# THE IMPACTS OF INDUSTRIAL WOOD CONSUMPTION

## ON THE NIGERIAN FOREST RESOURCE

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A Practicum Submitted In Partial Fulfillment of the Requirements for the Degree, Master of Natural Resources Management

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## THE IMPACTS OF INDUSTRIAL WOOD CONSUMPTION

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by

#### CHRIS CHUKWUOCHA

A practicum submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of Master of Natural Resources Management.

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#### ABSTRACT

This study examines important resource management problems facing the Nigerian forestry sector. In particular, this study addresses the question of whether the high forest of Nigeria can provide adequate amounts of industrial wood. Concern about wood supplies results from increased wood consumption, a rapid growth in the number and capacities of the forest industries, particulary sawmills, and a decrease in forest land.

Future timber availability is estimated using a simple supply model, it highlights various factors affecting the supply of timber from High forests. These factors include:

- 1. The increasing capacities and numbers of sawmills in the various high forest states,
- 2. The technological problems leading to a high percentage of waste in the forest industries,
- 3. The low percentage of species utilization, and
- 4. Inadequate forest management policies to regulate the performance within the forestry sector.

Based on the research, the following recommendations were reached:

- 1. The federal and state governments should carry out a wood-balance study in the various states. The primary motive is to determine the states demand to timber and the capacity of the forest to meet it.
- 2. The forest industry capacity should be related to the sustainable yield of the forest. This is necessary to avoid resource depletion

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- 3. Effort should be directed towards reducing waste in the various industries. This may include the need to establish particle-board industries to utilize waste from sawmills.
- 4. The forest revenue/pricing system should be examined and perhaps altered to reflect the relative scarcity of wood. This may lead to a more efficient utilization of timber.
- 5. Plantations should be established to complement yield from the natural High forests. However, environmental and social considerations should also be recognized.

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## Chapter |

#### 1.1 INTRODUCTION

Nigeria is located in West Africa at approximately 4-14 latitudes and 3-15 longitude. It covers an area of about 924,000 km<sup>2</sup>.

The climate of Nigeria is influenced by two wind systems, the rain-bearing southwest monsoon and the dry, dusty northeast winds called the harmattan. The weather is determined by the movement of the intertropical convergence zone which is the boundary between these systems. The climate of a particular locale is determined by the average period that one or other system is dominant each year.

Figure 1(a) shows then climate of Nigeria and the distribution of rainfall. Rainfall ranges from over 4000 mm per year in the extreme south to less than 500 mm per year in the northeast. As a general rule rainfall decreases with increasing latitude, with the exception of a rise around the central plateau. Rainfall variation is reflected in the natural vegetation zones. Average daily minimum temperatures of the coldest month range from 12° C in the north during the harmattan to 20° C. in the south during the rainy season. Humidity may fall to 20% or less

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during the dry season in both the north and south, but is generally over 60% in the south. Potential evapotranspiration ranges from 2700 mm in the north to 1000 mm in the south. The interaction of these climatic factors is important in determining the vegetaiton types throughout the country.

Forests cover a little over one-third of the total land area of Nigeria, about 360,000 km<sup>2</sup>. Because these forests are unevenly distributed, throughout different vegetation zones, their potential usefulness varies. Furthermore, forested areas are continually diminishing as a result of frastructural development and clearing for agricultural purposes. As a means of preventing further reduction of the forest land, approximately 10% of the total forest areas was set aside as forest reserves in the various states of the country. Figure 1(b) shows the distribution of the reserved forest, (World Bank confidential report 1978.

#### 1.2 VEGETATION ZONES OF NIGERIA

From a forestry point of view, Nigeria can be divided into two primary vegetation zones. Figure 1(c) shows the distribution of different vegetation types in Nigeria. The high forest vegetation zone in the south stretches along the Altantic coast in a 100-200 km belt covering a total of about 133,000 km<sup>2</sup>. The zone covers all or most of the states of Lagos, Ogun, Ondo, Bendel, Imo, Anambra and Kwara



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(FAO 1979). The savanna or grassland zone occurs north of the High forest zone.

Within the High forest zone are swamp and mangrove forests, occupying the areas closest to the Atlantic coast. There are two distinguishable types of swamp forest climaxes. These are the peaty swamp forests and non-peaty swamp forests. These forests occur in a zone to the landward side of the coastal mangrove forests, and cover an estimated area of about 18,000 km<sup>2</sup> (Skoup 1980). The forests are edaphic climaxes and likely to remain so unless a change in the water level is induced by external influences. Species most commonly found in these swamps forests include Anthostema aubryanum and Carapa procera, which constitute more than 65% of the total stocking. Other species found include Anthonotha macrophylla, Spondianthus preusii, Symphonia globulifer, Raphia vinifera, Pterocarpus mildbraedii, Xylopia rubescens, Alstonia boenei, Tredulig africana, being the dominant species (Skoup 1980). These species are predominantly softwoods with no annual rings and very low density. They have limited uses, such as for construction of light canoes, poles and piling timber for marine works. Some of the species are not durable and are used as "white" wood in shuttering and construction. Limited access to swamps impedes the exploitation of these swamp species.

Immediately north of the swamp forests is the moist tropical forest zone, sometimes referred to as the rain forest. This zone supports more tree species than any other vegetation zone in Nigeria. Hardwood timber products from this zone's forests provide industrial raw materials for a large variety of forest industries. With the great diversity of tree species in this zone (in some cases up to 750 species in a 10 km<sup>2</sup> area) the number of tree species that are removed per hectare in a harvest operation can be very small. Hence logging for a small quantity of a particular wood can effect large areas of the forest (Mergen 1983).

The next major division is the savanna vegetation zone, which occupies about 791,000 km<sup>2</sup> of the country's forest land. This zone is sparsely forested as a result of soil abuse through careless agricultural practices and result of repeated fires (Mergen 1983). The density of vegetation decreases as one moves from the southern savanna to the sahel savanna zones of desert-like vegetation. The savanna forests are a valuable source of fuelwood, and provide grazing for livestock. They provide environmental protection against desert encroachment and serve as a means of maintaining watershed areas.

Due to unfavourable soil and climatic conditions, rudimentary silviculture and poor technology in forest species utilization, zones adjacent ot the rain forest are

presently not viable for industrial wood production in Nigeria. This results in a situation where most industrial wood supply is restricted to the rain forest. Forest plantations, reserved and unreserved forests are the primary sources of industrial wood in Nigeria.

Forest areas outside the reserves are rapidly being depleted and the sustained production of timber rests with forest reserves and plantations. Studies by FAO (1979) and the Federal Department of Forestry in Lagos indicate that forest reserves account for almost half of the wood volume of the entire country. It is estimated that non-reserved forest will be totally depleted before 1995, assuming that the current annual rate of production (300,000 m<sup>2</sup>) annually continues (FAO 1979).

It has never been easy for government administrators to make wise decisions concerning resource use because of the enormous impacts their decisions have on both immediate and future affairs involving the general public. This is increasingly true in the case of forest resource. Strategies concerning either the harvest of forest or the establishment of plantations have to be based on an understanding of the overall effect of these decisions on the forest resource. Unfortunately however such strategies must often be reshaped to accomodate political and social demands which may contradict an efficient forest resource use plan. If the best interests of the country are to be

served, policy makers and planners must overcome these obstacles of political expediency and irrational emotionalism.

The search for scientific information to facilitate efficient planning of forest resource use has long been in progress in Nigeria. The country has gradually acquired technical and scientific knowledge in greater quantity than was ever before available to her. Yet government decision makers within Federal and State departments of forestry must continue to share blame with forest industry owners for the failure of the country to cope effectively with the problem of forest resource allocation. These problems are being exacerbated by increasing wood consumption, decreasing forest area, illegal forest operations and increasing capacities of forest industries, especially the sawmills. Environmental problems such as gullies, erosion, and desert encroachment have been associated with forest depletion (Ahsan 1981).

