cutting material.

The project was closed down because of financial difficulties and shortage of qualified personnel. In October 1990 MKU enterprises were interested in taking over the project. That same year MKU established a small clone bank of 400 seedlings at Rundu sawmill for production of cuttings. The species in this plantation are *Eucalyptus camaldulensis* × *grandis* and *E. grandis* × *tereticornis*. 
**Forest ecology**

**Forest fires**

Fire is an important ecological factor in African woodlands and savannas. During the long annual dry season the vegetation dries and thus can easily catch fire from lightning. Most fires, however, are set by man. Burning is done primarily to stimulate the growth of grass and to rouse game for hunting.276

Geldenhuys (1977b) studied the effect of annual burning on two forest sites in Kavango. Five different treatments were used: annual burning at the end of the rainy season (two slightly different treatments), burning in the early dry season, burning in the late dry season, and complete protection. The experiment was established in 1959. Treatment did not have a significant effect on tree growth. Complete protection was significantly beneficial to the regeneration of fire-sensitive species, e.g. *Baikiaea plurijuga, Commiphora* spp., *Guibourtia coleosperma* and *Ochna pulchra*. In this study *Pterocarpus angolensis* proved to be fire-tolerant; regeneration was significantly better in dry-season treatments than in complete protection and rainy-season treatments.

In several species, fire induces basal shoots. According to Rutherford, *Combretum collinum* thickets were the result of fires, in particular, because several trees were connected to each other underground. Another long-term effect of fires was multi-stemmed individuals, e.g. in *Combretum psidioides, Terminalia sericea* and *Burkea africana*. The coppicing ability of *Burkea africana* after fire seemed inferior to that of many other species; the mortality of tall individuals was also high.277

Breitenbach emphasizes that the effects of fires should not be generalized. They vary according to vegetation, frequency and season. If the land use priority is timber production, fires are always unfavourable, whereas late fires could sometimes be justifiable for pasture improvement or even for soil conservation.278
Vegetation structure

Rutherford studied the vertical distribution of biomass in the most common trees. LAR (ratio of the leaf area to the total biomass), calculated from Rutherford’s data, was higher in small trees compared to larger ones (Table 12). The exception, however, was *Burkea africana*, in which LAR was quite high.\textsuperscript{279}

\textbf{Table 12.}
\textit{Physiognomic structure and production of seven tree species in the Otjiwarongo district}

\textit{Modified from Rutherford 1975, pp. 67, 87–93.}

<table>
<thead>
<tr>
<th></th>
<th>Ba</th>
<th>Ts</th>
<th>Sl</th>
<th>Ln</th>
<th>Cp</th>
<th>Cc</th>
<th>Op</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height, m</td>
<td>6.6</td>
<td>7.5</td>
<td>6.6</td>
<td>6.0</td>
<td>4.4</td>
<td>4.3</td>
<td>4.6</td>
</tr>
<tr>
<td>Maximum canopy diameter, m</td>
<td>6.3</td>
<td>5.9</td>
<td>3.9</td>
<td>2.4</td>
<td>3.8</td>
<td>1.3</td>
<td>2.7</td>
</tr>
<tr>
<td>Diameter at 1.0 m, cm</td>
<td>26.4</td>
<td>23.8</td>
<td>19.4</td>
<td>20.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diameter at 0.2 m, cm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13.0</td>
<td>9.2</td>
<td>14.4</td>
</tr>
<tr>
<td>Number of leaves</td>
<td>7 000</td>
<td>33 000</td>
<td>54 000</td>
<td>5 000</td>
<td>10 000</td>
<td>4 000</td>
<td>8 000</td>
</tr>
<tr>
<td>Biomass (oven-dry), wood, kg</td>
<td>243.5</td>
<td>170.2</td>
<td>71.9</td>
<td>43.6</td>
<td>36.6</td>
<td>13.6</td>
<td>33.6</td>
</tr>
<tr>
<td>Biomass (oven-dry), leaf, kg</td>
<td>10.7</td>
<td>3.2</td>
<td>2.0</td>
<td>1.6</td>
<td>2.5</td>
<td>0.8</td>
<td>1.3</td>
</tr>
<tr>
<td>Biomass, tn/ha</td>
<td>11.8</td>
<td>6.2</td>
<td>0.2</td>
<td>0.1</td>
<td>3.4</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Leaf surface area, m\textsuperscript{2}</td>
<td>87</td>
<td>16</td>
<td>9</td>
<td>14</td>
<td>15</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>LAR</td>
<td>0.3</td>
<td>0.1</td>
<td>0.1</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.3</td>
</tr>
</tbody>
</table>

\textbf{Ba} *Burkea africana*  
\textbf{Ts} *Terminalia sericea*  
\textbf{Sl} *Securidaca longepedunculata*  
\textbf{Ln} *Lonchocarpus nelsii*  
\textbf{Cp} *Combretum psidioides*  
\textbf{Cc} *Combretum collinum*  
\textbf{Op} *Ochna pulchra*

LAR Leaf Area Ratio
**Phenology**

Rutherford also studied phenology. All constituent tree species were in the adult green-leaf phase from November to May (7 months, e.g. *Terminalia sericea*) and most of the species until July (9 months, e.g. *Combretum psidioides* and *Burkea africana*). In the shrub group this period lasted from November to March (5 months) and in the grass groups and other herbaceous species from December to April (5 months). According to Rutherford, the duration of the adult green-leaf phase is affected by the present and previous season’s weather conditions, especially rainfall.  

*Terminalia sericea* trees shed their leaves in June and July, whereas *Combretum psidioides*, *Burkea africana* and some other tree species lost theirs in August. Tree species flowered in December–January and April–May. Initiation of the vegetative phase in the tree species corresponded to the rapid rise in mean monthly temperature – from about 16° C in August to 20.5°C in September.

**Biomass Utilization**

Namibia has about 8 million ha of grazing land that is affected by serious bush encroachment, mainly in the districts of Tsumeb, Grootfontein, Otjiwarongo, Okahandja and Omaruru. Bush encroachment has caused a 30–50 per cent reduction in the grazing potential.

To clear the bush using mechanical eradication or herbicides is out of the question because it is too costly. One possibility for tackling the problem is commercial utilization of the biomass.

In the 1980s the First National Development Corporation (FNDC), the Tsumeb Corporation Ltd (TCL) and the Council for Scientific and Industrial Research (CSIR) started to test existing bush harvesting methods and to develop new ones. These organizations also tried to develop commercial products from the harvested biomass. FNDC is a parastatal organization for business development. TCL is a mining company in Tsumeb, which is looking for alternative sources of energy for imported coal. CSIR is the major South African research institute.
In the mid-1980s CSIR tested the low-cost mobile drum chipper and made studies on gasification of whole tree chips from invader bush (Hose 1984; 1985a,b,c) as well as on the market potential for wood chips (Hose 1987). Studies were also made on the utilization of invader bush in the wood industry. *Acacia mellifera* subsp. *detinens* (black thorn, swarthaak) and *Dichrostachys cinerea* subsp. *africana* (sickle bush) were shown to produce suitable raw material for manufacturing chipboard and wood-cement bricks (Sorfa and Bongers 1987). Wood-cement panels produced from sickle bush were as good as those made from pine, while black thorn panels were unacceptably weak. The pulp of sickle bush and puzzle bush (*Ehretia rigida*) was not suitable for high quality paper (Becker 1990).

The first attempt to establish a wood industry based on shrub wood biomass was the Tsumeb Bush Project, which was started in 1987. The First National Development Corporation (FNDC) was responsible for project management and coordination. The Tsumeb Corporation Ltd (TCL) provided the experimental base and engineering services. Work on technical development was the responsibility of the Council for Scientific and Industrial Research (CSIR).

*Biomass harvesting for charcoal production at a farm near Gobabis.*
The major component in the project was biomass production for energy. During the two first years the project produced for TCL about 1 300 tn of wood chips per month; later, wood chip production was changed to wood briquette production. The total biomass production from the area of 11 000 ha was 34 200 tn or 3.1 tn/ha. The preliminary results of the project have been very promising.283

**Biomass Assessments**

There has been no national assessment of woody biomass in Namibia. Nor have the tentative forest inventories conducted in the northern part of Namibia attempted to estimate the total biomass.

