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FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS

THE LIBERIA FOREST SECTOR ASSESSMENT, PERTINENT POLICY ISSUES AND RECOMMENDATIONS FOR CONSIDERATION

THE REPUBLIC OF LIBERIA

FAO/ECA/UNIDO FOREST INDUSTRIES ADVISORY GROUP FOR APRICA (FIAG)
RAF/82/006

Addis Ababa
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CONVERSION/MEASUREMENT UNITS USED IN THE TEXT

Plywood	50% recovery rate
Veneer sheet	50% recovery rate
Sawntimber	45% recovery rate
One cubic meter	424 board feet
One acre burnt farm on ave	20 cords fuelwood
One cord	3.6 m^3
One rural household upland rice farm	1.4 ha or 3.5 acres/yr
One acre	0.404 hectares
One rural household on ave	10 persons
One urban household on ave	5 persons
5 persons urban household charcoal consumption per week	4 bags
One metric ton charcoal	6 m^3 fuelwood
One acre	640 square miles
1 hectare	2.474 acres

1 ACKNOWLEDGEMENT

I wish to register my thanks to all the Regional Advisers on the Forest Industries Advisory Group for Africa Team for their understanding and their useful contribution to the success of my training programme.

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2 INTRODUCTION

This paper is written in fulfilment of the requirement of the Associate Regional Advisers (ARA) Programme which is run under the auspices of the Forest Industries Advisory Group (FIAG) for Africa.

Basically, the objective of the Forest Industries Advisory Group is to assist African countries in promoting the growth of forest industries and their optimum contribution to economic and social development. The FIAG in attending to its objective strives to attain the following targets:

1. Technical assistance to governments in project identification, pre-feasibility studies, market surveys and transportation investigation;

2. Promotion of investments, both in terms of new operations, expansion and improvement in existing plants;

3. Promotion of Intra-African cooperation in wood and wood products trade with the aim of maximum utilization of available resources and fostering of industrial development; and

4. Training of government personnel at the level of Associate Regional Advisers (ARA) to ensure the rational planning of forest resources, establishment and management of productive enterprises and consequently the efficient utilization of the available resources within the region.

In the light of FIAG's effort relative to the development of forest industries and the promotion of Intra-African Cooperation, initiation and implementation of joint ventured programmes in the region have started bearing fruits. African countries, both members and non-members of the African Timber Organization (ATO) have begun taking advantage of the ample opportunity which is associated with inter-region trade cooperation. Just to name a few, some of the already established and pipeline joint ventures and participating countries are namely:

Country	Nature of joint venture
Algeria-Mozambique	Logging (present) + sawmilling (future)
Algeria-Congo	Logging + sawmilling (present) veneer production future
Cameroon-Egypt	Veneer Production (pipeline)

FIAG also in putting the implementation of its terms-of-reference on the proper footing orientate senior employees of the region in the techniques of the promotion and development of forest industries.

The author during the period January to June ending 1984, like all other previous Associate Regional Advisers, association with FIAG afforded him the opportunity to get an insight into the activities and operation of the Economic Commission for Africa (ECA). This training scheme is implemented.

3 BACKGROUND

3.1 Geography/location

Liberia is situated on the west coast of Africa. The country is bounded by Sierra Leone to the West, Ivory Coast to the East, Guinea to the North and the Atlantic Ocean to the South. The Republic of Liberia covers a total land area of 111,369 square kilometres or 37,700 square miles which is approximately 24.0 million acres.

3.2 Climate

The climate is tropical and all the country is within the rainfall range of the humid or wet evergreen semi-deciduous forest. The annual rainfall decreases from 4,500 mm to 2,200 mm along the central and northern parts of the coast. The temperature varies from 21°C to 32°C.

3.3 Population

Liberia's population at the end of December 1981 was estimated at 1,971,636 and it is projected to reach 7,097,000 by year 2020 based on an annual growth rate of 3.0 percent (Table 1).

Table 1 Liberia demographic trend (1980-2025)

Population characteristics	1980	1985	1990	1995	2000	2010	2020	2025
a) Population by sex								
total (1,000)	1,967	2,355	2,821	3,370	4,002	5,471	7,097	7,897
- male	983	1,180	1,415	1,693	2,013	2,755	3,569	3,967
- female	984	1,175	1,405	1,677	1,989	2,717	3,528	3,930
Sex ratio	100.0	100.4	100.7	101.0	101.2	101.4	101.2	100.9
b) Urban- rural population								
- urban (1,000)	648	865	1,147	1,504	1,943	3,064	4,451	5,192
- rural (1,000)	1,319	1,490	1,674	1,866	2,058	2,407	2,646	2,704
- urban (%)	33	37	41	45	49	56	63	66
- rural (%)	67	63	59	55	51	44	37	34
c) Population density/km^2	18	21	25	30	36	49	64	71

Source: Demographic Indicators of countries estimates and projections as assessed in 1980, UN, New York, 1982 (published)

3.4 Economy

The Liberian economy is predominately characterizes by the free-enterprise system buttressed by the Government « Open Door Policy » launched in 1944.

The Gross Domestic Product (GDP) in 1976 and 1978 estimated were respectively $568.6 million and $640.0 million (Table 2).

Table 2 Gross Domestic Products by sector ($ million, at current factor cost)[1]

Category	1976	1977	1978
Agriculture	78.2	96.2	113.7
Mining	182.6	144.4	117.6
Manufacturing	45.2	50.2	51.2
Construction	37.9	44.1	50.1
Government Services	51.5	70.6	82.0
Other Services	24.4	26.9	n.a.
GDP at current factor cost	568.6	621.5	640.0

Table 3 Foreign trade balance (million Liberian Dollars)[2]

Category	1976	1977	1978	1979	1980
Domestic Exports	451.0	440.5	479.4	530.0	600.6
Re-exports	6.0	7.0	7.0	n.a.	n.a.
Imports	399.2	463.5	480.9	540.0	534.7

3.5 Foreign exchange earning commodities

Liberia natural resource endowment includes but not limited to (1) agricultural resources: cocoa, rubber, fish, coffee, Kola-nuts and oil palm; (2) Industrial resources - diamond, gold, lead, iron ore, colombite, and manganese; and (3) forestry resources - logs and wildlife. Of these, the most important foreign exchange earning commodities are, namely: iron ore, rubber, diamond and logs. Total foreign exchange earned aggregatively increased from $443.4 million in 1976 to $561.9 million in 1980, an increase of twenty seven (27%). However, the foreign earning exchange earnings dropped to ten (10%) percent in 1981 due to downward fluctuation in international commodity prices (Table 4).