## 1.3 STATEMENT OF THE PROBLEM

Wood consumption forecasts by both private and international forestry organizations (Adeyoju 1975; \*F.D.F. 1975; Enabor 1976; FAO 1979) indicate a rapid increase in the industrial wood consumption in Nigeria. Table 1.1 illustrates this growth trend. These forecasts indicate a

\* F.D.F. - Federal Department of Forestry, Nigeria

			1971	1985	2000
Polewood:	Production r Consumption Balance	million m <sup>3</sup> (r)	1.51 1.51 0.00	2.06 3.41 (-)1.35	2.66 5.99 (-)3.33
Sawnwood:	Production Consumption Balance	000 m <sup>3</sup> (s)	566 530 + 26	932 1190 (-) 258	1361 2710 (-)1351
Wood-based Panels:	Production Consumption Balance	000 m <sup>3</sup>	40 40 0	66 80 (-) 14	94 200 (-) 106
Paper & Paperboard Newsprint:	: Production	000 - t	-		-
	Balance	000 m.c.	(-)19.2	(-)31.8	(-)51.8
Printing & Writing:	Production Consumption Balance	000 m.t.	 25.1 (-)25.1	- 51.4 (-)51.4	_ 86.2 (-)86.2
Other Paper Board:	Production Consumption Balance	000 m.t.	10.0 52.9 (~)12.9	10.0 108.3 (-) 98.3	10.0 184.8 (-)174.8
Enabor, E.	"Forecasting Economics	Wood Requirement and Social Studi	s", <u>The Ni</u> es, 1975.	gerian Jou	rnal of

Table 1.1 Nigeria's Wood-Balance, 1971, 1985, and 2000.

deficit in paper and paperboards, printing and writing paper and other paperboard products as far back as 1971. The deficit is expected to spread to other wood products (polewood, sawnwood, and wood-based panels) by 1985. This shortage is bound to increase with time.

The problem of impending industrial wood shortage has been complicated by increasing capacities of forest industries and decreasing forest areas. Given the length of time required for wood production, this resource problem must be addressed immediately.

## 1.4 THE OBJECTIVE OF THE PRACTICUM

The objective of this practicum is to develop a model showing the capacity of Nigerian forests to supply industrial wood to forest industries. Possible surplus or shortfall situations under varying conditions in the different states will be demonstrated. This primary objective will be achieved through the following subobjectives:

- development of a supply and demand model for industrial wood in various states
- an assessment of raw material requirements of major wood-using industries throughout the country, by states
- an assessment of the capacity of natural forests and existing plantations to supply industrial wood.
- 4. findings from 1, 2 and 3 will serve as a basis for recommendations concerning future operations in both industrial and forest sectors of the Nigerian economy.

### 1.5 THE NEED FOR THIS STUDY

Timber production entails a long process. To ensure that sustainable yields from Nigerian forests are not jeopardized, forest planning policies must pay particular attention to harvesting schedules. This study will provide the information necessary to tailor industrial wood harvest to sustained forest production capacity.

The forestry sector requires increasingly specialized information for efficient allocation of forest resources as the locus of wood production changes from indigenous forests to the establishment of plantations of rapidly growing species. This study will identify areas of high priority within various states in Nigeria.

Finally, this study will provide an information base concerning the future of raw material supplies which is important to investors in forest industries.

## 1.6 OVERVIEW OF METHODOLOGY

Analysis of the forestry sector of the Nigerian economy was undertaken to assess activities within the sector which relate to the study objectives. Such analysis involve the identification and analysis of a range of feasible supply alternatives from Nigerian forests. In addition the forest industries of Nigeria are identified in terms of their location and capacities, to determine the extent of the industrial wood demand.

The first stage in the proposed analytical framework is to define the forestry sector through a model which identifies major parameters and interactions comprising the framework as shown in figure 1.2. Information concerning forest area, volume and growth are organized to determine the potential industrial wood stick which could be made availabe to the forest industries. Estimated wood requirements of the forest industries (demand analysis) is carried out by identifying the number of capacities of these industries and the number of shifts worked over a period of one year.

Data collected from analysis of the Nigerian forests and relevant industries were organized to permit a simple demand/supply analysis. The primary objective was to determine shortfalls or surpluses under existing conditions and varying conditions, including increasing log requirements, waste reduction in mills and the use of additional species. This analytical framework, by design and necessity, is iterative and involves successive approximations. With such methodology there are few limitations on the process of analytical alternatives.

The final stages of the research use information derived from the analytical framework to make recommendations.

Figure 1.2

## Operations in Sector Analysis

Define Forest Sector .... -

Identify Source of Wood

- area

- volume

- growth

Harvesting

- volume

Demand Side Primary Industries Veneer Pulp & Particle Board & Matches Sawmills Paper Plywood - raw material requirement requirement - production requirement requirement requirement - production - production - production - production - efficiency - efficiency - efficiency - efficiency - efficiency

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Supply Side

### 1.7 SCOPE OF THE STUDY

For the purposes of this study, assessment of the current industrial wood situation is concentrated primarily on the southern high forest states of Ogun, Lagos, Ondo, Oyo, Bendel, Cross River, Anambra and Imo states. These states are presently the major industrial wood producers and have the highest concentration of forest industries.

Only primary forest industries are considered when the demand for industrial wood is assessed. Supplies of wood to secondary wood industries, such as joineries and bench sawmills, usually come from primary forest industries and will therefore have already been taken into account.

## 1.8 SOURCES OF DATA

The study was based on secondary sources of information obtained from local and international forestry research and subsequent publications. Such information is supplemented by data obtained through a general literature review. These pieces of information were wholly accepted, as their accuracy or lack thereof cannot be verified. Data collection was geared toward meeting the objective of the study, stated earlier in this chapter.

The primary sources of data for assessment of the raw material supply include:

- 1. F.A.O., High Forest inventory of Southern Nigeria 1973-79.
- Confidential reports of the Federal Department of Forestry on plantation establishments in Southern Nigeria

- 3. World Bank monitoring the evaluation reports, 1980-81, concerning plantation establishments
- 4. FAO/UNDP working project document of forestry development in Nigeria, 1978-81.
- 5. Reports by Skoup and Nardes, Nigerian forestry consultants firm.

These reports provide information concerning wood production from natural forests (both from reserved and unreserved forests). Rotation age of plantation species, annual increments from natural forests, rate of plantation establishment, estimate of forest harvest, and other parameters vital for determining industrial wood supply are provided.

Determination of raw material requirements of Nigerian forest industries is achieved through information collected from the following sources:

- 1. Federal Department of Forestry, Nigeria, Publications concerning Nigerian forest industries
- FAO inventory on forest industries of Nigeria, 1975-80
- 3. Private publications and books on Nigerian forestry
- 4. Publications and journals of forestry.

These sources provide data on forest industry types, location, capacities and related parameters.

## 1.9 DELIMITATIONS OF THE STUDY

The study is carried out on the basis of secondary sources of data. On-the-spot surveys might yield better results, but would be prohibitively expensive and timeconsuming.

The statistics base for the forest sector of Nigeria is surely underdeveloped. Much of the desired information was simply not available. As a result, the approach is to develop a simple model with unsophisticated data requirements which isaemenable to the introduction of alternative figures.

#### Chapter II

### 2.1 METHODOLOGY

The calculations used in this study were derived primarily from data obtained in previous research carried out in the Nigerian forestry sector. The framework for the study methodology includes the following:

An assessment of raw material requirements of the major forest industries is achieved by identifying the capacities of the industries and number of shifts worked. A recovery ratio is used to multiply the production capacity to determine the total wood required for operation over the period of one year (1980 is used as a base year). An earlier study dealing with recovery rate of sawmills put this rate at 53% of total log input (Hawthanen 1975). As no new conversion rate was determined, the rate was used throughout the study. It is therefore assumed that the remaining 47% of the total log input, when not used for particle board or chip board manufacture, was wasted. The recovery rate in the plywood and veneer mills is estimated at 50% by FAO (1981). This rate is used in the calculation of their wood requirements. Total wood requirements for the forest industries were simply derived by the sum of the

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wasted wood and the portion recovered. The result for this calculation is summarized in Table 4.5. This section constitutes the wood requirement (demand section) of the model.