**Rutherford 1975**

One exception to the above findings is Rutherford, who studied carefully the woody biomass in 13 ha of woodland near Otjiwarongo. The average oven-dry biomass above the ground was 23 tn/ha, of which 4 per cent was in the herbaceous layer and 96 per cent in the tree layer. The biomass of tree leaves and the biomass of the herbaceous layer were more or less the same.284

<table>
<thead>
<tr>
<th>Table 13. Relationship between diameter (D) and oven-dry biomass (W) of four tree species in the Otjiwarongo district</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Burkea africana</strong> (diameter 1.0 m above ground)</td>
</tr>
<tr>
<td><strong>W</strong> = 0.01146 * D^2.09614</td>
</tr>
<tr>
<td><strong>D</strong>: 5.0–22.7 cm</td>
</tr>
<tr>
<td><strong>D</strong>: 22.7–35.0 cm</td>
</tr>
<tr>
<td><strong>Terminalia sericea</strong> (diameter 1.0 m above ground)</td>
</tr>
<tr>
<td><strong>W</strong> = -1.25860 + 0.51309 * D + 0.29737 * D^2</td>
</tr>
<tr>
<td><strong>D</strong>: 1.0–26.0 cm</td>
</tr>
<tr>
<td><strong>Combretum psidioides</strong> (diameter 20 cm above ground)</td>
</tr>
<tr>
<td><strong>W</strong> = 0.03701 * D^2.48634</td>
</tr>
<tr>
<td><strong>D</strong>: 1.0–9.3 cm</td>
</tr>
<tr>
<td><strong>D</strong>: 9.3–25.0 cm</td>
</tr>
<tr>
<td><strong>Ochna pulchra</strong> (diameter 20 cm above ground)</td>
</tr>
<tr>
<td><strong>W</strong> = 0.01250 * D^2.88710</td>
</tr>
<tr>
<td><strong>D</strong>: 1.0–5.5 cm</td>
</tr>
<tr>
<td><strong>D</strong>: 5.6–15.0 cm</td>
</tr>
</tbody>
</table>

The biomass estimations of the dominant tree species were based on species-specific regression equations (Table 13 page 142). Two different diameters were used: one metre above ground for *Burkea africana* and *Terminalia sericea*, and 20 cm above ground for *Combretum psidioides* and *Ochna pulchra*. It would be useful to compare the regression equations to those done for Botswanan woodlands.285

**The World Bank 1991**

The World Bank is funding a biomass assessment project, which covers all of Africa south of the Sahara.286 The analysis is based on AVHRR data acquired by NOAA satellite in 1986. In Namibia, according to preliminary estimations, the standing stock of woody biomass is estimated to be 670 million tons and the mean annual increment 34 million tons.

<table>
<thead>
<tr>
<th>Biomass classes</th>
<th>Area, %</th>
<th>Growingstock total 10^6 tn</th>
<th>Growingstock per ha tn</th>
<th>MAI per ha tn</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Desert</td>
<td>27.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>11 Veld grassland</td>
<td>1.9</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>24 Transitional wooded grassland</td>
<td>19.7</td>
<td>34 2</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>33 Bushy shrubland</td>
<td>0.9</td>
<td>4 6</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>34 Kalahari shrubland</td>
<td>7.8</td>
<td>39 6</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>35 Woody shrubland</td>
<td>6.2</td>
<td>30 6</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>41 Dry <em>Acacia–Commiphora</em> bushland and thicket</td>
<td>0.3</td>
<td>3 12</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>42 Fynbos thicket</td>
<td>0.3</td>
<td>3 14</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>43 Moist <em>Acacia–Commiphora</em> bushland and thicket</td>
<td>1.7</td>
<td>31 22</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>51 <em>Acacia</em> woodland mosaic</td>
<td>20.4</td>
<td>311 19</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>61 Open woodland</td>
<td>12.2</td>
<td>149 15</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>66 Seasonal miombo</td>
<td>0.2</td>
<td>4 27</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>72 Cultivation and forest/woodland mosaic</td>
<td>1.2</td>
<td>64 65</td>
<td>0.7</td>
<td></td>
</tr>
</tbody>
</table>

| Total/Mean                          | 100.0  | 672 8                      | 0.4                     |               |

*MAI (Mean Annual Increment)*

Table 14. Woody biomass resources in Namibia, preliminary estimates

Source: ETC(UK) 1990.
University of Joensuu 1991

The present study included a preliminary satellite image analysis of the eastern part of Ovambo. The Landsat-5 MSS image of 7th September 1989 (Fig. 29 page 146) was corrected geometrically according to the topographic map (1:250 000, Eenhana, 1975), and the pixel size was reduced to 60 m x 60 m. Roads and trails were digitized from the topographic map.

The geometrically corrected image was classified according to band values into 23 different homogenous groups or clusters (including one cluster for unclassified pixels). The image was printed on a scale of 1:127 000 as a false colour composite. This printout and the topographic map were used during the two-day field survey in October 1990. Several clusters were located and the vegetation was identified.

According to the field observations, clusters were amalgamated into six biomass classes (Fig. 30 page 147). The area studied covers 1 455 000 ha covering the area from 15°45'E to 17°20'E and from 17°25'S to 18°00'S.
Eucalyptus spp. plantation in Onankali, Owambo.

Manketti trees (Ricinodendron rautanenii) have been cut for cultivation near Nkurenkuru, Kavango.
Fig. 29. Landsat MSS image, eastern Owambo, 7th September 1989

Fig. 30. Preliminary biomass classes for eastern Owambo

**Class 5:** Height of the dominant trees: 14 m. Dominant tree species: *Baikiaea plurijuga, Pterocarpus angolensis, Combretum* spp., *Burkea africana, Lonchocarpus nelsii.*

**Class 4:** H: 12–14 m. *P. angolensis, B. africana, B. plurijuga, Combretum* spp., *Terminalia sericea.*

**Class 3:** H: 8–11 m. *B. africana, Colophospermum mopane, Acacia erioloba.*

**Class 2:** H: 4–7 m. *B. plurijuga, A. erioloba, Bauhinia petersiana, Combretum* spp., *T. sericea.*

**Class 1:** Small, scattered shrubs, *Acacia* spp.

**Class 0:** Mixture of fields, water pans, grazing and 1-2 m high shrubland.
Mopane (*Colophospermum mopane*) has good coppicing vigour; Okankolo area, Owambo.

Mopane (*Colophospermum mopane*) sprouts in Ombalantu, Owambo.
12. Forest products used by the African population

For the African population, Namibian forests and trees have for centuries provided building material, fuelwood, food, medicines, cosmetics and shelter. In addition to this, many tree species have had cultural importance, e.g. the *Omumborombonga* tree (see page 78).

The material culture in the most northern part of Namibia has in many ways been affected through acculturation. Contact with Europeans has been longstanding, and since the 1850s the communities in this part of the country have been under the continuous cultural and material influence of Europeans. Changes are especially marked with regard to dress, household utensils, implements and weapons.

European settlers valued forests and trees as an economic asset. In addition to fencing poles, fuelwood and mine props, it was hoped that indigenous trees would also produce commercially important non-timber forest products, e.g. nuts, rubber and fibres. However, only nara (*Acanthosicyos horridus*) was utilized commercially.

Nara is a cucurbit plant endemic to the Namib Desert where it has for several centuries been an essential source of food and water, especially for the local Khoisan communities. It grows on sandy places where the roots can reach the groundwater. The exportation of nara seeds to Cape Town began in 1877.\(^{287}\) They were used in confectionery as a substitute for almonds. Over-exploitation – the exportation of seeds was up to 1000 kg/a – prevented natural regeneration, and in the 1920s the export of seeds ceased.\(^{288}\)

Today the European population relies mainly on imported timber and forest industry products, but the African population still has to rely on the indigenous forest resources. Below is discussed the role of woody vegetation for the local population in the most northern part of Namibia, especially in Ovambo.
BUILDING POLES

Owambo homestead – egumbo

In rural areas only minor changes in building structure have occurred during the twentieth century. The nucleus of the homestead is an economic centre, which is surrounded by a palisade wall. The size and number of huts indicate the wealth of the homestead. At the end of the nineteenth century ten or more huts was a sign of a wealthy homestead. 289

Wood has been the most important building material for the Owambo people. The impressive and characteristic building in which wood is the main raw material is the homestead composed of huts, elaborate stockades and palisade passages.

The palisades are designed not only to separate huts from the surrounding environment; but they also serve as enclosures utilized for a variety of purposes such as meeting places, working space and family gatherings, and are therefore in fact living quarters. Although these enclosures are not provided with a roof, the routine of daily life is enacted within the privacy of these palisades, which to the Owambo constitute their home. Huts are used mainly as sleeping quarters or for storage.

A household is transferred to a new site in Owambo.
In building these stockades and palisades, shallow furrows are dug and the poles are rested in the furrows. Only hardwoods resistant to termites are used. The most popular tree species utilized in construction has been *Colophospermum mopane* (mopane). The bark is removed, and very often the upper ends of the poles are tapered.

The need for building poles has been great because of population growth and partly due to shifting cultivation and patterns of settlement. Formerly, the same fields were cultivated four to five years. After that, the household’s dwelling was transferred to the middle of freshly recuperated fields. This practice has increased considerably the consumption of building poles. In spite of the durability of the mopane against termites, most of the poles have had to be replaced.  