Table 4 Main exports by value and volume 1976-1981

Category	1976	1977	1978	1979	1980	1981
1. Iron ore						
- value ($ million)	328.7	273.5	274.4	290.0	310.2	325.4
- volume (million long tons)	20.5	17.4	20.8	19.6	16.9	20.4
2. Rubber						
- value ($ million)	53.3	59.1	69.2	87.8	102.2	86.7
- volume (thousand lbs)	161.5	153.6	158.0	165.3	168.7	169.2
3. Logs and timber						
- value ($ million)	34.6	29.3	54.9	58.4	72.5	36.6
- volume (thousand m^3)	535.0	389.0	389.0	389.0	400.0	221.0
4. Diamond						
- value ($ million)	16.6	21.4	30.3	39.6	33.5	23.4
- volume (million carat)	0.3	0.3	0.3	0.3	0.3	0.3
5. Cocoa + coffee						
- value ($ million)	10.7	49.6	39.7	38.1	43.5	33.2
- volume (million lbs)	14.8	26.7	28.0	25.6	36.2	33.1

Source: Economic Survey of Liberia – 1981

[1] New African Yearbook – Facts and Figures
[2] Economic Survey of Liberia, 1981

3.6 Banking

The currency use in Liberia for the medium of exchange is the United States Dollar. Banking activities are carried out by several financial institutions, some of which have branches established in the rural areas. The existing major banking institutions presently in operation are, namely:

Government (Public) Banks

National Bank of Liberia (NBL);
Liberian Bank for Development and Investment (LBDI);
Agricultural and Cooperative Development Bank (ACDB);
National Housing and Saving Bank (NHSB).

Commerical Banks

Chase Manhattan Bank (CHASE);
Citibank (Bank of Monrovia);
Bank of Liberia;
International Trust Company of Liberia (ITC);
Liberia Trading and Development Bank (TRADECO).

3.7 Infrastructure

3.7.1 Transport

The transportation system in Liberia is mainly by air and road.

3.7.2 Air transport

Presently, there are two major airports, the Robertsfield International Airport which exclusively caters to international flights and the James Spriggs Payne Airfield which serves domestic flights. Besides, there are airstrips in each of the administrative headquarters.

3.7.3 Road transport

At the end of 1981, the total road network was estimated as 6,268 miles as follows:

Public roads	4,794
Primary road	*1,165*
Paved roads	*366*
Laterite road	*799*
Secondary + Feeder roads	*3,629*
Feeder roads	*2,344*
Laterite (all weather roads)	*1,285*
Private roads	1,474
Paved roads	*93*
Laterite road	*1,381*
Total	6,268

3.7.4 Port

Liberia has four modern ports. These ports are all named after the capital of the countries in which they are located as follows:

Port	Location	Country
1. Monrovia Port	Monrovia	Montserrado County
2. Greenville Port	Greenville	Sinoe County
3. Buchanan Port	Buchanan	Gran Bassa County
4. Harper Port	Harper	Maryland County

4 CONTRIBUTION OF THE FORESTRY SECTOR

The forestry sector is export-oriented. In terms of foreign exchange earnings logs and lumber occupy the third place among various export commodities, the first and second places being occupied by iron.

Table 5 Forestry share in foreign exchange earnings

Year	Total value of export	Value of logs and lumber	Logs and lumber contribution to foreign exchange earnings (%)
1976	457.1	34.6	7.6
1977	447.4	29.3	6.5
1978	486.4	54.8	11.3
1979	536.6	58.6	10.9
1980	600.4	72.5	12.1
1981	529.2	36.8	7.0
1982	477.4	32.6	6.8

The forestry industry contributed in 1971 constant prices $16.4 million in 1977, $21.2 million in 1978 and $10.6 million in 1982 to the Gross Domestic Product (Table 6).

Table 6 Forestry share in foreign exchange earnings

Year	Total GDP		Forest contribution to GDP (absolute)		% of forestry sector to total GDP	
	Constant	Current	Constant	Current	Constant	Current
1977	354.2	633.2	16.4	25.0	4.6	3.9
1978	368.2	670.0	21.2	35.0	5.0	5.2
1979	384.4	766.3	23.0	40.0	6.0	5.2
1980	366.2	800.8	12.3	47.0	6.3	5.9
1981	350.1	754.4	16.5	26.5	4.7	3.7
1982[1]	328.5	716.4	10.6	26.0	3.2	3.6

[1] Economic Survey of Liberia (1982) MPEA

5 FOREST ADMINISTRATION

An act in early 1976 created a corporate body, the Forestry Development Authority to replace the Bureau of Forestry which was established in 1953 and concentrated only on inventories and concession allocations. The Forestry Development Authority is now entrusted with the overall coordination and monitoring of the forestry industry.

5.1 Functional structure of the Forestry Development Authority

The Forestry Development Authority (FDA) has five functional divisions and four regions. Each division is headed by a Manager and each region is headed by a Regional Forester.

Division

- Administration
- Planning, Research and Statistics
- Forest Management and Wildlife
- Forest Utilization
- Accounts

Region	Headquarter
Region I	Saniquelle, Nimba County
Region II	Zwedru, Grand Gedeh County
Region III	Voinjama, Lofa County
Region IV	Greenville, Sinoe County

5.2 Global national forest policy

The essential aspect of forest policy in Liberia is to protect the forest resources with emphasis on:

a) Maximum utilization of existing resources – An objective which is implemented through exploitation entirely by private timber companies on the basis of concession agreement. Harvesting is monitored by the Forestry Development Authority, a semi-public autonomous agency, to ensure that the logging operations are carried out in accordance with provisions of a prescribed Management Plan.

b) Perpetual conservation of timber potential – This second objective is promoted through the policy of restoration of forest land completely damaged by shifting cultivation or logged over areas by concessionaires. The total achieved acreage of the reforestation programme as of 1982 stood at 17,880 acres.

5.3 Concession allocation and control

In the Liberia forestry industry, the existing legal basis for utilization of public forests is contractual between potential concessionaires and the Government. The usual duration of a concession contract is 26 years. The forest exploitation and utilization activities of the concessionaires are controlled by a prescribed Management Plan. This plan requires that each concession cuts/harvests annually only 4% of its total contracted acreage. The Management

Plan guidelines are also supplemented by several regulations enshrined with punitive measures. Ten regulations are promulgated and are now in force. They are as follows:

Regulation No. 1:	on waste of forest resources
Regulation No. 2:	on registration of timber export sales contracts
Regulation No. 3:	on Waybills
Regulation No. 4:	on control of non-concession operations
Regulation No. 5:	on assistance to owners of private land
Regulation No. 6:	on exploitation permits for non concession public forest land
Regulation No. 7:	on revised forest fees and taxes
Regulation No. 8:	on revised industrialization incentive fee
Regulation No. 9:	on enabling a special trade allowance on certain forest fees
Regulation No. 10:	on enabling a further reduction on certain fee

5.4 Available incentives

The government of Liberia practices the Free Enterprise Economic System. This is buttressed by the « Open Door Policy » which provides conductive atmosphere relative to protection of foreign investments and no restriction on repatriation of profits. Normally, incentives granted to the forestry industry are in package and run from 5-10 years.