Estimating wood requirements by the forest industries is a hazardous exercise because of the many complex factors and the dynamic relationship which must be considered. The difficulty arises from uncertainty regarding the future value to variables which must be taken into account. Due to market imperfections in the forest sector, such variables as technology, prices, consumer tastes and preferences are virtually impossible to quantify and determine in Nigeria. These imperfections have been explained in chapter four. This study assumes that only factors such as availability of wood, type of technology and capacity of the forest industry will directly affect the industrial wood requirements. Other variables are assumed to have neutral effects as their impacts have not been studied. The findings based on this methodology are shown in tables 4.1 to 4.4.

An assessment of the capacity of natural forests and existing plantations to supply industrial wood relied heavily on the findings of the FAO/UNDP High Forest Development Project in Nigeria. The assumption made in my calculation is that all wood as reported to the inventory survey could be made available to the forest industries. This may not necessarily be true, especially as some areas

may either be inaccessible for logging purposes or may not be economically viable due to distance. Average timber harvest for industrial wood purposes was estimated at 40 cm \*(dbh). This is particularly due to the design of the equipment in the industry to handle logs of this dimension and larger. The information relating to the quantity of logs of this dimension and larger are contained in the high forest inventory reports (1973-79). The total estimate of wood available in these forests was compounded using an average growth increment factor of 1.27 cm/m³/annum in a ? (1.27%/annum?) simple compound formula.

 $Pn = (1 + r) ? (P_{n=} (I+r)^{n}?)$ 

where Pn = Present volume of wood (m<sup>3</sup>)

n = Period

r = growth increment (1.27 cm). ?  $(1,27 \% / \alpha m m m ?)$ The surveys carried out by FAO (1979) indicate that only 300,000 m<sup>3</sup> of wood per annum will be generated until 1995 from areas outside the reserved forests. This volume was allocated to each state, based on the extent of their productive forests outside the reserve. Table 3.4 shows the potential industrial wood available from natural forests, less the growth increment. This includes both utilizable and not-utilizable wood. Non-utilizable woods are those species with inappropriate qualities for use in industries

at present levels of technology. The unutilizable volumes were separated in the actual accounting for industrial wood supplies.

\* (dbh) = diameter at breast height

The estimated volume of wood that could be avaiable from areas outside the reserve is shown in Table 3.7.

Calculations of the volume of wood potentially available from plantations include only <u>Gmelina arborea</u> species. Other plantations species are assumed incapable of yielding logs of the required dimensions (40 sm dbh) before the year 2000. The volume that is potentially available from the <u>Gmelina arborea</u> plantations is calculated based on an eightyear rotation period for pulpwood, and fifteen-year rotation for was logs. The yield from these plantations based on these rotation periods is summarized in Appendix 1.1.

The total volume of wood which could be supplied for forest industry use from both natural forests and plantations is summarized in Appendix 1.(2-8).

From data concerning the wood requirements of the state forest industries and the supplies of wood from the forests, the duration of supplies is determined as shown in table 5.1. The effect of increasing species utilization, increasing recovery ratio through improved technology, possible cutbacks in the capacities of industry and increased forest plantation are used to illustrate how this log supply duration will vary under varying conditions.

#### Chapter III

FORESTRY IN NIGERIA AND THE SUPPLY OF INDUSTRIAL WOOD FROM THE HIGH FOREST ZONE

### 3.1 INSTITUTIONS AND FOREST MANAGEMENT

There are three institutions which are primarily concerned with the management of Nigerian forests: (i) the Federal department of forestry; (ii) the Forestry Research institute, and (iii) the various states forestry departments. The Federal department of forestry was established in 1970. Its functions include:

- 1. formulation of national forest policy
- promotion of forestry projects that are of national interests and the channelling of federal funds to finance these projects
- coordination and management of state forestry activities (federally funded).

The management of forest reserves and control of the exploitations of non-reserved forests are the responsibility of the various states.

The Forestry Research Institute of Nigeria is responsible for forestry research within the country. Forestry research comes under the National Research Council and operates independently of the state and federal forestry departments. The relationship between the Research Institute and other forestry departments is that of a consultant. Figure 2.1 shows the administrative relationships within the forestry sector of Nigeria.

Whereas the states are responsible for the control and exploitation of the natural forests, the actual exploitation is planning and executed by the private sector. The states control exploitation through the terms within a concession agreement. This agreement, which is very important in regulating the exploitation of the forest resource, reflects the interests of the state rather than of the entire country.

Forest charges are levied for woods removed from inside the forest reserve (out-turn volume charges and area-based charges), and from outside the reserves (stumpage charges). These charges are established by the various state governments through administrative procedures, irrespective of any market influence. Hence, prices may not be adjusted to indicate the relative scarcity or, rather, actual market situation in the timber trade.

## 3.2 HIGH FOREST ZONE SUPPLY OF INDUSTRIAL WOOD

Man's influence has been an important factor in determining the extent, the composition and the structure of the natural forests of Nigeria. In the past, the harvesting of the high forest was so localized that it recovered




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easily. Large blocks of forest existed in a virtually untouched state. By the beginning of this century man's need had increased and new techniques for harvesting forests wre introduced. As the population grew there was a spread of shifting cultivation. Plantation crops such as cocoa, rubber, and palm oil were introduced and more fertile forest land was cleared (Adeyoju 1975).

The problem of diminishing high forest areas in Nigeria was exacerbated by log exports to overseas markets before 1960 (Adeyoju 1975). Finally the mechanisation of exploitation effors and the establishment of numerous forest industries resulted in virually every forest area having been logged and some, many times over.

In response to diminishing natural forest areas, forest reserves were created. Forest reserves are constituted forest areas, where harvesting exploitation, ownership and management are by individual state governments. By 1950 this process was almost completed (See Table 3.1).

Forest trees in non-reserved forests are partially owned by individuals who may require a permit from the state forestry service before any harvesting can be undertaken. The reliance on the natural forests to supply wood is rapidly becoming an academic option. Most state governments have embarked on the establishment of plantations to supply industrial wood. In some cases, the federal government has taken an aggressive stand in funding many state plantation

## Area of Constituted Forests

at ten year periods

Year	Forest Area	<u>% Total Land Area</u>	% Increase
1900	971 km²	0.01	
1910	less than 2590	.27	2169
1920	8,143	.88	214
1930	29,878	3.20	265
1940	57,366	6.40	798
1950	73,320	7.90	23
1960	85,631	9.50	28
1970	93,420	10.00	8

Source: FAO, <u>Forestry Development Nigeria</u> <u>Project findings</u> and <u>Recommendations</u>, Terminal Report F0:DP/NIR/71/546, 1979. p. 8. projects, especially when it is considered of national interest.

The three primary sources of industrial wood supply in Nigeria are:

- 1. Reserved forests
- 2. Non-reserved forests
- 3. Plantations.

Forest reserves are currently the most important sources of industral wood supply in the high forest zone of Nigeria. It contains about 20443 km<sup>2</sup> or about 21% of the country's total reserved forest area. A breakdown of the total forest reserve rea by vegetation zones in shown in table 3.2.

The wood potentially available to industries, desregarding the economics associated with transportation and logging, is shown in table 3.3. This table shows that Bendel state has the largest net stock volume of both commercial and non-commercial trees. The utilization of Nigerian forest wood is largely determined by the current level of technology in the various industries. Trees that are presently classified as unusable or non-commericial have characteristics such as poor seasoning capability, excessive hardness, twisted grain or brittleness. Most of the high forest species are very slow=growing. Studies examining the growth increment of most high forest species indicate an average increment of 1.27 cm/annum.