---

**Fig. 31. Traditional Owambo homestead**

*Cartogram of a Kwanyama homestead built for the 1935 exhibition in Windhoek*

Source: Loeb 1951, p. 290.
**Historical outlook**

Among the first Europeans to pay attention to the Owambo building habits was the explorer Hans Schinz, who visited northern Namibia and southern Angola in 1885–86. Schinz estimated that to build an average homestead at least 600 poles were needed. This meant cutting at least 200–300 trees if two to three poles could be obtained from one tree.  

The observations of a German, Johannes Paul, from the late 1920s confirmed Schinz’s earlier estimate of the consumption of poles in building. According to Paul’s estimate, the length of the palisade wall of an average homestead in northern Owambo was about 100 metres, but at the homesteads of the community’s elite, the length was 300 metres or even more. The height of the wall varied from 2.5 to 3 metres and the diameter of poles was 10–15 cm. This meant that to build a homestead, over 300 trees had to be cut.  

It is very probable that the inside corridors of the homestead were not taken into account in these estimates, which probably led to underestimation of the total consumption of poles. 

Since the First World War, shortage of building poles has been a reality in the most densely populated areas of southern Owambo. Poor families have replaced building poles with branches and even with millet stalks. In a few cases the use of palm leaves has even been found. Changes in the material used for the palisade wall is one of the best indicators of deforestation in Owambo.

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*The residence of King Ueyulu of Uukwanyama in Owambo at the beginning of the twentieth century. (From: Leutwein 1906, p. 197)*
In its 1962 report the Odendaal Commission appointed by the South African government focused attention on the Owambo building structures, but nothing was done to conserve Owambo’s forest resources. Rodin and Jensen demonstrate clearly that changes in local building structures have remained minimal. In some places clay or cement bricks have replaced poles, but most of the huts are still constructed of traditional materials.

An example

To estimate more accurately the amount of wood used for building an average homestead, one farm in Owambo near Oshigambo was visited and measured in October 1990.

The head of the farm is Mr. Lazarus Uugwanga. At the time of the visit, ten family members were living at the farm, which included the main homestead, a smaller homestead for the grandmother, a pen for animals and a milling floor. The main crop cultivated was mahangu (pearl millet). During the visit no domestic animals were seen; most of the cattle were said to be held at a cattle post near Etosha.

The size of the farm was about 9 ha, of which about 4 ha were under cultivation. The borders of the farm were fenced, as well as about 3 ha of uncultivated land. The tree species found on the uncultivated land were: Acacia sp., Berchemia discolor (bird plum, brown ivory), Colophospermum mopane (mopane), Diospyros mespiliformis (African ebony), Ficus sycomorus (cluster fig), Hyphaene petersiana (real fan palm) and Ziziphus mucronata (buffalo-thorn).

The main homestead covered about 1,900 m² and consisted of a 2 m high outside palisade with its inside corridors. Inside the palisade there were one rather large main building, 15 smaller huts, a storage area for grain and several outdoor living and cooking areas.

The main building was constructed of bricks, sawn roof beams, manufactured windows and doors, and a tin roof. This building consisted of a kitchen and 4 living rooms. The size of the huts was about 8 m². Two of them had wooden walls and the other 13 huts were made of clay bricks. One of the small huts had a tin roof; on the others the roof was made of grass, small poles and branches. The grain storage area consisted of 8 large baskets.
The total length of the palisade (outside wall and inside corridors) in the main homestead was 302 metres (Table 15). The palisade was built of 7,700 poles, with a density of 26 poles/metre. The average diameter of the poles, measured at the middle, was 6 cm. The species used for the palisade were mainly *Colophospermum mopane* and *Combretum* sp.

The field fences were constructed of poles 1.8 metres in height and 12 cm in diameter, which were dug into the soil every three metres. Between these large poles, about 20 small sticks were hanging from four wires. The length of the field fences was 1.5 km. The total number of large poles was about 500 and of small sticks, 9,000.

The amount of wood in the constructions was estimated to be 70 m³ (50 tn oven-dry wood): palisades 43 m³, huts 8 m³, fences and other constructions 19 m³. These figures do not include the wood used for the main building. The timber for this building, may, however, have originated from Owambo woodlands. Thus, the removal of wood was certainly much more than 100 m³. If woody constructions last 6 years, the removal of wood from indigenous woodland for construction will be at least 15 m³/a or 1.5 m³/capita/a.

The size of the poles used for the palisade in the homestead of Mr. Lazarus Uugwanga was rather small compared to many other Owambo homesteads. For the sake of comparison, another homestead under construction was measured in Oniipa (Table 16 page 156). The length of the palisade wall was assumed to be the same as the homestead of Mr. Uugwanga. This might, however, be a rough underestimation. Even so, the consumption of wood for a palisade wall in Oniipa will be twice as high as in Oshigambo. The difference increases if we take into count the larger amount of waste in debarking, hewing and cutting of large poles. The amount of waste wood left is also much greater in Oniipa, because only top quality mopane poles were used.

These two examples show how different the wood consumption pattern can be. The wood cut from natural woodland is still cheap compared to bricks. In Owambo there are no signs of giving up the custom of building palisades. The deforestation process in the eastern part of Owambo can be seen clearly *in situ* as well as from the most recent satellite images (see Fig. 35 page 178).
<table>
<thead>
<tr>
<th></th>
<th>H (m)</th>
<th>D (cm)</th>
<th>Length (m)</th>
<th>Poles (pieces)</th>
<th>Volume (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main homestead</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palisade:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inside corridors</td>
<td>2</td>
<td>6.1</td>
<td>148.5</td>
<td>3,425</td>
<td>19.9</td>
</tr>
<tr>
<td>outside wall</td>
<td>2</td>
<td>4.9</td>
<td>153.2</td>
<td>4,290</td>
<td>16.3</td>
</tr>
<tr>
<td>Two huts:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walls</td>
<td>1.5</td>
<td>10</td>
<td>18</td>
<td>330</td>
<td>3.9</td>
</tr>
<tr>
<td>Roofing</td>
<td>1.8</td>
<td>4</td>
<td>20</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Thirteen huts:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roofing</td>
<td>1.8</td>
<td>4</td>
<td>130</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td><strong>Grandmother's homestead</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palisade</td>
<td>1.8</td>
<td>6</td>
<td>70</td>
<td>1,365</td>
<td>6.9</td>
</tr>
<tr>
<td>Four huts</td>
<td>1.3</td>
<td>8</td>
<td>32</td>
<td>480</td>
<td>3.1</td>
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<tr>
<td>Roofing</td>
<td>1.6</td>
<td>4</td>
<td>40</td>
<td>0.1</td>
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<tr>
<td><strong>Pen</strong></td>
<td>1.5</td>
<td>4.5</td>
<td>57</td>
<td>1,710</td>
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</tr>
<tr>
<td><strong>Fencing around fields</strong></td>
<td></td>
<td></td>
<td></td>
<td>1,464</td>
<td></td>
</tr>
<tr>
<td>big poles</td>
<td>1.8</td>
<td>11.8</td>
<td>488</td>
<td>9.6</td>
<td></td>
</tr>
<tr>
<td>small poles</td>
<td>1.1</td>
<td>2</td>
<td>9321</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td><strong>Other constructions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>21,599</td>
<td></td>
<td></td>
<td>69.5</td>
<td></td>
</tr>
<tr>
<td>+ debarking and hewing 20 %</td>
<td></td>
<td></td>
<td></td>
<td>13.9</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td></td>
<td>83.4</td>
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</tr>
<tr>
<td>+ waste wood left in the forest 10 %</td>
<td></td>
<td></td>
<td></td>
<td>8.3</td>
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<tr>
<td><strong>TOTAL REMOVAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>91.7</td>
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</table>
### Table 16.
**Rough estimate of the amount of wood used for homestead constructions in Oniipa**

<table>
<thead>
<tr>
<th>Colophospermum mopane:</th>
<th>H m</th>
<th>D cm</th>
<th>Length m</th>
<th>Poles pieces</th>
<th>Volume m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palisade:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inside corridors</td>
<td>3</td>
<td>9</td>
<td>150</td>
<td>1 800</td>
<td>35</td>
</tr>
<tr>
<td>outside wall</td>
<td>3</td>
<td>9</td>
<td>150</td>
<td>1 800</td>
<td>35</td>
</tr>
<tr>
<td>Small hut (1):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walls</td>
<td>1.8</td>
<td>9</td>
<td>10</td>
<td>120</td>
<td>1</td>
</tr>
<tr>
<td>Large huts (14):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walls</td>
<td>2</td>
<td>9</td>
<td>200</td>
<td>2 400</td>
<td>30</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>101</td>
</tr>
<tr>
<td>+ debarking and hewing 30 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6 120</td>
</tr>
<tr>
<td>+ waste wood left in the forest 30%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>131</td>
</tr>
<tr>
<td><strong>TOTAL REMOVAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>170</td>
</tr>
</tbody>
</table>

| Treated pine:         |     |      |          |              |           |
| Roofing               | 3   | 8    | 135      | 2            |           |

**FUELWOOD**

No marked changes have occurred in the priority of different energy sources in Owanbo. Fuelwood is the most important source of energy for cooking, lighting and heating. According to the recent UNICEF survey, 95 per cent of the households in Owanbo had no electricity and 85 per cent used wood for cooking.296

The most marked long-term change in the energy supply scheme has been the increase in the hauling distance of fuelwood. At the beginning of this century fuelwood was fetched mainly from the adjacent forested areas lying between population clusters or communities,297 but today these forested areas have almost totally disappeared from densely populated central Owanbo.
Woody fibres (e.g. *Colophospermum mopane*) are needed for large granary baskets in Owambo.