These incentives are renewable based on the degree of bargaining and they are as follows:

a) Fiscal incentives – income tax holiday.
b) Duty and excise incentives :
   – exemption of plant, equipment machinery etc. from customs duties ;
   – exemption on processed timber and manufactured wood articles from export duties ;
   – exemption on petrol land fuel oil used solely for industrial purposes from excise taxes
c) Others-generous allowance for reinvestment and/or repatriation of profits.

5.5 Forestry taxation

Forestry taxation is employed not only for revenue generation but equally as for scientific forest management. The taxes are pro-rated in a way where they complement other acceptable forest management activities. Forest taxes established are used to influence the rate of harvest area harvested and the species cut. The rates reflect differences in stumpage between species; i.e. high taxes pay on high value species and low taxes pay on low value species. Export taxes which also vary with species and grades are used as policy instrument to promote intended domestic manufacture of forest products.

5.5.1 Structure of forestry taxation

The basis of forest revenue assessment in Liberia is the cubic meter. The valuation system based on tree-length volumes and per species in logs or timber form is used.

The tax structure consists of four main components, namely:

- Severance fee (tax):	\$1.50/m^3 full tree length irrespective of grade or intended use;
- Reforestation fee (tax):	\$3.00/m^3 full tree length irrespective of grade or intended use;
- Industrialization incentive fee (tax):	fee charged/or levied on round logs intended for export; rates vary according to species;
- Forest products fee (tax):	fee levied on export processed wood; rates vary according to species and degree of processing, i.e. being reduced with increased processing.

Land rental fee: Besides the four major tax categories, there is a surface rent of \$0.10 per acre. This surface rent is applied onto the allotted concession holding of a concessionaire until the expiration/cancellation of a granted Utilization Contract Agreement with the Government of Liberia.

6 FOREST ESTATE AND RESOURCES DISTRIBUTION

The total land area of Liberia covers 37,743 square miles or 24,155,000 acres. The forests occupy 12,000,000 acres or 49.8 percent of the total land area of the country. The composition by forest types and the geographical distribution of the 12,000,000 acres are as follows:

6.1 Composition of forest of estate (in millions)

Types	Acres	Hectares	% share
Undisturbed productive (protected)	4.2	1.70	35
Disturbed productive (unprotected)	5.4	2.18	45
Total productive	9.6	3.88	80
Disturbed unproductive (unprotected)	2.4	0.97	20
Total	12.0	4.85	100

6.2 Geographical distribution of forest (in millions)

Region/Sector	Acres	Hectares	% share
South Eastern	6.80	2.75	60
North Western	3.00	1.12	20
Northern Sector	0.15	0.06	3
Others	2.05	0.83	7
Total	12.00	4.85	100

6.3 Species composition

The forest of Liberia contains about 230 species (Appendix I). Some of these are classified on the basis of their technical properties and usage[3] as follows:

Established (commercial) species

a. Iroko
b. Makore
c. Sapelli
d. Sipo
e. Kossipo
f. Tiama
g. Khaya (Mahogany)
h. Dibetou
i. Niangon
j. Samba/Wawa
k. Framire
l. Doussie/Afzelia
m. Bosse/Guarea

Veneer species

a. Frake
b. Aiele
c. Abura
d. Ilomba
e. Ako
f. Faro
g. Bombax
h. Ceiba

[3] Source: Forest Resources available in the ATO countries July 1982

Semi-heavy softwood

a. Naga
b. Bondu
c. Sikon
d. Emien
e. Kanda
f. Ebiara
g. Longhi
h. Mutundu
i. Idewa
j. Taubaouate
k. Amazakoue
l. Essessang
m. Ohia
n. Lati

Heavy hardwood

a. Kusia
b. Limbali
c. Oboto
d. Ozonga
e. Angus
f. Eyown
g. Rikio
h. Tali
i. Dambema
j. Bodioa
k. Apome
l. Eveus
m. Vesambata
n. Ekki/Azobe

7 PRESENT SITUATION OF PRODUCTIVE WOODY VEGETATION

According to Lanly[4] and quoted by FIAG (1984), the commercially exploitable forest area of the 9.6 million acres productive forests was taken as 3,290,420 acres or 1,330,000 hectares and the woody productive forests classified under two main categories as follows:

Areas of productive woody forests (1000 acres)

Forest types	Acres	Hectares	% share
Undisturbed	2,239	905	68
Disturbed (loggedover)	1,051	425	32
Total	3,290	1,330	100

The Liberia forestry sector Management Plan prescribed a four (4) percent annual allowable coupe. Therefore, assuming that 4% of the productive commercially exploitable forest area would be released for exploitation, the area worked annually would be 132,000 acres or 53,000 hectares and the productivity of the Liberia natural forest were properly managed, would likely continue beyond the year 2000 as opposed to the prediction of some experts. Notwithstanding, in view of the apparent depletion of the forest and in consideration of the significance of ecological balance and the perpetual socio-economic contribution of the forest estate, annual plantation programmes as direct function of the maximum extraction rate (MER) of the natural forest are proposed (Appendix II). The successful implementation of the plantation programmes, of course, will to a large extent depend on the orientation of the political will of the government. The forest estate has to be looked at as the only entity which contains renewable resources on which the nation's future livelihood depends and not the exhaustible resources or wasting assets, that is iron ore, diamonds, gold etc.

7.1 Annual timber potential (estimated), 1984

The gross timber potential of the total productive forest analytically would work out to 95,455,000/15,700,000; 177,705,000/29,000,000; and 259,955,000/42,300,000 acres/hectares under three yield assumptions as follows:

Assumption I

Productive forest	Total Acres	Total hectares	m^3/ac	m^3/ha	Total m^3/ac^3	Total ha
Undisturbed	2,239	905	37	15	82,843	13,575
Disturbed/logged over	1,051	425	12	5	12,612	2,125
Total	3,290	1,330	49	20	95,455	15,700

Assumption II

Productive forest	Total Acres	Total hectares	m^3/ac	m^3/ha	Total m^3/ac^3	Total m^3 ha
Undisturbed	2,239	905	62	25	138,818	22,625
Disturbed/logged over	1,051	425	37	15	38,887	6,375
Total	3,290	1,330	99	40	177,705	29,000

[4] Forest Resources of Tropical Africa

Assumption III

Productive forest	Total Acres	Total hectares	m^3/ac	m^3/ha	Total m^3/ac^3	Total m^3 ha
Undisturbed	2,239	905	87	35	194,793	31,675
Disturbed/logged over	1,051	425	62	25	65,162	10,625
Total	3,290	1,330	149	60	259,995	42,300