# Forest Reserve Area by Vegetation zone

Zone	Reserve Area (km²)	ች of Reserve Area
Sahel	2,571	3
Sudan	31,247	31
Guinea	38,271	39
Derived savanna	3,208	3
Moist Tropical:		
a) Ferruginous soils	7,095	7
<ul> <li>b) Ferralitic soils on Basement Complex</li> </ul>	4,326	4
<ul> <li>Ferralitic soils on Sedimentary Formations</li> </ul>	9,022	9
Freswater Swamp	256	3
Mangrove	522	1
	96,518	

Source: FAD, Technical Report 3, NIR/71/546.

		<u>Meserves</u> , <u>by</u> <u>state</u>	, <u>111 1000 m</u>		
9	State	Net Stock Volume Utilizable (40 cm dbh & above)	Net Stock Volume Not Utilizable (40 cm dbh & above)	Total (Gross Volume)	
	0gun	7,970	2,078	10,048	
	Ondo	28,369	6,854	35,223	
	0yo	8,180	1,341	9,521	
•	Bendel	33,523	7,392	40,915	
	Anambra & Imo	632	186	818	
	Cross River	22,639	10,175	30,814	
	Kwara	926	321	1,247	_
	TOTAL	100,239	28,347	128,586	

#### Potential Wood Available from Forest Reserves, by State, in 1000 m<sup>3</sup>

Source: FAO, <u>The Indicative Inventory of Reserved High</u> <u>Forest in</u> <u>Sourthern Nigeria</u> <u>1973-77</u>, Technical Report 1, FO:NIR/71/546, 1979.

#### 3.3 NON RESERVED FORESTS

Table 3.4 shows the distribution of non-reserved forest areas in the high forest zone. About 20% of the total industrial wood is supplied from these forests (FAO 1978). Current round wood supplies from areas outside the reserves are estimated at about 300,000 m<sup>3</sup> per annum. These forests are undergoing heavy depletion. The Western states of Ogun, Oyo and Ondo, are already showing signs of exhaustion. The FAO (1978) believes that at the present rate of supply from these areas, the resource will be exhausted by 1995.

TAble 3.5 shows the distribution of areas outside the forest reserve, by forest types. In terms of wood supplies, production is restricted to the mature and immature forests.

The total estimated volume of wood from the non-reserved forests by state is shown in table 3.6. Cross River and Bendel states show greater supplied than the other states. These two states are capable of supplying 160,121 m<sup>3</sup> and 42476 m<sup>3</sup> of industrial wood per annum respectively

#### 3.4 FOREST PLANTATION

In the past, the forest industries wood requirements were met adequately from limited areas of the high forests. But due to increased wood consumption by Nigerian and the vulnerability of the natural forests, the forest plantations are gradually becoming viable alternative for industiral wood supply. The establishment of compact forestry

# <u>Area, in Hectares, of Forest Outside</u> <u>Reserves in South High Forest Zone</u>

State	Total Area (ha)
Ogun	122,700
Ondo	196,000
Ογο	52,600
Bende !	673,400
Anambra & Imo	277,500
Cross River	585,000
TOTAL	2,460,000

Source: FAO, <u>The Indicative Inventory of Reserved High Forest</u> <u>in Southern Nigeria</u>, <u>1973-77</u>, Technical Report 1, FO:NIR/71/546, 1979.

Forest Type	0gun	Ondo	Оуо	Bendel	Anambra & Imo	Cross River	River	TOTAL
Mature	-	-		33	_	1786	-	1819
Mature Disturbed	95	-	42	49	195	316	-	697
lmmature Disturbed	197	447	363	677	-	1641	-	3355
Immature	22	-	121	244	788	38	-	1213
Riverine	493	236	-	405	1069	297	135	2635
Swamp	420	1247	-	5326	723	1452	5715	14883
TOTAL	1227	1960	526	6734	2775	5530	5850	24602

# $\frac{Area of Forest, by Type, Outside Reserves,}{by State}$

Source: FAO, <u>Forestry Development Nigeria Project Findings</u> and <u>Recommendations</u>, Terminal Report F0:DP/NIR/71/546, 1979.

# Estimate of Volume Yield Per Annum<br/>From Forest Areas Outside<br/>by State, in m³StateVolume Per AnnumOgun13,297.6Ondo20,200.4Oyo22,275.5Bendel42,476Anambra & Imo41,629Cross River160,121

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Source: FAO, <u>Forestry Development Nigeria Project Findings</u> and <u>Recommendations</u>, Terminal Report FO:DP/NIR/71/546, 1979.

plantations on selected sites in northern and southern Nigera began in the early 19th century (Adeyoju 1975). Early forestry plantations were for protective and research purposes. The species most often used were native species. In the north, the major species used were those capable of withstanding adverse climatic conditions. In the south, most of the early plantation species were for experimental and educational purposes. More recently extensive planation projects have been undertaken by various government agencies.

By 1980, about 140,000 ha of plantation had been established in Nigeria. Appendix 2, (1-7), shows the breakdown of plantations by individual states and species. The most commonly planted single species is the Gmelina arborea, a fast-growing exotic species capable of reaching 40 cm (dbh) in 15 years, and yielding about 200 m<sup>3</sup>/ha/annum. The <u>Gmelina</u> arborea tree is suitable for either sawlog for sawnwood or as pulpwood. An average volume of 4 million m<sup>3</sup> of wood could be generated from the Gmelina plantations in the various states before the year 2000. Most states such as Bendel, Cross River, Ogun and Onto states, show higher production figures than other states. This is as a result of the ongoing pulpwood plantations projects currently being carried out in these states (FDF monitoring report 1980). These pulpwood plantations primarily use Gmelina arborea. The importance of plantations for industrial wood supply

will undoubtedly increase after the year 2000, by which time other plantation species will have reached harvest sizes. Appendix 2.8 shows the growth characteristics of the main plantation species.

#### Chapter IV

## 4.1 THE FOREST INDUSTRIES OF NIGERIA

Forest industries were the earliest established industries in Nigeria. A few of the sawmilling industries were established in the early part of this century. Divrsification into plywood mills and panel products started in the late 1940s (Adeyoju 1975).

There are six major categories of forest industries in Nigeria: sawmills, particle board mills, plywood mills, veneer mills. pulp and paper mills. In some cases two or more of these industries are integrated. In Bendel state, for example, plywood mills are integrated with veneer mills, particle board and sawmills.

Nearly all wood-based products consumed within Nigeria are produced by domestic industries with the exception of most paper and paperboard products. There has been a tremendous decline in the export trade of wood products from Nigeria. Between 1970 and 1978 revenue dropped from #6.2 million to #76,000. Recently, a ban was placed on the export of wood products from Nigeria. This move is partly to satisfy local demand and also to encourage development of local wood industries.

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Forest industries are concentrated in the southern part of Nigeria, within the high forest zone, where there is easy access to sources of raw material. In addition, rivers and streams in this zone provide cheap transport of logs to the mill sites. Presently a greater concentration of sawmill industries is found in the southwestern states of Oyo, Ondo, Ogun and Bendel. As the supply of forest wood is rapidly decreasing in these states, the forest industry will assume increasing importance in the southeastern states as they have a more reliable potential.