Wooden pestles (*Colophospermum mopane*) sold at the Ondongwa market in Owambo.
The fruit of the marula (*Sclerocarya birrea* subsp. *caffra*) is highly valued in northern Namibia.

Monkey orange (*Strychnos* spp.) has a delicious fruit; Kavango.
Nara (*Acanthosicyos horridus*), a cucurbit plant endemic to the Namib Desert, is an important source of food and water.

The fruit of the manketti tree (*Ricinodendron rautanenii*) has for several centuries been an essential source of food in northern Namibia.
Wood carvings are an important source of income in Kavango; the most important tree species used for this purpose is wild teak (*Pterocarpus angolensis*).

Wood briquettes have potential as a commercial product; Tsumeb Bush Project.
A considerable amount of fuelwood in Owambo is brought from forests and woodlands located outside the settled areas. According to Jensen’s enquiry, the average hauling distance is 33 km and the wood is transported in pickup vans. The lengthening of the hauling distance has meant that the responsibility for the energy supply has been transferred from women to men. Deforestation has also generated the creation of fuelwood markets in the most densely populated areas.

As in building, *Colophospermum mopane* is also the most popular fuelwood. When the prospects for energy supply in the most northern part of Namibia are considered, there is no indication that fuelwood will be replaced by any other source of energy in the near future.
OTHER FOREST PRODUCTS

The African people have learned to utilize various wild plants. The San people, who are said to know as many as 150 edible plants, have the best reputation as plant ecologists. Below are mentioned briefly a few important woody species and their uses. The examples are from northern Namibia, especially Owanbo. 299

According to Jensen’s survey, the most important fruit trees in Owanbo are: omugongo or marula (Sclerocarya birrea subsp. caffra), omuye or bird plum (Berchemia discolor), omwandi or African ebony (Diospyros mespiliformis) and omulunga or fan palm (Hyphaene petersiana). These indigenous species are commonly protected and sometimes are even planted in the fields. In addition, many farmers grow introduced fruit trees, especially guavas and oranges. 300

Wine and brandy are made from various wild fruits. The most popular wine is made of marula. Palm wine was formerly made by cutting the terminal bud of the fan palm. However, since excision of the bud kills these valuable trees, this practice has long been forbidden. 301

Ricinodendron rautanenii (mongongo, manketti tree) was named by the Swiss botanist Schinz after the Finnish missionary Martti Rautanen. Manketti is a large tree 7–20 m in height growing on Kalahari sand in the northern part of Namibia and often forming pure stands, especially on dunes. The pulp of the plum-shaped fruit is eaten raw or cooked. The kernels or nuts of the seeds are the most valuable part of the fruit. The protein content of the nuts is nearly 30 per cent and the yield of high quality yellow oil is about 60 per cent. The nuts are eaten raw, cooked or dried. 302

According to Lee, in 1963–1965 the diet of the San community living in the Dobe area in Botswana near the Namibian border was still based more on manketti nuts than on cultivated foods. When a San was asked why he had not taken to agriculture, the reply was: Why should we plant, when there are so many mongongo nuts in the world? 303

Baskets of various types are used in the daily routine in the northern part of Namibia. Basketry is predominantly the profession of women, but men also participate, especially in the making of cereal containers, fishing baskets and tunnel nets. The most common material used in baskets is young leaves of fan palm, which are first dried and then split into narrow strips. 304
Owambo brandy is usually made from Berchemia discolor (bird plum) or Hyphaene petersiana (real fan palm).
Various wooden containers, cups and buckets are made from the fairly soft woods of *Albizia anthelmintica*, *Berchemia discolor*, *Commiphora africana*, *C. angolensis*, *Peltophorium africanum*, and *Ricinodendron rautanenii*. 305

Wooden mortars and pestles are used to grind millet and sorghum and sometimes also to pulverize dry leaves of several species for body powders used to reduce body odours and provide a pleasant scent. The main reason for using wooden mortars and pestles is the lack of stones. The mortar or base is usually made from the heartwood of *Burkea africana* and sometimes from *Combretum imberbe* or *Pterocarpus angolensis*. The pestle is obtained from the heartwood of *Colophospermum mopane*. 306

Wooden spoons and ladles of a very simple design are used in stirring porridge and cooking vegetables. Because all food is eaten with the fingers, there has been little development of eating utensils such as spoons and forks. 307

Cylindrical snuff boxes are carved from *Berchemia discolor*, *Diospyros mespiliformis* or *Ochna pulchra*. Drums, the universal musical instrument throughout southern Africa, are usually made of hardwoods such as *Pterocarpus angolensis* or *Sclerocarya birrea* subsp. *caffra*. 308

Dugout canoes (*mikolos*) are used commonly along the rivers and flooded areas in East Caprivi and Kavango. According to one survey, about 75 per cent of all *mikolos* were produced from *Baikiaea plurijuga*, *Guibourtia coleosperma* and *Pterocarpus angolensis*. The main area for production of *mikolos* in East Caprivi is in the northwest. 309

Of all the weapons used earlier, both for war and for hunting, bows and arrows were the most important. The bows used by very young boys were usually made from small branches of *Terminalia prunioides* or *Ricinodendron rautanenii*. The bows used by the men were made from stems of *Acacia mellifera*, *A. ataxacantha* or *Dicrostachys cinerea* subsp. *africana*. Arrow shafts were made from the thin straight stems of many different species of shrubs. The knobby kerrie was a weapon carried into battle, where it was used for clubbing and throwing, but now it only serves for hunting small animals such as hares. The hardwoods used for knobby kerries include *Acacia erioloba*, *Colophospermum mopane*, *Croton gratissimus*, *Euclea divinorum* and *Terminalia prunioides*. 310
The traditional forms of transportation in Kavango.
13. Trends in the vegetation

Succession

Natural progression from one kind of vegetation community to another is called succession. Vegetation develops towards a final stage of succession, i.e. climax, if it is not disturbed. Climax vegetation remains stable in unchanged conditions.

Breitenbach (1968), who studied this regular sequence of changes in woody vegetation in East Caprivi, showed that communities of woody vegetation rarely developed towards their climax stage. The major disturbing factors were human activities in the form of fires and shifting cultivation. During his study, which was made in the 1960s, animals did not significantly disturb the natural dynamics of woody communities.

Baikiaea plurijuga

According to Breitenbach, the climax Baikiaea plurijuga forests in northwestern East Caprivi have been largely converted into pioneering and secondary development types, mainly because of destructive fires. In eroded depressions, the seasonal rise of water has caused B. plurijuga to be replaced by water-tolerant species. 311

The natural regeneration of Baikiaea plurijuga requires very favourable conditions. Because this species is light-demanding, it cannot grow in the shade of other trees. In openings, however, incessant fires often destroy the seedlings or frequently rejuvenate them for a long period. Meanwhile, more fire-resistant species emerge and form so-called mutemwa thickets, rarely allowing B. plurijuga to come up. In the absence of fires, the wide-spaced and tall Pterocarpus angolensis trees offer ideal conditions for the regeneration of B. plurijuga. 312

Baikiaea plurijuga, one of the most important commercial tree species in southern Africa, today faces serious dangers. Extensive felling, shifting cultivation and fire could turn the forest into less valuable thickets and cause serious soil erosion.
**Pterocarpus angolensis**

*Pterocarpus angolensis* is a leguminous tree, which grows on Kalahari sand in northern Namibia. The mature tree is usually 10–12 m high, forming a fairly straight stem. One-seeded, circular, winged fruits with their bristly centres can easily be distinguished. The timber is very handsome, extremely durable and has good working qualities. This species has been introduced and maintained as a direct result of cultivation and fire. \(^{313}\)

Reproduction by fruiting increases with the degree of openness of the stand. The seeds, which are very resistant to fire and termites, are released from the fruits in the later part of the first rainy season. After germination, the seedling rapidly develops a 0.5–1 m long carrot-like tap-root and several shoots. The 1–2 m tall shoots produced during the growing season will die back during the following dry season, and this cycle is repeated for several years. This period (seedling stage) lasts until the root system has become large and dense enough to support a permanent shoot capable of surviving over the dry season. When the plant has reached the sapling stage, it is strong enough to withstand drought and fire. In the sapling stage *Pterocarpus angolensis* is more fire resistant than many other species, e.g. compared to *Baikiaea plurijuga*.