In accordance with the 4% annual allowable coupe provision, annual area to be worked would be 132,000 acres or 53 hectares and under the three yield/ac/ha assumptions above the annual potential volume production on acreage basis would be 3,834,000 m^3; 7,134,000 m^3; and 10,434,000 m^3 as computed below:

Assumption I

Forest type	Acres	Hectares	m^3/ac	m^3/ha	Total m^3/ac^3	Total m^3 ha
Undisturbed	90	36	37	15	3,330	540
Disturbed/logged over	42	17	12	5	504	85
Total	132	53	49	20	3,834	625

Assumption II

Forest type	Acres	Hectares	m^3/ac	m^3/ha	Total m^3/ac^3	Total m^3 ha
Undisturbed	90	36	62	25	5,580	900
Disturbed/logged over	42	17	37	15	1,554	255
Total	132	53	99	40	7,134	1,155

Assumption III

Forest type	Acres	Hectares	m^3/ac	m^3/ha	Total m^3/ac^3	Total m^3 ha
Undisturbed	90	36	87	35	7,830	1,260
Disturbed/logged over	42	17	62	25	2,604	425
Total	132	53	149	60	10,434	1,685

7.2 Exploitation and promotion of New Species

Under the assumptions I, II and III on an increasing trend, forest exploitation is expected to feature the following aspects:

- expansion of the exploitation of secondary species, e.g. Limbali, Frake, Loto, Movingui, Aide, Tali, Kotibe, Bilingeu ;
- exploitation and promotion of new species virtually unused (or lesser known) ;
- exploitation of remote and/or inaccessible productive forests.

The secondary species, and even the lesser known species, can be put to essential uses and hence marketable, e.g.:

Species	Usage
Ako, Aiele, Faro, Kondrotti	peeling
Agniegre, Koto	sawing and slicing
Framire, Frake, Movingui	sawn for internal joinery
Badi, Kolibe, Loto, Tali, Limbali	sawn for external joinery
Bahia	sawn for furniture
Samba	peeling, moulding, etc

Under a species-mix (established, secondary and lesser known) logs extraction from the forest, the life span of the Liberia forest estate may be stretched further into the longer future than anticipated by some experts where the selective cutting practice, i.e. creaming of the forest, which is largely practised by logging concessions is discouraged. This will intensify the utilisation of the available species which constitute the Liberia forest estate. The commercial species are becoming depleted due to the intensity of their harvesting. For instance, during the fiscal year 1981/82 established species exploited accounted for seventy-seven (77) percent in the total production of 412 thousand cubic metres (Table 7).

Table 7 Intensity of established species extraction (00 m^3) Fiscal 1981/82

Established species	Production (00 m^3)	% Share
Niangon	130,608	32
Sipo	50,853	12
Makore	29,680	7
Lovooa	28,634	7
Tiama	16,226	4
Khaya	12,824	3
Wawa	11,808	3
Framire	9,772	3
Sapelli	9,277	2
Kossipo	8,364	2
Iroko	4,278	1
Bosse	5,550	1
Afzelia	130	-
Sub-total (established species)	316,004	77
Other species	95,811	
Sub-total	95,811	
Grand total (all species)	411,815	

Source: Annual Report (1981/82), Forestry Development Authority

8 PLANTATION FORESTRY

The National Reforestation on Programme started in the 1970's. In 1971, loggers in fulfilment of the reforestation obligation as eshrined in the Forestry Sector Concession Agreement began planting activities in their areas of operation. This led to the proliferation of small plantations with little or no maintenance. Consequently, due to the thinly dispersion of these plantations, even sometimes of their establishment in inaccessible areas, the Government of Liberia around 1977 took over all National Reforestation activities with the assistance of the World Food Programme (WFP) and the Germany Forestry Mission (GFM). Presently, every active concession pays a reforestation fee of $3.00/m3 irrespective of species and intended use as contribution to the National Reforestation Programme.

8.1 Contributors to the national reforestation

Several international bilateral funding and private agencies have been involved with the promotion of the Liberia Government National Reforestation Programme. To name a few, the agencies are as follows:

- World Food Programme: assistance through which food is provided to reforestation labourers to supplement their daily wages;

- Germany Forestry Mission: a technical bilateral assistance mission of the Federal Republic of Germany to Liberia to assist in the silvicultural facet of the National Reforestation Programme and other scientific forest management techniques;

- International Development Association/African Development Bank (IDA/ADB): international funding agencies jointly contributing to the establishment of a Trial Industrial Pulpwood Plantation for a subsequent development of a large-scale pulpwood plantation;

- Liberia Forestry Corporation (LFC): a private joint venture of three Swedish Pulp Manufacturing Companies with intention to establish large scale pine plantation. However, unfortunately after planting about 825 acres, the company abandoned the project site following the April 2 1980 Coup. The planted area is now being maintained by the Forestry Development Authority.

8.2 Plantation achievement

At the end of 1981, the area of established plantations stood at 17,880 acres (Table 8).

Table 8 Area of established plantations (acres) 1971-1982

Centre/Site	Location	Acres	Hectares	%Share
1. Bomi Hills	Borni County	8,333	3,372	47
2. Cavalla	Grand Gedeh County	2,614	1,058	15
3. Siga	" "	1,367	553	8
4. Glaro	" "	2,211	895	12
5. Yekepa	Nimba County	1,355	540	7
6. Others		2,020	818	11
a) TIPP		(1,195)	(484)	(7)
b) LFC		(825)	(434)	(4)
TOTAL		17,880	7,236	100

The annual plantation achievement on the average exclusive of the Liberia Forest Corporation (LFC), a private establishment, is 1,550 acres. This annual target plantation achievement of 1,550 acres as compared with the annual average allotted coupe of 350,000 acres is 99.6 percent behind the rate of extraction. In other words, for every 226 acres harvested only one acre is replanted (350,000 ÷ 1550). As the natural forest is diminishing very fast, the reforestation programme must judiciously be stepped up.

8.3 Future plantation programme

In recognition of the shortfall of plantation establishment programme as compared with the rate of the natural forest exploitation in Liberia, an attempt is made to propose practical achievable annual plantation target for the period 1985 to 2030. The proposed plantation programme is based on the maximum extraction rate of the natural forest. However, the success of the proposed reforestation programme will entirely depend on the government commitment, a commitment which has to be expressed in three ways: giving priority to reforestation, budgetary support and the provision of staff. The conceived plantation programme would put emphasis on the cultivation of five species[5] (exotic and indigenous) and the developmental structure would be as given (Tables 9-11).