## 4.2 THE SAWMILLS

Growth in the forest industries, especially the sawmills, was rapid between 1974 and 1980. A survey carried out in 1974/75 showed 400 sawmills in Nigeria. by 1977 this number had grown to 500 (FAO 1979). The most recent survey of forest industries in the country shows that the number has more than doubled to 1030 sawmills (FAO 1981). From 1974 to 1980 there was an average increase of 105 new sawmills per year. This increase has been accompanied by an increase in the production of sawnwood from 824,000 m<sup>3</sup> in 1974 to 2.7 million m<sup>3</sup> in 1980, an average increment of 311,150 m<sup>3</sup> of sawnwood per annum. Table 4.1 shows sawnwood production figures in 1980, by states. Growth in the number of sawmilling industries and their capacity can be attributed to growth in gross domestic product during the 1970s which

#### Table 4.1

State	Small	Medium	Large	Total
Bendel	226,800	-	82,500	309,300
Cross River	-	-	15,000	15,000
Gongola	13,440	-	-	13,440
Kano	10,080	-	-	10,080
Kwara	57,120	-	-	57,120
Lagos	174,720	48,000	172,500	395,220
Niger	10,080	-	-	10,080
Ogun	322,560	40,000	52,500	415,060
Ondo	235,200	244,000	187,500	666,700
Оуо	327,600	252,000	202,500	782,100
Rivers	16,800	-	-	16,800
TOTAL	1,394,400	584,000	712,500	2,690,500

# Estimated Sawn Wood Production by Sawmill Size and State in m<sup>3</sup>, 1980

Source: Oni et al, Forest Industries Inventory of Nigeria, FAO, 1981.

- Small sized mills are estimated on the basis of one shift operations for 240 days; medium and large mills are estimated at one shift per day for 250 days.

was greatly influenced by the oil industry, by growth in the construction industries following the civil war at the beginning of the 1970s, and by growth in population.

There are three major categories of sawmills presently in operation, as indicated in table 4.2. They are categorized by equipment and capacity. About 93% of all sawmills whether large, medium or small, use French-manufactured horizontal bandmills model CD 0, CD and CD . These machines have a low investment cost (FAO 1981). Sawmills are classified as small when they have only one horizontal handmill and are capable of producing up to 10 m<sup>3</sup> of sawnwood per shift. About 80% of all sawmills in Nigeria are in this category. For 1980, these small sawmills produced over 56% of the total sawnwood produced in Nigeria. Sawmills have two horizontal handmills with headrigs, or one vertical bandmill capable of producing 10-30 m<sup>3</sup> of sawnwood per shift are classified medium-sized sawmills. In 1980 they constituted over 14% of all sawmills, producing over 19% of the total sawnwood produced. Sawmills with three or more horizontal bandmills with headrigs, or two vertical bandmills having a total production capacity of more than 30 m<sup>3</sup> of sawnwood per shift, are classified as large sawmills. There were 54 of these mills in 1980, producing over 24% of the total sawnwood.

Table 4.3 shows the distribution of the various categories of sawmills throughout the states. A major

Table 4.2

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# <u>Distribution of Sawmills, by</u> Size, and Their Production Capacity

1980

Sawmill Size	Number	Mills %	Production	Capacity
SMALL below 10 m³/shift	830	80.6	6,640	56.15
MEDIUM over 10-30 m³/shif	t 146	14.2	2,336	19.75
LARGE over 30 m³/shift	54	5.2	2,850	24.10
TOTAL	1,030	100	11,826	100

Source: Oni et al, Forest Industries Inventory of Nigeria, FAO, 1981.

Table 4.3

State	Small	Medium	Large	Total	
Bendel	135		3	138	
Cross River	-	-	2	2	
Gongola	8	-	-	8	
Kano	6	-	-	6	
Kwara	34	-	-	34	
Lagos	104	12	10	126	
Niger	6	-	-	6	
Ogun	192	10	4	206	
Ondo	140	61	22	223	
0yo	195	63	13	271	
Rivers	10	-	-	10	
TOTAL	830	146	54	1030	

# Distribution of Sawmills by Size and State

Source: Oni et al, Forest Industries Inventory of Nigeria, FAO, 1981.

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characteristic common to these mills is a low log recovery ratio. Studies by Hawthanen (1975) put this recovery rate at 53%. In 1980 over 2.6 million m<sup>3</sup> or sawnwood was produced with about 5 million m<sup>3</sup> of round log. Table 4.4 shows the estimated volume of log input into the various mills in Nigeria.

#### 4.3 THE PARTICLE BOARD INDUSTRY

The particle board mill came into existence in 1978, with an annual production capacity of 35,000 m<sup>3</sup> (per annum.) Presently there are two particle board mills in Bendel state with a combined annual production capacity of 55,000 m<sup>3</sup> (per annun). these two mills are integrated with sawmills and veneer mills, whose solid residues are used as raw material for particle board. Therefore, the annual log requirement for the particle board industry is zero.

#### 4.4 PLYWOOD AND VENEER MILLS

By 1980 there were six plywood mills in Nigeria, with an annual production capacity of 89,000m<sup>3</sup>. The second component of wood-based panels is the veneer mills. By 1980 there were six veneer mills in the country. These mills are integrated with the plywood mills. The veneer mills have a production capacity of 5000 m<sup>3</sup> of veneer per annum. Both the plywood mills and the veneer mills require substantial amounts of round log. Studies by the FAO (1981) put the log Table 4.4

State	Small	Medium	Large	Total	
Bendel	427,925		155,660	583,585	
Cross River	-	-	28,300	28,300	
Gongola	25,360	-	-	25,360	
Kano	19,020	-	-	19,020	
Kwara	107,775	-	-	107,775	
Lagos	329,660	90,565	325,470	745,695	
Niger	19,020	-	-	19,020	
Ogun	608,605	75,470	99,055	783,130	
Ondo	447,775	460,375	353,775	1,261,925	
Оуо	618,115	475,470	382,075	1,475,660	
Rivers	31,700	-	-	31,700	
TOTAL	2,634,955	1,101,880	1,344,335	5,081,170	

#### Estimated Volume of Logs Processed by Sawmills in 1980, in M<sup>3</sup>

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Source: Oni et al, Forest Industries Inventory of Nigeria, FAO, 1981.

A recovery factor of 53% is used in estimating log input, based on a study conducted by Hawthanen, N[R/71/564.

recovery ratio of the plywood mill at 50% of total log input. In 1980 log requirements for the plywood mill were 197,785 m<sup>3</sup> and 11,100 m<sup>3</sup> for the veneer mills.

#### 4.5 PULP AND PAPER MILLS

The earliest pulp and paper mill was established in Kwara state in 1967, although production did not start until 1968 (Enabor 1976). Today there are three pulp mills, with an annual production capacity of about 700 metric tonnes of paper per annum (FA) 1981). An estimated log requirement of about one million m<sup>3</sup> of round log was required in 1980.

# 4.6 MATCH FACTORIES

Five match factories exist in Nigeria. Only the one in Ogo state was reported to be a major user of round logs. Others import their raw material or make use of chips from other wood-using industries. About 2000 m<sup>3</sup> of round log was consumed by the match industry based in Oyo. A total of 14 million boxes of matches were produced in 1980.

Table 4.5, is a summary of the total industrial wood requirement. From this table, it is evident that most of the timber is used up by the sawmill industry. By 1980, it required over 5 million m<sup>3</sup> of round logs. This is followed by pulp and paper and plymills. The total wood requirement was over 6.8 million m<sup>3</sup> of round logs.