Although *Pterocarpus angolensis* is not as sensitive to fire as *Baikiaea plurijuga*, periodic fires are killing off the over-mature trees and inhibiting regeneration. \(^{314}\) Gradually this could lead to the deterioration and exhaustion of the economically valuable stands.

Moderate fires could improve the regeneration of *Pterocarpus angolensis*. According to Geldenhuys, this might already have happened in some areas of Kavango where he found high stem density of the smaller diameter classes. In contrast, *Baikiaea plurijuga* had a relatively high stem density in the larger diameter classes and shortage of the smaller classes, which is an indicator of high sensitivity to fire. \(^{315}\)

The total absence of fire could, however, cause retention of several stems, reduced annual shoot growth or die-back at the end of the growing season. In extreme cases the exclusion of fire could promote development of whorls of twigs at the shoot-ends, so-called bird’s nests. \(^{316}\)
Colophospermum mopane

A dense Colophospermum mopane forest usually has a very sparse grass cover and therefore little burnable material. This favours the successful regeneration of the species. If the canopy is opened up and coarse grasses invade, however, the fire hazard is greatly increased. Although ground fires are not so wild, the highly resinous leaves and branches of C. mopane allow severe crown fires. If the tree is badly damaged, it may still regenerate from suckers.

BUSH ENCROACHMENT

Bush encroachment is an imbalance in the vegetation between extensive and deep rooting woody vegetation and shallow rooting grasses. In most cases it is caused by overgrazing. Overgrazing allows more water to penetrate deep into the soil, thus favouring the woody species. Cattle also eat the pods of thorny acacias eagerly, and seeds passed through the gastro-intestinal tract germinate easily. If overgrazing is repeated for several years, the result could be a dense thorn thicket, or depending on ecological conditions and other human activities, even a man-made desert.

Historical outlook

Marsh explained the bush encroachment near Tsumeb partly as the consequence of overcutting for mine props. The removal of trees had reduced the moisture content of soil and thus hindered the regeneration of tamboti (Spirostachys africana). As a result, more drought-tolerant invader species, such as Acacia mellifera subsp. detinens (black thorn), Combretum apiculatum var. leutweinii (hairy red bushwillow) and Dichrostachys cinerea subsp. africana (sickle bush or Kalahari Christmas tree) had become dominant. The cut tamboti trees produced waist-high thickets of stump shoots and root suckers. Grass production was thus reduced by extensive shading and root competition. The bush encroachment was aggravated by overgrazing and broadcast burning. The problem of bush encroachment was recognized already in the 1920s. Keet had seen large burnt areas in the districts of
Gobabis, Otjiwarongo and Grootfontein reverting to desert grass with short bush. He emphasized that, contrary to the Lowveld trees of the Transvaal in South Africa, dominant tree species such as *Acacia erioloba* and *Terminalia sericea* do not withstand fires.  

Twenty years later bush encroachment had become a serious problem in central Namibia. The South African forestry experts Keet (1947) and Marsh (1954) tried to call the attention of the authorities to the matter. The long drought and the outbreak of foot and mouth disease in the 1960s led to serious overstocking and worsened the situation by leaving the ground bare for encroaching bush species.

### Bush encroachment today

Bush encroachment is more common in areas with low annual rainfall (600 mm or less), which thus have a low carrying capacity. In Namibia this has become a serious problem in the cattle farming areas, mainly in the districts of Tsumeb, Grootfontein, Otjiwarongo, Okahandja and Omaruru. The affected area is 8–10 million ha. It has been estimated that due to bush encroachment the agricultural sector loses an income of R100 million annually.

The cost of bush clearing has been too high to encourage farmers to recondition pasture land and increase the grazing capacity. The Tsumeb Biomass Project has attempted to find solutions to this problem (see page 141).

The bush encroachment area can be divided into two main regions and five subregions according to the vegetation and climate (Fig. 32). The southern region occupies 5.5 million hectares and the northern one 2.5 million hectares. The total biomass of shrubs and trees has been estimated to be 100 million tons. The average tree was defined as three metres in height with a stem diameter of less than 15 cm and oven-dry weight of about 150 kg.

According to very rough estimations made by Lubbe and Slater, the woody biomass in the southern region is 10 tons per hectare and the average stocking 70 stems per hectare. Shrubs under two metres in height were left out of these calculations. In the northern region woody biomass was estimated to be 17.6 tons per hectare and average stocking 6,800 stems per hectare, of which 60 per cent were shrubs shorter than two metres.
Overgrazing also influences species composition and can change the community structure. It should be kept in mind that there is a significant difference between the grazing of domestic livestock and that of the indigenous game animals. Domestic animals are more selective in their grazing habits than wildlife are. Therefore it is recommended that the browsing of the indigenous game (e.g. giraffe) be favoured in order to make better use of the vegetation and thus avoid bush encroachment.  

When clearing the bush, one should remember not to destroy protected species. Some species, e.g. fruit trees, could even have an important economic value. Research on environmental impact should precede large-scale cutting operations. For example, in order to optimize the long-term grazing capacity, it is essential to know how many trees should be left per hectare.
DEFORESTATION AND DESTRUCTION OF WOODY VEGETATION

The destruction of the woody vegetation in Namibia was first recorded from the area around Walvis Bay. Along the Swakop and other rivers, the uncontrolled felling of trees started already before the German colonial period and continued until the supplies were exhausted. The harsh environment did not allow the vegetation to recover. 328

The first European settlers and explorers cut trees and shrubs all over the area where they camped and settled. Wood was needed for fuel and for construction. They even had to clear the woody vegetation out of the way for their wagons. For example, in the late 1850s the Swedish explorer Andersson estimated that about 800 trees were felled for this purpose during his expedition from Walvis Bay to Kavango. 329

In the 1890s environmental degradation in the surroundings of European settlements started to arouse the attention of the German colonial authorities, who tried to regulate the cutting of trees through legislation. The first forest law, which was enacted in 1894 restricted the cutting of trees in the district of Windhoek, and the ordinance of 1900 limited cutting in the whole Police Zone. 330 Governor Leutwein was also worried about the destruction of wood resources around European settlements. 331

Rehoboth – increased land settlement

Camel thorn (Acacia erioloba) provided the main supply of fuel and fencing posts in the Police Zone during the first decades of the twentieth century. The most important camel thorn resource in the country was in Rehoboth district, south of Windhoek. Unfortunately, the forest legislation of 1925 was open to various interpretations and was not applied to tree felling in the Rehoboth district.

In 1946, according to Keet, large supplies of Acacia erioloba were still available in many locations; but at Rehoboth and further south, for instance, overcutting combined with overgrazing had caused soil erosion. 332
Tsumeb and Grootfontein – mining

Another important tree species for the European population was tamboti (*Spirostachys africana*), which was mostly exploited by the mining companies in the districts of Tsumeb and Grootfontein.

As the mines were dug deeper, the demand for props increased accordingly; e.g. at Tsumeb in the mid-1920s the consumption of tamboti trees was about 2,700 m³ and thirty years later 13,000 m³ per annum. Overcutting, grazing and broadcast burning converted the former valuable tamboti woodland to shrubland. It is estimated that today invader shrub species cause a serious problem on an area covering about 10 million hectares in central Namibia (see pages 169–171).

“Native Reserves” – increased population pressure

Deforestation and destruction of woody vegetation was not unfamiliar in the areas allotted to the African population. Keet reported in 1946 that the Ankeigas Native Reserve near Windhoek had been entirely denuded, the soil severely eroded and only cattle dung used for fuel.

Before the colonization of Namibia, the African population lived and moved rather freely over quite a large area. Gradually the local inhabitants were pushed by the Europeans to marginal areas, and they were forced to stay in the regions allotted to them.

Despite the dramatic decrease in the African population due to the uprising of 1904–1907, population density and land pressure increased in the so-called native reserves.

As the years went by, the situation worsened. In 1990 about half of the Namibian population lived in Owambo, which makes up only 6 per cent of the land surface. The population density in Owambo is 11.5 inhabitants/km², whereas the average for the country as a whole is 1.5 km². In the most populated parts of Owambo the population density has increased to 100/km².
Owambo – deforestation of mopane forest

Deforestation is complete clearing of trees from the land and replacing them with other land uses, e.g. arable land. Overgrazing, selective logging and repeated fires may, but do not absolutely necessarily, result in deforestation.

In the 1850s the Owambo population in the Cuvelai floodplain (including the Angolan side) was probably 100,000. The area was divided into several communities governed by hereditary rulers, i.e. kings. The size of the communities varied, but the largest had approximately 10,000–15,000 members. The area within the community was cleared for fields. Fuelwood was collected mainly from the surrounding shrubland zone, which was 8 to 10 km wide; and building poles were taken from the mopane forest lying behind the shrubland.336

The communities were clearly separated from one another by forested areas. For example, the missionary Hugo Hahn reported in 1866 that between the communities of Ondonga and Uukwanyama existed a forest area about 60 km wide (Fig. 33). Half a century later the width of the forest area was only 40 km.337 The Finnish missionary Olle Eriksson (interviewed in a sauna in Onipia in 1990) recalled that in the 1950s the wooded area was still about 10 km wide. Today there is no forest left between Ondonga and Uukwanyama.