[5] FIAG data (see Annex II)

Table 9 Species composition (plantation programme)

Species	Share %	Rotation	Max. annual increment m^3/yr/acre	Yield/acre	
				Th cut m^3/acre	Fin cut m^3/acre
Pinus	30	20	25	371	866
Terminalia	25	30	12	272	619
Tripl	20	40	8	247	544
Khaya	15	50	5	124	495
Makore	10	60	4	99	495

Table 10 Required Plantation (000 acres)

Year/ Species	Pinus	Terminalia	Wapa	Khaya	Makore	Total
1980	2.30	2.57	2.30	2.30	1.53	11.00
1985	2.08	2.40	2.15	2.08	1.43	10.14
1990	1.93	2.22	2.00	1.93	1.33	9.41
1995	2.52	2.92	2.62	2.52	1.73	12.31
2000	3.27	3.76	3.39	3.27	2.25	15.94
2005	4.16	4.80	4.33	4.16	2.87	20.32
2010	5.05	5.84	5.24	5.05	3.49	24.67
2015	6.23	7.20	6.48	6.23	4.33	30.47
2020	7.42	8.54	7.72	7.42	5.15	36.25
2025	8.76	10.12	9.10	8.76	6.06	42.80
2030	10.09	11.68	10.51	10.09	7.00	49.37

Table 11 Estimated yield (000m^3)

Year/ Species	Pinus	Terminalia	Wapa	Khaya	Makore	Total	Ave, i.e. Annual
1980	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-
1990	334	-	-	-	-	334	67
1995	312	-	283	-	-	595	119
2000	1069	264	230	-	-	1563	313
2005	1106	245	215	111	-	1677	335
200	1165	964	200	104	61	2494	499
2015	1507	1014	262	96	57	2936	587
2020	1900	1085	845	126	53	4009	802
2025	2390	1372	906	163	69	4900	980
2030	2880	1732	965	853	90	6320	1264

8.4 Manpower requirement (plantation programme)

In order to implement the establishment, development and maintenance of the proposed programme, the annual manpower requirement, assuming that 272 persons[6] are need to establish one acre plantation, would be as follows:

Table 12 Estimated annual manpower requirement (plantation programme)

Year	Total estimated required acres	No. of persons to establish one acre	Total manpower required	Average Annual Requirement
1980	11.00	272	2992	-
1985	10.14	-	2758	552
1990	9.41	-	2560	512
1995	12.31	-	3348	670
2000	15.94	-	4336	867
2005	20.32	-	5527	1105
2010	24.67	-	6710	1342
2015	30.47	-	8288	1658
2020	36.25	-	9860	1972
2025	42.80	-	11642	2328
2030	49.37	-	13429	2686

The breakdown of the annual manpower requirement according to job category is assumed as given below:

Professional	2%
Technical	4%
Vocational	20%
Labourer	74%
Total	100%

On the basis of the above assumption, the estimated annual manpower deemed necessary to execute the plantation programme would be as contained in Table 13.

Table 13 Detailed estimated annual manpower per job category

Period	Total	Professional	Technical	Vocational	Labourers
1980-85	552	11	22	110	408
1985-90	512	10	20	102	379
1990-95	670	13	27	134	496
1995-2000	867	17	35	173	642
2000-2005	1,105	22	44	221	818
2005-2010	1,342	27	45	268	993
2010-2015	1,658	33	66	332	1,227
2015-2020	1,972	39	79	394	1,459
2020-2025	2,328	47	93	466	1,723
2025-2030	2,686	54	107	537	1,988

[6] Source: Memento – Du Forester on average 110 person/ha – 272 persons/acre

9 DEFORESTATION

The pressure of deforestation is essentially due to shifting cultivation (traditional slash and burn) of upland rice farmers following tracts of forests opened up by the network of logging roads. These shifting cultivators move almost at the same pace as the logging roads.

Although there is not as yet systematic comparative study of aerial photographs[7] available, deforestation can be derived based on Lanly's estimates (1981)[8]. According to Lanly, land cleared annually per farm family (household) for growing upland rice is 1.4 hectares. Lanly also mentioned that annually 20%, 50% and 30% respectively of total household cut young, medium and high bush for upland cultivation, and further that 50% of high bush is closed forest and 50% secondary growth above 12 years.

Based on the above Lanly's assertions and the United Nations published 1981 demographic trend of Liberia which showed that the rural population will be increasing at a decreasing rate, the derived average annual deforestation rate for both undisturbed and disturbed (logged-over) forests 1980-2025 would be 50,000 hectares (details in Appendix III) as given in Table 14.

Table 14 Annual deforestation projections 1980-2025 (in thousand hectares)

Period	Undisturbed forest	Disturbed (logged-over) forest	Total hectares
1980-1985	10	23	33
1985-1990	11	27	38
1995-2000	13	29	42
2005-2010	17	40	57
2015-2020	19	44	63
2020-2025	20	46	66

Apart from the continuous deforestation which reduces forest fallow to shrub vegetation, degradation takes place in the open woodlands of the coast and in the north west of the country due mainly to repeated fires. As there is no adequate fire control, the movement of savanna is growing. There is a need to check the savanna growth, hence some of the reforestation centres must be established in these areas, i.e. the coastal and north western regions.

[7] Recently, some study done but still under analysis and scrutiny
[8] Forest Resources of Tropical Africa

10 PRODUCTION AND EXPORT

Log production increased from 607,000 m^3 in 1976 to 775,000 m^3 in 1978, an average of 660,000 m^3 per annum. However, log production registered a declining trend in 1980 with a volume of 745,000 m^3 reaching a level of 389,000 m^3 at end 1982. Actual export also dropped from 342,000 m^3 to 226,000 m^3 during the same period. The downward trend in both production and export volumes can mainly be explained by two reasons, namely: 1) the April 12, 1980 coup after which many companies closed down due to uncertainties and 2) the shrinkage of world demand for forest products, especially Western Europe, Liberia's traditional wood trade partners. Log exports share percentage-wise, notwithstanding, in total production registered modest increase from 56% in 1976 to 58% in 1982 (Table 10).

Table 15 Log production and export trend (1000 m^3) 1976-1982

Year	Total	Actual Export	% of log export
1976	607	342	56
1977	599	318	53
1978	775	356	46
1979	756	389	51
1980	745	470	63
1981	451	255	56
1982	389	226	58

10.1 Liberia share of forest exploitation revenue/income

The direct benefits the Liberian Government receive from the exploitation of its forest resources by concessionaires are taxes and royalties. The present situation is that logging concessionaires are reluctant to honour their tax obligations when become due. There are always huge accumulated tax arrears which the Government writes off as bad debt in the eventual down closure of bankrupt companies. This attitude of the concessionaires is unwholesome.

Analytical results (Tables 16 and 17)[9] show succinctly clear that Liberian participation in the forest revenue/income sharing is negligible. The bulk of the benefits from the utilisation of the forest resource accrues to the concessionaires.

[9] Details found in Appendix IV C & D

Table 16 Government participation in forest revenue

Year	Assessed $	FOB $	Unit $/m3 as % unit FOB/m3
1976	12	104	12
1977	13	113	12
1978	16	129	12
1979	17	140	12
1980	21	166	13
1981	23	172	13
1982	19	149	13

Unit assessed revenue/m^3 compared with unit FOB/m^3.