State	No.	SAWMILLS Production Capacity	Log Re- quirements	No.	PLYWOOD MIL Production Capacity	LS Log Re- quirements	No.	VENEER MIL Production Capacity	LS Log Re- quirements	Р/ No.	ARTICLE BOAN Production Capacity	RD Log Re- quirements	M. No.	ATCH FACTOR Production Capacity	LES Log Re- quirements	No.	PULP AN Production Capacity	D PAPER Log Re- quirements	TOTAL ANNUAL LOG REQUIREMENT
BENDEL	138	342,000	645,000	2	30,000	66,670	2	1,500	3,335	2	5,500		-		_				715,005
CROSS RIVER	2	15,000	28,000	2	30,000	66,670	2	1,400	3,110	-	-	-	-	-	-	1	-	500,000	397,780
COXDOL	8	15,000	28,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28,000
KANO	6	12,000	25,000	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	25,000
KWARA	34	65,000	125,000	-	-	-	-	-	-	-	-	-	1	-	-	1	-	300,000	425,000
LAGOS	126	420,000	790,000	1	14,000	31,110	1	700	1,155	-	-	-	1	-	-	-	-	-	822,665
NIGER	6	12,000	25,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25,000
OGUN	206	461,000	870,000	-	-	-	-	-	-	-	-	-	-	-	-		-	-	870,000
ONDO	223	700,000	1,320,000	1	15,000	33,335	1	1,400	3,110	-	-	-	-	-		1	-	325,000	1,681,445
oyo	272	829,000	1,565,000	-	-	-	-	-	-	-	-	-	1	_	20,000	-	-	-	1,585,000
RIVER	10	19,000	36,000	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	36,000
TOTAL	1030	2,890,000	5,457,000	6	89,000	197,785	6	5,000	11,130	2	5,500	_*	5	-	20,000	3	-	1,125,000	6,810,895

Table 4.5 Annual Production Capacity and Log Requirements, in M<sup>3</sup>, by State and Industry Type

\*Particle Board mills utilize the solid residues from sawmills and plywood mills, in which they are integrated.

Source: Oni et al, Forest Industries Inventory of Nigeria, FAO, 1981.

#### Chapter V

# 5.1 <u>ANALYSIS OF DATA/INDUSTRIAL WOOD SUPPLY AND DEMAND</u> BALANCE IN THE HIGH FOREST ZONE OF NIGERIA

Table 5.1 demonstrates the supply and demand balance of the industrial wood supply in the high forest zone. It also illustrates the improvement in the form of increased duration of log supply with increased species utilization and decreased waste in the forest industries.

From the analysis, given the current level of round log requirements of the forest industries, level of technology and species utilization, states such as Bendel, Cross River and Ondo states could achieve supply periods of 68, 56, and 24 years, respectively. Other states in the zone-- Ogun, Kwara and Oyo states--could only achieve supply periods of 18, 8 and 8 years, respectively.

Under increased species utilization, there is a relative improvement in the duration of log supply in the various states. Bendel, Cross River and Ondo states could achieve supply periods of 83, 84, and 30 years, respectively. Ogun, Oyo and Kwara states could achieve supply periods of 30. 10 and 11 years, respectively.

Most states of Nigeria will face the problem of acute industrial wood shortages in the near future. The severity

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	Industrial Wood Require-	Duration of Log Supply Current Tech-	Percent of	Duration of Log Supply Under Full	Duration Supply Increas	n of Log Under ed Conver-	Full S Utiliz Increa	pecies ation sed Con-
State	nent (round log) m <sup>3</sup> 980	Utilization	Utilized	lization	60%	70%	60%	70%
Bendel	715,005	68	22	83	77	90	94	110
Cross Rive	r 597,780	56	49	84	63	74	95	111
Kearn	452,000	8	35	11	9	11	13	15
Ogus	870,000	18	21	22	20	24	25	29
Ondo	1,681,445	24	30	27	27	32	34	40
Оуо	1,585,000	8	16	10	9	11	11	13

Table 5.1 Industrial Wood Supply/Demand Balance in the High Forest States (m<sup>3</sup>)/Years

Current conversion ratio 53%

Potential Industrial Wood Net Stock (round log) Appendix 2 (1-7) Potential Industrial Wood Cross Stock (round log) Table 3.4, 3.7 Industrial Wood Requirement Table 4.5 % of Wood not utilized (Derived from Table 3.4) of this shortage will vary from state to state. The analysis shows that only states such as Bendel and Cross River could rely on the high forest for continuous wood supply, provided effort to sustain this yield is not relaxed. In states such as Kwara and Oyo it is almost unthinkable to go bake to a situation of sustained yield management, unless drastic policies are adopted, such as cutting back on the number of indsutries, or increased plantation establishment. The states of Ogun and Ondo have a longer time to adjust for a sustained yield from the forest than Kwara and Oyo states.

States such as Lagos, which have almost no productive forest areas, may have greater difficulties in the procurement of raw materials from other states.

With an increased conversion ratio and possible increase in species utilization, substantial improvement can be possible in the duration of log supplies. Bendel, Cross River, Ogun and Ondo states will be able to supply wood for a considerable period of time, enabling forests to achieve sustained yield.

#### Chapter VI

#### 6.1 SUMMARY/RECOMMENDATIONS

The need for efficient resource management in the forestry sector of the Nigerian economy cannot be overemphasized. This sector provides benefits such as employment, wages, taxes and purchases. Hence efforts should be geared towards the efficient operation of this vital sector.

The analysis within this study shows a lack of managment of the forest resource which will ultimately result in acute wood shortages in most states. The extent of such shortages will vary from state to state (Table 5.1). While a few states can cope with the problem of wood shortage by relying on existing stock and planning for a sustained harvest, others are past the point of a sustained harvest. This situation that will eventually result in total depletion of the forest resource.

The impact of the present timber consumption poses serious problems for resource administrators. The following are identified as critical areas that must be addressed to achieve efficient management of the forest resource:

increasing capacities of the sawmills in the various states,

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- technological inefficiencies leading to high percentage of waste in the industries,
- 3. low percentage of species utilization, and
- 4. inadequate forest management policies to regulate the forestry sector.

The total effect of these will lead to an acute wood shortage states such as Kwara and Oyo will essentially run out of industrially usuable wood by 1988. This situation calls for serious government attention.

#### 6.2 RECOMMENDATIONS

A wood balance study in the forestry sector of the Nigerian economy is needed to assist in forest planning. From these studies, the government should be in a position to determine the appropriate size and capacity of wood industries, and to identify the needs for management of the high forests and plantation establishments. Such planning will encompass supply will encompass supply and demand studies with a thorough consideration of the environment and equity issues. The problems of the forest indsutry, including species utilization, recovery ratio and total wood requiremtns, must be based on the sustainable levels of forest production. Over-consumption of the forest resource which leads to resource depletion must be discouraged.

To arrive at such a comprehensive plan, a strong information base is needed. The forestry sector information base is sorely underdeveloped in Nigeria, due to political, cultural and economic reasons. These are described in appendix 3. No matter ho good-intentioned, any policy which lacks the backing of a solid statistical base is bound to be inefficient. Appendix 4 shows the type of information that might be helpful in planning the forestry sector.

Each state should strive for self-sufficiency in the production of industrial wood, especially in the areas which provide it with a comparative advantage. This necessitates an adequate silvicultural knowledge of the zones and species therein. This knowledge is especially needed in Kwara and Oyo states where resource depletion has already started.

A busy timber industry benefits the economy of the country through employment, wages, purchases, taxes. It may be necessary to examine the current ban on the importation of round logs into the country.

This might be necessary to keep industries in operation, allowing ample opportunity for plantations to start yielding, and avoiding a situation of irreparable depletion of the forest.

Forest practice in the states of Nigeria is still in the "cut-and-get-out" stage of the 1890's, when lumber men were interested only in logs. Tree-stumps, limbs, branches and foliage were left in the forest as worthless debris that frequently served as tinder for disastrous fires. The same oldfashioned operation is observed in the mill operations. Waste occurs at the mills where square timber is fashioned

from round logs. Slabs, trimmings, bark and sawdust is hauled to refuse dumps where it is burned. Too much of the forest harvest is squandered. Current estimates put the amount of waste generated by the sawmills at 47% of log input (Hawthanen 1975). This amounts to enormous volumes of wood wasted. This is most acute in Ondo, Oyo, Kwara, Cross River and Ogun states, which have no particle board or chip board mills. A number of ingenious methods of utilizing every part of the tree, including the bark, have been developed in most developed nations (Owen 1975). It is necessary as a matter of policy to establish at least one particle board industry in each state where forest operations are carried out. This will help achieve more efficient resource utilization.