There are also similar descriptions from other parts of Owambo. At the end of the 1920s the Ondonga community had reached the Ombuga Grassland in the south.338

The first European to pay attention to deforestation was the botanist Hans Schinz, who visited Owambo in 1885–86 and warned that deforestation would be a problem in Owambo in 50 years if population growth continued to follow the same trend and the patterns of wood consumption remained unchanged.339

Schinz’s prediction came true in the beginning of the twentieth century. The Finnish missionary Martti Rautanen wrote in 1907 that, because of deforestation, households in the southern parts of Owambo were compelled to use millet stalks as a substitute for poles in building.340

The mandate administration also became concerned about deforestation in the beginning of the 1930s as the following words in a letter of the Officer in Charge Oshikango (near the Angolan border) demonstrates.
The destruction of forest trees has been carried on in this tribal area during the past 10 years at an alarming rate. ... In the course of 50 years or so the country will be practically denuded of forest and there is of course no need to dwell on the disastrous effect of such denudation. It is thought that the time has arrived to take active steps to preserve the forests and to reduce lumbering to be barest minimum. 341

With regard to the future economic development in Ovamboland, the Odendaal Commission, appointed by the South African government in 1962, considered deforestation to be one of the greatest economic and environmental problems.

**Fig. 33. Ovambo communities in the 1850s**

Source: Siiskonen 1990, p. 263.
An alarming phenomenon is the large-scale deforestation which is taking place in the central areas of Ovamboland. The erection of intricate palisades around kraals is an Ovambo tradition, and it frequently happens that in the laying out of a large kraal literally thousands of trees are destroyed. This is an unfortunate national custom which, unless some solution can be found to the problem, will undoubtedly lead to a chronic shortage of firewood in the near future.342

Present situation in Owambo

Today Owambo communities have almost grown into each other. In the most populated areas, mopane woodlands have been transformed into low shrubland with only a few fruit trees growing on the fields. In the western part of Owambo, mopane woodland has been transformed widely into grazing ground. There are still a few mopane woodlots left, but in many cases the trees have been cut one to five metres above the ground.

The less populated eastern part of Owambo still has a fairly large forest area. The deforestation process is, however, accelerating, especially near the population centres. Due to selective cutting for construction purposes, degradation of the forest is common (see pages 150–155).

Because South African military vehicles used to drive on cultivated fields, the Owambo farmers started to fence the fields around their homestead. Despite the withdrawal of South African troops, the fencing habit seems to have remained in force, which will increase wood consumption considerably.

*Mopane woodland cut for cultivation, Owambo.*
Figure 34 provides a rough idea of the present relationship between the woody vegetation and the human population in Owambo.

A: Saline grassland with a few shrubs; no population.

B: Colophospermum mopane woodland transformed into one- to two-metre high shrubland and cultivated fields; Hyphaene petersiana (real fan palm) the most characteristic tree; other trees, e.g. Acacia erioloba, Combretum spp., Commiphora spp., Croton gratissimus var. gratissimus, Diospyros mespiliformis and Terminalia sericea.

The most densely populated area in Owambo, in some parts with a population density up to 100 inhabitants/km²; acute shortage of building poles and firewood (average haulage distances 40 km and 30 km); serious soil erosion.343

C: Mosaic of mopane woodland and wooded grassland, greatly influenced by farming and grazing; Colophospermum mopane (mopane) woodlands transformed into shrubland and pasture lands, some pollarded trees remain (stumps up to 5 m); other trees, e.g. Acacia spp., Adansonia digitata (baobab), Commiphora spp. and Hyphaene petersiana.

Cultivated fields and wide temporarily flooded oshanas (shallow water courses); partly overgrazed; shortage of building material and in some areas also scarcity of fuelwood; quite many areas densely populated.

D: Wooded grassland, sparsely populated.

E: Mosaic of mopane woodland and wooded grassland which has been transformed into pasture lands, some fairly closed Colophospermum mopane stands still remain; sparsely populated.
F: Dry deciduous forest, e.g. Acacia erioloba, Baikiaea plurijuga, Burkea africana, Combretum spp., Erythrophleum africanum, Guibourtia coleosperma, Pterocarpus angolensis and Terminalia sericea, in the western parts also Colophospermum mopane; height of the dominant trees up to 14 m.

Still fairly sparsely populated but villages are expanding; deforestation and degradation in process due to shifting cultivation and cutting trees for building poles and for fuelwood, as well as to some extent due to grazing and commercial logging.

G: Ricinodendron rautanenii woodland; extremely important source of manketti nuts for the local San population.

The deforestation process in East Owambo can also be seen clearly from the satellite images (Fig. 35, see the technical information on page 144). The edge of the forest is moving eastward, and the uniform forest areas are breaking up into the smaller woodlots.

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**Fig. 35.**

**Deforestation of dry deciduous forest in Owambo**

Source:

Forests (black areas): Landsat MSS image of 1989. Interpreted at the University of Joensuu.
Future trends

The high demand for poles for construction will be the main reason for deforestation in Ovambo. Large forest areas will also be transformed into pasture and arable land. Natural regeneration is going to be endangered due to frequent fires and collection of fuelwood. Good road connections will attract more people to settle deep in the less populated forest areas, especially in Kavango and eastern parts of Ovambo. Some agricultural development projects will accelerate deforestation in East Caprivi and Kavango. Logging will ease the shifting cultivation. West Caprivi will have the last forests remaining in Namibia.

The above-mentioned trend will not necessarily come true. Deforestation could be controlled by better forest management and by using alternative building material and energy sources. Forest utilization could be diversified and more income from commercial forestry directed to the local population. Because of the strong coppicing vigour of mopane (Colophospermum mopane), coppice forestry has great potential in large areas of Ovambo. Mopane trees could be raised from shoots, which sprout from the stumps. The number of stool shoots should be gradually reduced to one or two. This type of management was practised during the 1960s in Ombalantu–Oshikuku area. According to Jensen, the method has been known among farmers for generations.
14. Conclusions and recommendations

Forests and woodlands in Namibia are located in the northern and northeastern parts of the country. The central region is covered with wooded grassland and deciduous bushland. In the Namib Desert only a few scattered trees and shrubs occur along the river beds.

Namibia was colonized in the late nineteenth century by Germany, which at that time was the leading country in forest management and forest research. Also in Namibia, Germany put considerable emphasis on forestry matters. However, all activities of the German colonial administration, including forestry, were concentrated in the central and southern regions, the areas settled by Europeans.

In the south, camel thorn (*Acacia erioloba*) was utilized for fencing poles and for energy. In the mining area around Tsumeb and Otavi, tamboti (*Spirostachys africana*) was used for mine props and lagging. Considerable amounts of timber and other forest industry products were imported. In order to be self-sufficient and to save the indigenous wood resources, German colonial authorities wanted to establish large-scale plantation forestry. More than ten forest stations and nurseries with adequate personnel were established, the central nursery being in Okahandja. Different methods of establishing plantations were used, including intercropping with agricultural crops. More than 200 woody species, mainly exotic but also indigenous, were used in experiments. On the basis of species trials, two genera, *Eucalyptus* and *Casuarina*, were selected for timber production; however, this production never was put into effect on the scale planned.

The change in colonial master after the First World War put a stop to Namibian forest policy and forestry activities. South Africa, which began to establish large plantations on its own territory, was not interested in investing in the development of Namibian forestry. Forest stations and experiments established during the German colonial period were abandoned and no personnel were appointed. A serious problem with bush encroachment gradually arose in the central part of the country, due mainly to selective logging and overgrazing. South African forest consultants paid some
visits to Namibia, but no serious efforts were made to develop forestry.

After the Second World War, attention was focused on the timber resources in the northern part of the country. Loggers were interested in utilization of two precious tree species, Zambezi teak (*Baikiaea plurijuga*) and wild teak (*Pterocarpus angolensis*). To handle the increased number of cutting permits and other forestry issues, a Regional Forestry Officer was sent from the South African forest service to Grootfontein in 1957.

In the 1960s and 1970s South African forestry personnel carried out forest inventories in northern Namibia, and a few trials with *Eucalyptus* spp. were established. At the same time a few academic studies were also made in forestry and related fields of science. These activities did not lead to the practice of sustained forestry, although tentative management plans were made. Logging was continued on the basis of concessions. Due to the lack of professional personnel and after 1968 especially because of the South African policy of ethnic fragmentation, it was not possible to carry out any national forest policy.