Table 17 Determination of Liberia share in gross sale value ($000) gain from forest resources utilisation (1976-1982)

Year	Total FOB $(r+s)	Local sale $ (s)	Gross sale (Export + Local)	Government Assessed Tax	% share of assessment in gross $
1976	45,376	11,427	56,803	7,160	13
1977	46,976	12,317	59,293	7,511	13
1978	59,259	21,073	80,332	12,777	16
1979	72,127	16,027	88,154	13,156	15
1980	95,108	11,575	106,683	15,828	15
1981	53,784	9,201	62,983	10,453	17
1982	39,660	8,165	47,825	7,552	16

The forest revenue collection system needs overhauling. To put the stumpage tax collection system on the proper footing a new approach should be adopted – each active concession must deposit certain amount of money, of course, depending on concession size to be reduced gradually per cubic meter harvest. This will minimise if not eliminate, the accumulation of stumpage tax arrears by concessions.

11 WOOD PROCESSING INDUSTRY

11.1 Sawnwood and wood-based panels

The Liberian wood processing industry is in its embryonic stage. The major product is sawn timber and moreover it is characterized by low productivity. The recovery rate for sawn timber is estimated at forty-five (45%) percent.

11.1.1 Installed capacity

In 1981, there were twenty-three (23) processing establishments with an aggregate installed (nominal) input capacity of 367,000 m^3/annum (Table 18).

Table 18 Established Sawnmills (Active and inactive)

Sawmill	**Location/Region**	**Nominal Capacity (000)**
Ganta Sawmill	I	6
Jo-River	"	7
Mim/FAT	"	15
Cestos Nimba Corp (CNC)	"	30
Nimbaco	"	12
TALK Lumber	"	35
Subtotal		105
Cape Palmas Logging	II	15
Libco Timber Company	"	40
LLWPC	"	15
Siga Lumber	"	18
MLC/MWPI	"	12
Prime Timber Products (PTP)	"	15
LETCO	"	30
Subtotal		145
Sawmill	**Location/Region**	**Nominal Capacity (000m^3)**
Associated Liberian Timber Corp.	III	17
Bolado	"	4
Tropical Farm Corp.	"	10
Upper Lofa (Loffaco)	"	3
LIFC/LWMC	"	6
LOTICO	"	16
Mecca Logging	"	4
Subtotal		60
LTPC[10]	IV	45
Cavalla Timber Company	"	10
INWOCO	"	2
Subtotal		57
Grantotal (1+2+3+4)		367

[10] Also established plymill respectively

11.1.2 Sawmill productivity level

At the end of 1981, production statistics showed that out of the twenty-three establishments, only fifteen (15) with a total installed nominal capacity of 252,000 m^3 were actually in operation. The total recorded/calculated output for the year amounted to 88,000 m^3 (Appendix IV (b)) hence putting the performance of the industry at 35 percent. In reality, this result is the contrary on account of inefficiency of the forestry industry. In fact, if 10-20% for wastage and logs abandonment, the likely actual situation, with is neglected in the apparent local processed wood consumption computation (i.e. total production less actual export) is considered, the industry performance would be in the magnitude of 32 and/or 28 percent.

11.1.3 Sawmill products participation in foreign exchange earnings

Primary conversion of wood - sawmilling and plywood manufacture - contribution to foreign exchange earnings have been insignificant over the years. For the years 1978 and 1981, the forestry sector contributed 11% and 7% respectively to foreign exchange earning. Sawn timber participation was 2% and 1% while round logs accounted for 9% and 6% (See Tables 19 and 20).

Table 19 Processed wood contribution to foreign exchange earnings

Year	Total foreign exchange earnings	Total forestry section contribution		Logs contribution		Processed wood contribution	
		Absolute	%	Absolute	%	Absolute	%
1978	486.4	54.9	11	46.7	9	8.1	2
1979	536.0	58.5	11	50.1	9	8.5	2
1980	600.4	72.5	12	65.3	11	7.2	1
1981	529.2	36.6	7	32.3	6	4.3	1

Source: Economic Survey of Liberia, 1981

The insignificant contribution of processed wood to foreign exchange earnings strongly registers that wood is mainly being exported in the form of round logs.

There is an indication that the Liberian Government 1973 declared industrialization policy, in the light of the Lagos Plan of Action, for the maximum utilization of forest resources locally is far from being promoted and materialized. This farsighted proposed policy then stipulated that all logging concessions were to increasingly process at the rate of 20% their total annual harvest, reaching 100% by the year 1977. Disappointingly, the actual status of forest resources utilization locally up to date is on the contrary. Log export still continues to occupy a greater share (80%) in the exportation of forest products while processed wood suffers a neglect (20%) on the average for the period 1976 to 1982 (Table 19).

Table 20 Actual export – logs and processed wood (1000 m3) – 1976 – 1982

Year	Logs	Processed wood	Processed wood log equivalent	Total log equivalent	% Logs	% Processed wood
1976	342	42	93	435	79	21
1977	318	43	96	414	77	23
1978	356	46	102	458	78	22
1979	389	57	127	516	75	25
1980	470	46	102	572	82	18
1981	255	26	58	313	81	19
1982	226	18	40	266	85	15
Average	337	40	88	336	80	20

The higher round log export is not both in the short and long-term interest of the country especially so when the forestry sector is being predominately exploited by foreign investors. The foreign investors participating in the industry prefer round logs export for the net foreign exchange they earn are higher because of less imported production inputs. Comparatively, actual (not assessment) stumpage and royalties pay to the government of Liberia are significantly less than the FOB prices/m^3 for export species (Appendix IV). This means that the larger share of the benefits from the exploitation of the Liberian forest resources accrues to the expatriate investors.

11.1.4 Magnitude of the value of imported wood products

Despite the scarcity of immediate needed funds for operation, Liberia should not give lower priority to the long-term benefits associated with primary and secondary processing of wood products. The proper development of the wood processing industry will save the Government foreign exchange. As Liberia grow and develop, the country needs for diversified forest products will increase. In fact, in recent years, Liberia's demand for processed wood products – sawn wood, plywood, particle boards, fibreboard, paper and paper board has been on the increase. The value of Liberia's import of processed wood products and manufacture have grown from $7,064 million 1979 to $10,990 million in 1981 (Table 21).

Table 21 Value of imported forest products (in $1000 – 1979-1981)

Product/Year	1979	1980	1981
1. Sawnwood & sleepers	74	3,900	3,900
2. Wood-based panels	100	200	200
3. Paper products	6,890	6,890	6,890
a) paper + paper boards	3,445	3,445	3,445
b) other paper + paperboard	3,000	3,000	3,000
c) writing + printing paper	44.5	44.5	44.5
Total	7,064	10,990	10,990

Source: FAO Yearbook of Forest Products 1982.