Current low levels of species utilization in all the states need adequate attention. Research on the use of lesser known species should be considered a top priority. Presently, the average percentage of unusable wood is about 28% (table 5.1). Adjacent vegetation zones to the high forest has the species utilization problem as the major cause for the inability of the swamp forest to produce industiral wood (Skoup 1980). Effort should therefore be geared towards providing knowledge of these species.

Supervision and control of forest operations should become a national, not a state, priority. A federal forest advisor should be appointed to each state forestry service.

He should be governed by a national policy which gives the appropiate guidance. The adviser should assist in planning location and log supplies and to set standards on methods for increased productivity and efficiency in the forestry sector. A minimum standard of equipment should be specified in licences to ensure full logging operations in the forests and high conversion ratios in the industry. The adviser should also assist in setting forest charges to reflect the relative scarcity of forest wood.

In summary, more active planning and management of the forestry sector is urgently needed in Nigeria. The government should decide which steps to take in correcting the forest resource situation. Based on the analysis of this study some options include:

- Make regulations guiding forest operations in Nigeria,
- Relate forest industry capacity to sustainable harvest production; direct policies to achieve it,
- Carry out studies and implement findings on reducing waste in the forest industry; establish particle board mills,
- The forest revenue/pricing system should be examined, and perhaps altered to reflect the relative scarcity of wood,
- Conduct studies on use of lesser known species, presently not utilized,
- 6. Embark on the management of natural forest on a sustained yield schedule,
- Introduce plantations or expand where necessary to compensate for the slow growth from the natural forests, and

- 8. Appoint advisers for each state who use government policy to set production goals and objectives.
- 9. Examine the current ban on the importation of round logs, it may be necessary to complement domestic production from external sources.

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APPENDIX 1.1									
( <u>Gmelina</u> Plantations)	Summary of Yie	ld by States	- m <sup>3</sup>	(1980 -	2000)				

State	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	´ 1995	1996	1997	1998	1999	2000	
Ondo	64980	64980	67260	40020	133020	282320	296520	331980	104980	107260	58820	237220	242320	256520	291980	64980	67260	40020	130020	282320	296520	
Ogua	139520	139520	139520	181680	186680	337360	331360	333920	133920	133920	195360	215560	327840	321840	339520	139520	139520	151680	186680	337340	331360	
Kwara	20840	20840	20840	110440	173460	175960	142960	72160	28960	31600	134640	214840	158440	125440	64040	20840	20840	110440	173640	175690	142960	
Bende l	238280	238280	265380	174943	201660	322620	197620	257680	238280	265380	174943	201660	332620	197620	257680	238280	265380	174943	201660	332620	197620	
Oye	60960	60960	60960	139240	136240	8720	8620	10560	63360	26640	300520	197120	24800	24800	139760	60960	60960	189240	136240	8720	8720	
Cross River	211200	211200	200000	240000	240000	425800	438200	381800	355200	355200	400000	440000	281800	294200	237800	211200	211200	200000	240000	428400	438209	
Anambra & Imo	33880	33880	33880	159480	501680	358400	151200	399200	89200	152240	488640	530840	332240	125040	343880	33880	33580	33880	501680	358400	151200	

Calculation

Rotation age 8 years - Pulpwood 15 years - Sawlog Yield - 200 m<sup>3</sup>/ha each falling Management - Coppice Rotation

#### APPENDIX 1.2

# Estimate of the Potential Log Supply of Industrial Wood - Ondo State (1980-2000)

Estimated volume of wood supply from non-reserved forest

= 20,200.4 m³/annum

Estimated duration = 15 years (FAO 1979) Growth increment = 0.27 m/annum ? (1.27%/3/7)

Total volume at Year 1995

 $= 20,200.4 (1 + .0127)^{15}$ 

$$= 24,410.16 \text{ m}^3$$

From reserved forest

Growth increment = .0127 m/annum ? (1.27 % / ?)

At 20 years estimated volume =  $28,369,000 (1 + .0127)^{20}$ 

From Plantation 3,458,300 m<sup>3</sup>

Total Potential log supply = 39,996,734 m<sup>3</sup>
# Estimate of Potential Industrial Wood Supply Ogun State 1980-2000

Estimated volume from non-reserved forest = 13,297.6/annum Estimated duration = 15 years (FAO 1979) Growth increment = .0127 m/annum Total volume at Year 1995 = 13,297.6 (1 + .0127)<sup>15</sup> = 16,068.82 m<sup>3</sup>

Estimated volume from reserved forest = 7,970,000 m<sup>3</sup> Growth increment = .0127 m/annum

At 20 years estimated volume = 7,970,000 (1 + .0127) 20

= 10,258,267 m<sup>3</sup>

Estimated volume from Plantation = 4,773,640 m<sup>3</sup>

Total Potential log supply = 15,047,076 m<sup>3</sup>

# Estimate of Potential Industrial Wood Supply Bendel State, 1980-2000

Estimated volume from non-reserved forest = 42,476 m<sup>3</sup>/annum Growth increment = .0127 m/annum Estimated duration = 15 years Total volume Year 1995 = 42,476 (1 + .0127)<sup>15</sup> = 51,327.99 m<sup>3</sup> Estimated volume from reserved forest = 33,523,000 m<sup>3</sup> Growth increment = .0127 m/annum At 20 years volume = 33,523,000 (1 + .0127)<sup>20</sup> = 43,147,789 m<sup>3</sup> Estimated volume from Plantation = 4,975,149 Total Potential log supply = 48,174,266 m<sup>3</sup>

## Estimate of Potential Industial Wood Supply Cross River State, 1980 - 2000

Estimated volume from non-forest reserves = 160,121 m<sup>3</sup> Estimated duration = 15 years Annual growth increment = .0127 m/annum Total volume = 160,121 (1 + .0127)<sup>15</sup>

## = 193,490.22 m<sup>3</sup>

Estimated volume from forest reserves = 20,639,000 Growth increment = .0127 m/annum At 20 years Estimated Volume = 20,639,000 (1 + .0127)<sup>2</sup>°

= 26,564,663 m<sup>3</sup>

Volume from Plantation =  $6,410,000 \text{ m}^3$ 

Potential Supply Total Volume = 33,168,153 m<sup>3</sup>

## Estimate of Potential Industrial Wood Supply Oyo State, 1980 - 2000

Estimated volume from non-reserved forest = 22,275.5 Estimated duration = 15 years Growth increment = .127 m/annum Total volume = 22,275.5  $(1 + .0127)^{2.5}$ = 26,917.714 m<sup>3</sup> Estimated volume from forest reserve = 8,180,000 Growth increment = .0127 m/annum At 20 years Total Volume = 8,180,000  $(1 + .0127)^{2.0}$  m<sup>3</sup> = 10,528,560 m<sup>3</sup> Estimated volume from Plantations = 1,778,200 m<sup>3</sup> Total Potential log supply = 12,333,678 m<sup>3</sup>

## Estimate of Potential Industrial Wood Supply Kwara State, 1980 - 2000

Estimated Volume from reserved forests = 926,000 m<sup>3</sup> Growth increment = .0127 m/annum  $\frac{?}{;}$ At 20 years Total Volume = 926,000 (1 + .0127)<sup>20</sup>

= 1,191,863.9 m<sup>3</sup>

Estimated volume from Plantations = 2,140,320 m<sup>3</sup>

Total Potential log supply = 3,332,183.9 m<sup>3</sup>

Estimate of Potential Industrial Wood Supply imo and Anambra State, 1980 - 2000 Estimated volume from non-forest reserves = 41,629 m<sup>3</sup> Estimated duration = 15 years Growth increment = .0127 m/annum Total volume = 41,629 (1 + .0127)<sup>13</sup> = 50,304.48 m<sup>3</sup> Estimated volume from reserved forests = 632,000 Growth increment = .0127 m/annum At 20 years = 632,000 (1 + .0127)<sup>20</sup> = 813,453.52 m<sup>3</sup> Estimated volume from Plantation = 4,709,600 m<sup>3</sup> Total Potential log supply = 5,573,358 m<sup>3</sup>

Growth Characteristics	of Main Plan	station Speci	es
Species	Age A	iverage dbh (	( <u>cm</u> )
<u>Gmelina</u> arborea	15	40	
<u>Tectona</u> grandis	40	40	
<u>Nauclea</u> diderrichii	40	40	
Triplochiton Scleroxylon	40	40	

Source: Forest Development Nigeria 1979. 19 p.