In the twentieth century there have been two distinct trends in the woody vegetation of Namibia. Firstly, bush encroachment has reduced the grazing capacity in the commercial cattle farming areas. Secondly, deforestation has begun to be a serious problem, especially in Owambo, where due to the high population pressure and unplanned exploitation, large areas have been converted to low shrubland. It is probable that the rate of deforestation will be accelerated everywhere in the northern regions.

To alleviate the deforestation process, ‘new’ approaches are needed, e.g. agroforestry, farm forestry or social forestry. However, substitution of imported timber for domestic wood requires the establishment of plantations.

The growing conditions in Namibia, low precipitation and poor soils, do not permit fast-growing indigenous forests. The proportion of the GDP made up by the forestry sector is minimal, and forestry would hardly develop into a major economic sector compared, e.g. to mining or fishing. In spite of this, most of the Namibian population is dependent upon forest products daily, e.g. for building material, fuelwood,
food and shade. If trees are removed, the soil is exposed to erosion, and the fertility of the soil may be permanently lowered.

Based on the analysis of previous forest policy and forestry activities, the field survey of northern Namibia, the preliminary satellite image analysis and several interviews, we would like to point out the following:

1) There is a need for a comprehensive national forest inventory and management plan, which should include assessment of total woody biomass, timber resources, non-timber forest products, and conservation aspects.

2) The management of indigenous forests should be improved.

3) In order to recover the destroyed mopane stands in Owambo, coppice forestry is recommended. Because of the immense coppicing vigour of mopane, this should not be a technical problem.

4) Alternative building materials and solutions for saving wood should be sought for rural homesteads. If the present pattern continues, ecological conditions in many areas will deteriorate severely and living conditions will get worse.

5) The scarcity of fuelwood should be alleviated in central Owambo, as well as in many other regions of the country.

6) In order to improve grazing capacity, the problem of bush encroachment in the central part of the country should be tackled.

7) Environmental education and awareness should be intensified.

8) The utilization of forests should be diversified. This includes, in addition to timber species, also the so-called non-timber forest products.

9) The local population should be discouraged from clearing forests. More jobs should be created in the forestry sector and the number of beneficiaries increased.

10) Forest research should have a high priority. The important research topics are, e.g. the natural regeneration of commercial timber species, artificial regeneration (both indigenous and exotic species), agroforestry systems, management of indigenous forests, patterns of wood consumption at both national and local levels, long-term analysis of the deforestation process, previous logging activities and utilization of woody biomass.
11) A management and research programme should be prepared for all plantations. Data collection should begin without delay.

12) The national herbarium should be given adequate facilities.

13) Useful documents dealing with forestry matters in Namibia might be found at the Central Archives Depot, Pretoria and at the Cape Archives Depot, Cape Town. Nor should documents owned by individual companies, e.g. the Tsumeb Corporation Ltd. and Loxton, Venn & Associates, be neglected in this context. Oral sources are necessary when forestry is studied from the point of view of the African population.

The biological and silvicultural prospects for developing Namibian forestry into a sustained mode are good; the most difficult issues are socioeconomic. The status of sustained forestry will be achieved by planned and monitored research and development. Namibia has now taken the challenge and started to build up a new forestry administration with the aim of implementing a successful national forest policy.
FOOTNOTES

1. Physical and socioeconomic environment

2. See, e.g. Du Pisani 1985, pp. 6–7; Selle 1988, p. 5.
18. For further information on *Baikiaea plurijuga* see Pierce 1986.
25. See, e.g. UNIN 1986, pp. 26–27.
32. Pütz et al. 1990, pp. 52–53.
43. Pütz et al. 1990, p. 376.
47. See The Constitution of Namibia 1990, pp. 29–43.

2. Owambo

54. See, e.g. Stengel 1963a, p. 375.
55. Stengel 1963a, p. 375; Loxton et al. 1985a, p. 31.
56. Stengel 1963a, p. 376.
58. Lempp (1963b, pp. 366–367) wrote: Very important is the conservation of natural tree cover where the land is being cultivated, or where new fields are being laid out. Where there are no trees, trees must be planted.
59. See, e.g. Department of Water Affairs, SWA 1989b.
60. Loxton et al. 1985a, p. 31.
64. White 1983, p. 94.

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71. Loxton et al. 1985a, p. 87; Jensen 1990, pp. 11–12.
72. Loxton et al. 1985a, p. 87 + 114.
75. Loxton et al. 1985a, p. 88.
78. Interview with Mr. F.H. Pönnighaus in 1990.
79. Loxton et al. 1985a, p. 102.

3. **Kavango**

83. Schneider 1987, p. 201.
84. Schneider 1987, p. 201.
4. East Caprivi

97. See, e.g. Koen 1988, p. 3.
112. Land... 1991, pp. 7–8.

5. West Caprivi

117. See Adams & Werner 1990, p. 121.

6. Forest policy

120. ZBU, Nr. 1169, M.1.a.1.Bd.1., pp. 1–4, NAW.
121. Dinter 1909a, pp. v-viii.
122. ZBU, Nr. 1169, M.1.a.1.Bd.1., pp. 18–25, NAW.
123. ZBU, Nr. 1169, M.1.a.1.Bd.1., pp. 32–35, NAW.
124. ZBU, Nr. 1169, M.1.a.1.Bd.1., pp. 27–38, NAW.
125. ZBU, Nr. 1169, M.1.a.1.Bd.1., pp. 31–33, NAW.
126. ZBU, Nr. 1169, M.1.a.1.Bd.1., pp. 72–77, NAW.
127. ZBU, Nr. 1169, M.1.a.1.Bd.1., p. 76, NAW.
129. ZBU, Nr. 1169, M.1.a.1.Bd.1., pp. 111–121, NAW.
130. ZBU, Nr. 1169, M.1.a.1.Bd.1., pp. 96–103, NAW.
131. S.W.A. Police, Tsumeb to the Magistrate Grootfontein, Tsumeb 16 June 1920, SWAA 1, A 1/1 vol. 2, NAW.
132. Magistrate of Swakopmund, Swakopmund 22 January 1925, Memorandum, SWAA 1, A 1/1 vol. 3, NAW.
133. Keet 1927, pp. 17–43.
134. Schornfelder, Timber and Afforestation in Grootfontein District, Grootfontein 10 May 1932, SWAA 5, A 1/4/1 vol. 1, NAW.
   Unable to control the northern regions (Kaokoland, Owambo, Kavango and Caprivi) militarily or by a police force, the German colonial authorities declared in 1907 that protection should be confined to those areas which fell within the sphere of influence of the railway line or main roads. Then it was common to refer to central and southern Namibia as the Police Zone (Du Pisani 1985, p. 23; Adams & Werner 1990, p. 9).
135. Permit issued under the terms of Section 3 of Proclamation no. 26 of 1928, Windhoek 17 January 1933, SWAA 5, A 1/4/1 vol. 1, NAW; Concession to cut timber: Okavango area, SWAA 5, A 1/4/1 vol. 1, NAW.
136. See, e.g. SWAA 4, A 1/4 vol. 1, NAW.
137. See SWAA 2–5, NAW.
138. Keet, Memorandum on protection ..., 11 February 1948, SWAA 5, A 1/8 vol. 1, NAW.
139. According to the Preservation of Trees and Forests Ordinance, 1952.
144. Hilbert 1990b.

7. Forest legislation

146. DKB 15 November 1894.
8. Early explorers' observations on the woody vegetation

9. Forestry activities during the German colonial period
173. For example, after the discovery of the extensive occurrence of manketti trees (*Ricinodendron rautanenii*) east of Etosha in 1911, Dinter was asked to visit the site and report the feasibility of collecting manketti nuts for oil production.


Das Pressen des Öles kann entweder im Lande selbst geschehen, und es müsste dann das Öl für den Konsum im Lande verbleiben, oder die Kerne müssten nach Deutschland verschiffen werden, Auf keinen Fall dürfte aber ein Export eines Landesproduktes stattfinden, so lange man, wie dies in D.-S.-W.-A. der Fall ist, ähnliche Produkte, beschwert durch teure Fracht, aus dem Auslande noch einführen muss, wie dies der Fall ist mit Speiseöl, Schweinefett, Seifen und dergl. (Dinter 1921, pp. 73–74).