This huge foreign exchange outflow in the absence of an equal gain from the industry tellingly well calls for the need for the judicious promotion of wood processing industries.

11.1.5 Advantages of local conversion

The benefits associated with local log conversion in terms of contribution to the national economy are numerous. These benefits, though not limited to, are the following:

- diversifies industries;
- provides direct and indirect employment with relatively limited investment compared with other industries. Wood industries are labour intensive;
- boosts regional development (infrastructure, socio-economic conditions), often in remote areas;
- gives higher value added than log exports and develops skills;
- provides more foreign exchange earnings in the long term;
- contribute towards balances economic utilisation of forest resource;
- helps to reduce malpractices in the timber trade because down grading is more difficult and volumes can be defined more exactly;
- increases national income both directly and through the multiplier effects;
- exports of wood products support other export trade.

11.1.6 Future incentive structure (proposed)

The advantages offered by local conversion fits well into Liberia national development goal which accords rural development and diversification of production an appropriate place. Therefore, the Government of Liberia must take a fresh look at its declared farsighted declared 1973 industrialization policy for the economic viability of the forestry sector in terms of its maximum contribution to the national economy. This industrialization policy must be judiciously strengthened and promoted along the following proposed strategic lines:

- size and duration of forest concession be tied-in with the proposed level of local conversion of logs;
- large proposed establishments with intention to operate diversified and integrated production units be accorded preference in terms of granting of concessions;
- there must be local log conversion stipulation, i.e., specific annual output, grade per species etc. both for existing and new companies;
- to put the forest resources industrialization goal on the proper footing, the policy should be strengthened and promoted through differentiated incentives as follows:

Table 22 Proposed differentiated incentives for the forestry sector

Incentive categories	Logging only	Sawmilling only	Logging & Sawmilling	Logging & Sawmilling Veneer & Plywood	Veneer & Plywood only
1. Exemption from corporation tax	3 yrs	4 yrs	6 yrs	10 yrs	8 yrs
2. Exemption from custom duty on plant equipment, medical facilities drugs, spare parts & industrial supplies	2 yrs	3 yrs	5 yrs	5 yrs	5 yrs
3. Exemption from export duty	2 yrs	3 yrs	5 yrs	5 yrs	5 yrs
4. Product for own use	Free	Free	Free	Free	Free
5. Severance fee	Normal	-	Normal	0.75	-
6. Excise tax exemption on fuel and oil	2 yrs	3 yrs	4 yrs	8 yrs	8 yrs
7. Import restriction similar products	-	yes	yes	yes	yes

11.2 Charcoal

Universally, charcoal is the product of wood carbonization under controlled conditions. In Liberia, the traditional method, i.e. earth pile, is still predominantly used. This method of production is crude, hence yields are low. The carbonization of the earth kiln is not easy because of the difficulty in controlling the process. Moreover, the production is not organized.

11.2.1 Raw material (input)

High forests cleared for farming (traditional and commercial schemes) and rehabilitated rubber farms provide the bulk of raw material inputs for the production of charcoal. In fact, all the high forest wood is not fully utilised due to the remoteness of such sites end high transportation costs.

11.2.2 Production (past and projection) estimated

In the presence of the disorganized charcoal activity, there are no reliable production data. However, using FAO estimates (1981) which showed that production per head of population in Liberia is 0.1411 metric tons in combination with UN selected demographic indicators by country 1950-2025, charcoal production estimates in Liberia are derived as given in Table 23.

Table 23 Charcoal production trend (1000 mt) – 1950-2025

Year	Total population (1000)	Production per head of population	Total production (MT)	Fuelwood equivalent m^3
1950	758	0.1411	107	642
1960	1004	"	142	852
1970	1393	"	197	1182
1975	1653	"	233	1398
1980	1967	"	276	1656
1995	3370	"	476	2856
2000	4002	"	565	3390
2010	5471	"	772	4632
2020	7097	"	1001	6006
2025	7897	"	1114	6684

11.2.3 Charcoal consumption (estimated)

Charcoal usage in urban Liberia is becoming more common as fossil fuel prices are increasing rapidly. Majority of the urban dwellers can no longer afford the high price of cooking gas. The consumption in years to come will definitely increase tremendously as a direct function of the rapid rural – urban migration. Liberia urban population is projected to increase from 119,000 (16%) in 1950 to 4,193,000 (66%) by the year 2025 while rural population will equally take on a downward trend.[11]

Table 24 Liberia urban and rural population trend (000) 1950-2025

Year	Total population	Urban population	Rural population	Urban %	Rural %
1950	758	119	639	16	84
1960	1004	205	799	20	80
1970	1393	365	1028	26	74
1975	1653	486	1167	29	71
1980	1967	648	1319	33	67
1985	2355	865	1490	37	63
1990	2821	1147	1674	41	59
1995	3370	1504	1866	45	55
2000	4002	1944	2058	49	51
2010	5471	3064	2407	56	44
2020	7097	4451	2646	63	37
2025	7897	5193	2704	66	34

[11] Source: Demographic Indicators of Countries, estimates and projections, UN, 1982

Table 25 Estimated charcoal consumption (1000 bags) 1950-2025

Year	Total population (1000)	Urban population %	Total urban population	Total family in urban population	Annual consumption (bags)
1950	758	16	119	24	4,992
1960	1,004	28	205	41	8,528
1970	1,393	26	365	73	15,184
1980	1,967	33	648	130	27,040
1985	2,355	37	865	173	35,954
1990	2,821	41	1,147	229	47,632
1995	3,370	45	1,504	301	62,608
2000	4,002	49	1,944	389	80,912
2010	4,571	56	3,064	613	127,504
2020	7,097	63	4,451	890	185,120
2025	7,897	66	5,193	1,039	216,029

Based on average family size: 5 / No. of bags per week: 4 / No. of weeks per year: 52

11.2.4 Proposal for future charcoal programme

In the light of the growing urban population and the apparent consumption of charcoal, there is an urgent need to properly organize and develop the Liberia charcoal industry. Organized charcoal production and the utilization of simple modern kilns will increase productivity and economisation of raw materials. The expertise of partnership for productivity (PFP), a non-profit organization located in Yekepa, Nimba County, in the manufacture of modern kilns can be tapped. Metal kilns (Appendix V) can be built from materials available in Liberia with less investment cost.

11.2.5 Advantages of charcoal production

Charcoal, in recent times, due to the enormous increase in the prices of fossil fuels, has become more economic in most of the non-producing countries. In fact, it is the most economic and socially desirable fuel for urban areas. It is essentially used for domestic heating and cooking. Moreover, besides charcoal suitability for simple domestic purposes, a well organized and developed industry offers socio-economic advantages summarised as follows:

- smokeless and transport cost is almost half of fuelwood which is bulky;
- creates employment and provides money to the rural poor (distributive effects);
- saves foreign exchange that would otherwise be spent on imported fuel;
- provides chemical and fuel base for other industries;
- increases the profitability of the forests:
  a) utilises wood species of low economic importance;
  b) utilises residues from cleaning and thinning natural forests and logs cross-cutting wastes and stumps/slabs.