# Forest Plantation Establishment (ha) Ogun State, by species

Species Up t	:0 1960	1961-65	1966-70	1971-75	'76	'77	'78	'79	'80
<u>Gme</u> . <u>arb</u> .									
Pulp wood	-	-	1643	2946	800	825	1050	1020	1000
Saw timber	-	-	378	238	144	220	NA	-	-
Tec. gra.	148	282	966	3794	516	588	NA	-	-
Nau. did.	456	13	185	586	40	80	-		-
Nau.& Mel.	263	-	-	-	-	-	-	-	-
Nau. & Ter.	-	143	144	-	-	-	-	-	-
Tec. & Gme.	-	59	250	161	-	-	-	-	-
Tec. & Tri.	-	-	152	188	-	-	-	-	_
Kha. ivo	-	-	~	44	-	-	-	-	-
Pin. car.	-	-	-	-	6	10			-
Others	130	-	-	-	158	140	-	-	-

Total

Total plantation establishment up to 1980 = 19766 ha.

Tec. gra. - Tectona grandis (Teak)

Nau. - Nauclea diderichii

<u>Ter.-</u> <u>Terminalia</u> <u>spp</u>.

<u>Gme. arb. - Gmelina arborea</u>

Pin. car. - Pinus Carribea

<u>Kha. ivo - Kkaya ivorensis</u>

Source: Compiled from: (For App. 1-9) World Bank Monitoring Report 1980 FAO 1979

#### Forest Plantation Establishment (ha) Ondo State, by species 1977 1978 1979 1980 1976 1971**-7**5 1961-65 1966-70 Species <u>Gme. arb</u>. 985 1135 914 150 600 57 -186 1431 Pulpwood ---594 536 -1000 -Sawtimber ---1128 1256 -3032 1303 283 Tec. gra. -622 \_ -675 Tec. & Gme. 308 <u>Tec. & Ter</u>. <u>& Gme</u>. ----1374 ---892 528 \_ 416 633 286 -----12 <u>Ter. Spp</u>. \_ 61 --------Ter. & Gme. \_ 206 2100 ---128 <u>Tec. & Tri</u>. 88 336 --۳, 132 --<u>Nau</u>. did. 30 120 \_ ----\_ -<u>Pin. Car</u>.

Total = 23356 ha.

# Forest Plantation Establishment (ha) Oyo State, by species

Species	Up to 1960	1961-65	1966-70	1971-75	1976	'77	'78	'79	' 80
<u>Gme. arb</u> .									
Pulpwood Sawtimber	123	- 402	46 1260	218 1452	685 728	420 476	-	14	394
<u>Tec. &amp; Gme</u>	-	83	830	696	-	-	-	-	-
<u>Tec. &amp; Ter</u> .	-	-	394	552	-	-	-	-	-
<u>Pin. Car</u> .	-	-	-	-	102	200	-	-	-
Indigenous	-	-	-	-	146	200	-	-	-

Total = 9421 ha.

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# Forest Plantation Establishment (ha) Kware State, by species

Species	Up to 1960	1961-65	1966-70	1971-75	'76	'77	'78	'79	'80
<u>Gme. arb</u> .									
Pulpwood Sawtimber	- 64	- 66	301	220 604	492 168	808 253	735	570	216
Gme. & others	6	3	-	-	-	-	-	-	-
Tec. gra.	86	140	104	199	-	37	-	-	-
<u>Tec. &amp;</u> others	101	6	2	20	107	510	-	-	-
Other mixtures	57	70	19	286	157	20	-	-	-

Total = 6333 ha.

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Forest Plantation Establishment (ha) Bendel State, by species									
Species	Up to 1960	61-65	66-70	70-75	1976	1977	1978	1979	1980
<u>Gme.</u> arb.									
Pulpwood Sawtimber	462	678	1944	4263	400	534	625	-	97
<u>Tec</u> . <u>gra</u> .	-	233	1618	3910	1692	-	-	-	-
Tec. & Gme.	190	899	340	359	-	-	-	-	-
<u>Nau</u> . <u>did</u> .	124	247	1090	5172	711	-	-	-	-
<u>Ter. spp</u> .	86	495	1340	960	579	-	-	-	-
<u>Mel</u> .	542	-	-	209	25	-	-	-,	-
Nau. & Mel.	311	200	2080	1595	520	-	-	-	-
<u>Nau. &amp; Ter</u> .	783	689	1936	159	-	-	-	-	-
<u>Nau. &amp; Others</u> .	357	172	288	518	123	-	-	-	-
Nau./Mel./Ter.	4093	813	563	39	-	-	-	-	-
Mel. & Others		47	85	240	-	-	-	-	-
<u>Tri. Sci</u>	223	80	24	-	4	-	-	-	-
Other Indigenous	7177	4732	11438	18364	4205	-	-	-	-

Total = 47172

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# Forest Plantation Establishment (ha) Anambra & Imo states, by species

Species	Until 1960	1961-65	1966-70	1971-75	1976	1977	'78	'79	'80
<u>Gme. arb.</u>									
Pulpwood Sawtimber	878	1576	847	2230	628 1500	2000	346	310	155
Tec. gra.	-	294	160	318	100	-	-	-	-
<u>Gme. &amp; Others</u>	192	654	80	24	-	-	-	-	-
<u>Nau. did</u> .	5	77	176	62	-	-	-	-	-
Ter. spp.	-	121	44	43	-	-	-	-	-
Other spp. in mix	116	146	103	49	50	-	-	-	-

Total = 14285 ha.

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	Fore	<u>Forest Plantation Establishment (ha)</u> <u>Cross River state, by species</u>							
Species	Pre-1971	1971-75	1976	1977	1978	1979	1980		
<u>Gme</u> . <u>arb</u> .									
Pulpwood Sawtimber	2000	4280 3600	800 1000	1000 1000	353	415	133		
Pine	-	-	10	30	-	-	-		
Other Hardwood	2700	1000	500	<b>90</b> 0	••	-	-		

Total = 19721 ha.

#### APPENDIX 3



A Description of the Problems of Statistical Agencies in the Nigerian Forest Sector

System of Environmental Statistics

Forest Resources Data System Industrial Logging Data System Forest Management Data System Forest Plantation Data System Fuelwood and Energy Data System Sawmill Data System Other Forest Industry Data System Foreign Trade Data System Forest Product Uses Data System

Source: Palo, M.S., 1981. Forest Sector Statistics, FAO: Rome, p. 93.

Land Use Data System Water Erosion Data System Watershed Data System Desertification Data System Flora Population Data System Fauna Population Data System National Park Data System Wood Biomass Data System

Source: Palo, M.S., 1981. Forest Sector Statistics, FAO: Rome, p. 89

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System of Environmental Statistics

System of Social Statistics

Agro-Forestry Data System Shifting Cultivation Data System Hunter - Collectors Data System Forest Sector Workers Data System Forest Administration Staff Data System Education and Training Data System Non-Market Fuelwood Data System

Source: Palo, M.S., 1981. Forest Sector Statistics, FAO: Rome, p. 97.