174. ZBU Nr. 1172, M.1.d.2., pp. 1–2, NAW.
175. ZBU Nr. 1169, M.1.a.1.Bd.1., pp. 32–35, NAW.
176. ZBU, Nr. 1169, M.1.a.1.Bd.1., pp. 34–35, NAW.
177. BzDKB 1903, Jbr. über die Entwicklung der deutschen Schutzgebiete in Afrika und Südsee im Jahre 1901/02, pp. 72–73; ZBU Nr. 1169, M.1.a.1.Bd.1., pp. 48–50, NAW.
178. Dinter 1921, p. 18.
179. BzDKB 1903, Jbr. über die Entwicklung der deutschen Schutzgebiete in Afrika und Südsee im Jahre 1901/02, pp. 72–73; ZBU Nr. 1169, M.1.a.1.Bd.1., pp. 47–48, NAW.
180. Tree seedlings were also produced in Omaruru by the Rhenish Missionary Society.
181. ZBU Nr. 155, A.VI.a.3.Bd.16., p. 66, NAW; ZBU Nr. 156, A.VI.a.3.Bd.18., p. 134, NAW.
182. ZBU Nr. 156, A.VI.a.3.Bd.18., pp. 198–199, NAW.
183. ZBU Nr. 157, A.VI.a.3.Bd.21., pp. 153–154, NAW.
184. See, e.g. ZBU Nr. 155, A.VI.a.3.Bd.16., pp. 64–69, NAW; ZBU Nr. 156, A.VI.a.3.Bd.18., pp. 137–138, NAW.
185. Dinter 1921, p. 18.
186. ZBU Nr. 155, A.VI.a.3.Bd.16., pp. 95–96, NAW.
188. Dinter 1909a, p. 146.
189. Dinter 1909a, p. 147.
190. ZBU Nr. 1169, M.1.a.1.Bd.1, pp. 127–128, NAW.

191. The following citation describes the ordinary nursery activities in Gibeon in 1910–11:


192. Dinter 1909a, pp. 148–149.
193. Dinter 1909a, p. 150.
195. ZBU Nr. 1169, M.1.a.1.Bd.1, p. 127, NAW.
196. Dinter 1909a, p. 168.
197. ZBU Nr. 156, A.VI.a.3.Bd.18, pp. 192–194, NAW; ZBU Nr. 156, A.VI.a.3.Bd.18., pp. 198–199, NAW.
198. Dinter 1909a, p. 143.
199. Agroforestry methods were used to reduce the costs of establishing plantations.

Zum ersten male wurde die Gelegenheit der starken Bewässerung dieser Pflanzung dadurch besser ausgenützt, dass zwischen je 2 Eucalypten 2 Maiskörner gesteckt wurden. Dieser Mais Entwickelte sich vorzüglich und trug durch seinen Ertrag wesentlich zur Verbilligung der Eucaliptuspflanzung bei, die auf dem schwer zu bearbeitenden Boden wenigstens doppelt so teuer ist als eine Casuarinen-Pflanzung auf Revierinseln (ZBU, Nr. 156, A.VI.a.3.Bd.18., p. 193, NAW).
200. Probably by Hugo Hahn in Grossbarmen (Dinter 1909a, p. 166).
201. See Dinter 1909a, p. 161.
203. See Poynton 1990.
204. Keet 1927, p. 64.

10. Forestry activities during the mandate period

207. See Walter & Volk 1954, p. 23.
208. Keeping of rainfall statistics was started by German missionaries at the Rehoboth mission station in 1883 and two years later in Olukonda, Owambo by Finnish missionaries (Stengel 1966, p. 441; Siiskonen 1990, p. 37). Continuous rainfall records have been kept in Namibia since 1891 (e.g. Heidke 1919).
209. See Walter & Volk 1954.
210. In 1924–1926 the railways consigned about 11 000 tons of wood annually, almost all of it Acacia erioloba. The total wood consumption – for fuel, mining and fencing – in the mid-1920s was about 40 000 m³ per annum (Keet 1927, p. 8).
211. Keet 1927, pp. 6–7, p. 17.
213. Keet 1927, p. 34 + 37.
214. Keet 1947b, p. 3.
216. E.g., memoranda on forest nurseries see, SWAA 7, A 1/11 vol. 1, NAW.
217. See NAO 70, 28/1, NAW.
221. SWAA 5, File A 1/8/1 vol. 1, NAW.
222. The wood of the tamboti (Spirostachys africana), which is very heavy, fine textured and termite-resistant, is one of the most beautiful of all southern African woods. The sandalwood-like (Santialum album) odour gives it a unique combination of properties. Among the African population this tree species was almost taboo because of its toxic effects (e.g. Palmer & Pitman 1972; Coates 1990).
225. Keet, Okahandja plantation, SWAA 7, A 1/11 vol. 1, NAW.
226. Keet, Okahandja plantation, SWAA 7, A 1/11 vol. 1, NAW.
227. Sale of plants to S.W.A. Administration ex Okahandja Railway Nursery, Windhoek 8 March 1950, SWAA 7, A 1/11 vol. 1, NAW.
228. Keet 1947b, p. 15.
232. S.W.A. Police, Tsumeb to the Magistrate Grootfontein, Tsumeb 16 June 1920, SWAA 1, A 1/1 vol. 2, NAW.
233. Magistrate Grootfontein to the Manager, Otavi Mines, Grootfontein 9, August 1921, SWAA 1, A 1/1 vol. 3, NAW.
237. Marsh 1954, SWAA 5, A 1/8/1 vol. 1, NAW.
238. In 1987 the Tsumeb Corporation used about 24 000 tons of wood chips for fuel, in addition to consuming a small number of mine props (Hose 1987, p. 11).
239. Marsh 1954, SWAA 5, A 1/8/1 vol. 1, NAW.
240. Marsh 1954, SWAA 5, A 1/8/1 vol. 1, NAW. In 1990 there were still a few *Eucalyptus* sp. trees growing close to Tsumeb.
242. Marsh 1954, SWAA 5, A 1/8/1 vol. 1, NAW.
246. Schoenfelder, Timber and afforestation in Grootfontein District, Grootfontein 10 May 1932, SWAA 5, A 1/4/1 vol. 1, NAW.
247. For more on granted cutting permits see, file SWAA 4, A 1/4 vol. 1, NAW.
249. Keet 1956, p. 86.
251. See, e.g. Hilbert 1990b; Finne et al. 1991, p. 2.
11. Forestry activities since the 1960s

253. We were not able to find this publication, but it is cited by Claassen & Page (1978, pp. 12–16) and Loxton et al. (1985a, pp. 65–67).


255. See Millington et al. 1989.

256. ETC... 1990.


261. Interview with Mr. Pönnighaus 1990.


266. Onuno plantation is located 12.5 km south of Oshikango, on the western side of the tarred main road. The size of the plantation is 12 ha but in 1990 only about 30 % of the planted trees were alive.

267. The plantation is 200 m from the Kavango River. Many of the Eucalyptus sp. trees are second rotation from 1985. The oldest Eucalyptus sp. at the site were planted already in 1967. In 1972 a few seedlings of Albizia versicolor were also planted and more recently Pierocarpus angolensis.

268. Darrow 1983; Hilbert 1985a. Chevalier (1989) has recently measured the experiments in Onunu and Onankali. Unfortunately we were not able to get hold of that study.

269. Roeder 1980. The site in Owmbo was probably near Onunu. The one in Kavango could have been 50 km from Rundu towards Grootfontein. The plantation was destroyed in 1982 when the safety zones on both sides of the road were cut. In 1990 there were a few trees left at the site.

270. The plantation in Onankali is on the both sides of the main road, 48.5 km from Oniiipa junction towards Tsuneb.

271. The site is tens of kilometres east of Rundu, close to the Kavango River.
272. Seedlings were planted in 1974–1975 and watered during the two first years; most of seedlings died soon after. The site is on the way from the airport to Katima Mulilo; in 1990 a few *Eucalyptus camaldulensis* trees were still growing here.

273. FAO 1976, p. 50. See also Loxton et al. 1985a, p. viii.

274. Rural... 1987.

275. See Hilbert 1986d.


286. ETC(UK) 1990.

12. Forest products used by the African population


288. See Dinter 1912b, pp. 18–19; Keet 1973, p. 32.


295. Woody biomass densities according to ERL... (1985b, p. 20):
   - Dry wood (25 % moisture content): 0.909 tn/m3,
   - Oven-dry wood: 0.727 tn/m3.


299. For further reading the following are recommended: Dinter (1912b), Bruwer (1961), Loeb (1962), Lee (1965), Maguire (1978) and Rodin (1985).

13. Trends in the vegetation

314. Breitenbach 1968, p. 64.
320. Marsh 1954, SWAA 5, File A 1/8/1 vol. 1, NAW.
326. Lubbe & Slater 1985, p. 3 + 7.
330. ZBU Nr. 1170, M.1.b.1.Bd.1., p. 1, NAW.
334. The Herero and Nama uprising (1904–1907) played a decisive role in the colonization of Namibia. The uprisings were great tragedies for the Herero and Nama: by 1906 the German military forces had exterminated about 40,000–60,000 of the Herero population, reducing their number to 16,000; the Nama population fell from 15,000–20,000 to 10,000 (see, e.g. Siiskonen 1990, pp. 183–185).

337. Siiskonen 1990, p. 43.
340. Rautanen to Mustakallio, Olukonda 30 August 1908, Eac:24, FMSA.
341. Officer in Charge, Oshikango to the Native Commissioner, Ovamboland, Oshikango 17 March 1931, SWAA 3, A 1/2 vol. 1, NAW.
344. Interview with Mr. Pönninghaus in 1990.
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