The Liberia charcoal industry must be organized to contribute meaningfully to the national economy. However, for the realisation of its significant contribution, the satisfaction of the following lines of strategies are necessary:

- As charcoal-making is concerned with the exploitation of the forest resources the planning of the industry must be a function of the Forestry Development Authority;

- The Forestry Development Authority must appoint a professional forester with interests in chemistry and economics to coordinate activities of the industry;
- The Forestry Development Authority must organize traditional charcoal makers into production and sales cooperatives;
- Charcoal development and research unit be set up to promote planned charcoal production as a complement to efficient forest management – e.g. organized thinning of forest plantations and their use in or conversion into charcoal making.

12 AGGREGATE PRODUCTION AND CONSUMPTION OF FUELWOOD AND CHARCOAL (000m3) – ESTIMATED

According to 1981 FAD Yearbook of Forest Products, fuelwood and charcoal production per head estimates in Liberia are respectively 1.2306 cubic meter and 0.1411 metric tons or 0.846 cubic meters. On the basis of these parameters and the declining rural and increasing urban population trend (UN Demographic Indicators 1982), derived fuelwood and charcoal production and consumption (details in Appendix VI) would be by the year 2025 as follows:

Table 26 Fuelwood and charcoal production and consumption by 2025 (1000 m3 fuelwood equivalent)

Product	Production	Consumption	Surplus/Deficit
Fuelwood	9,718	5,577	4,141
Charcoal	6,684	10,825	- 4,141
Total	16,402	16,402	-

The derived surplus fuelwood production of 4,141,000 m^3 over consumption will be converted to satisfy the apparent deficit of 4,141,000 m^3 in charcoal demand by the 2025.

12.1 Area required for fuelwood and charcoal production in 2025 (estimated)

Assuming that one acre burnt farm yields twenty cords of fuelwood and also that one cord fuelwood is equivalent to 3.6 m^3, the total acreage that would be required to meet fue1wood and charcoal production by the year 2025 would be 227,806 acres derived as follows:

12.1.1 Procedure for determination

Basic parameters

1 acre burnt farm = 20 cords fuelwood
1 cord = 3.6 cubic meters
derived required 2025 fuelwood + charcoal (fuelwood equivalent)
(Appendix VI) = 16,402,000 m^3

12.1.2 Results

(i) Number of cord determination

Number of cords = derived total fuelwood cubic meter equivalent ÷ one cord cubic meter equivalent
= 16,402,000 m^3 ÷ 3.6 m^3
= 4,556,111 cords

(ii) Number of acreage determination

No. of required acreage = derived total cords ÷ one acre burnt
farm cord equivalent = 4,556,111 ÷ 20
= 227,806 acres

Also using Lanly's[12] estimate of cleared annual 1.4 ha or 3.5 acres per farm family, the computed total deforested area in year 2025, that is, the fuelwood and charcoal main raw materials source would work out to 163,000 acres (Appendix III). This apparent fuelwood 163,000 acreage that would be made available by rural population as a result of upland rice

[12] Lanly, Forest Resources of Tropical Africa

cultivation is 64,806 acres or 28 percent less than the apparent derived requirement for both fuelwood and charcoal production. Even where the computed annual deforestation in year 2025 of 163,000 acres (Appendix III) is inflated by 5% or 8,150 acres to account for provision of rehabilated rubber farms and then add projected plantation acreage of 49,370 acres (Table 10) in year 2025, total acreage demand for fuelwood production would equal 220,520 acres, which, of course, as compared with fuelwood and charcoal .(fuelwood equivalent) acreage demand for the same year is still 7,286 acres or 3.2 percent less. In fact, all the anticipated available fuelwood from the annual deforestation and reforestation acreages may not be fully utilized for fuelwood and charcoal production mainly on account of remoteness of these sites and high transportation costs. The rural population may not face problem relative to meeting their fuelwood demand, however, there will be a major constraint as to meeting the charcoal consumption demand of the rapidly growing urban population. The individual and disorganized traditional producers will be constrained by the lack of financial capital and transport equipments to fully convert to charcoal the apparent available fuelwood (charcoal raw material input). This apparent situation registers a strong case for the promotion of an organized charcoal industry in Liberia.

13 DOMESTIC CONSUMPTION OF WOOD AND WOOD PRODUCTS

Liberia future requirement for wood and wood products consumption is likely to grow steadily (simplified version of FIAG Model for Development of Forest Industries in Liberia (Appendix VII). The projection contained in the Model is based on the assumptions that the population, gross domestic products (GDP) and the urban population will grow constantly on the average by 1.03, 1.24 and 8 percent per annum respectively during the period 1985 to 2000.

As regards mill-processed wood products, sawnwood will continue to be the most heavily used processed wood product with 97% share and plywood will account for 3% (Appendix VII.4.4).

In the overall wood and wood products (log equivalent) projected domestic consumption of fuelwood will decline from 60% in 1985 to 49% in 2000 while charcoal consumption will increase from 35% to 47% during the same period, a state of affair that will be conditioned by the Trend of rural-urban migration (Appendix VI).

A global picture of Liberia projected domestic consumption of wood and wood products is given in Table 27.

Table 27 Domestic Consumption of Wood and Wood Products (local production & import)

Year	LOCAL PRODUCTION					Imp-ort(s)	Total log m^3 equivalent	Per capita consumption
	Fuelwood	Charcoal	Sawnwood	Plywood	Veneer			
1970	2143	756	76	-	-	-	2975	2140
1980	2740	1350	278	10	-	2	4380	2223
1985	3081	1806	249	8	-	-	5144	2256
1990L	3457	2406	238	8	-	-	6109	2305
1990H	3803	2646	289	10	-	-	6748	2546
1995L	3852	3150	227	8	-	-	7237	2357
1995H	4237	4074	329	12	-	-	8046	2621
2000L	4665	4482	380	15	-	-	9542	2680

14 POLICY ISSUES AND RECOMMENDATIONS

The organization and administration of forestry activities are complex, and because of the complexity of the forestry sector programmes and their implementation and monitoring, the definition of policies and strategies are of crucial importance. In the framework of this conception, an attempt is made to pen down some policy issues and recommendations for consideration as they are viewed vital for the viability of the forestry sector and its greatest contribution to the national economy. The policy issues and recommendations are, namely:

14.1 Forest resource conservation

The forest resources are diminishing and the valuable species are exploited at an increasing rate, hence the following steps must be taken:

(a) Forest management be geared to the decrease of the "Creaming" of the valuable species
(b) Exploitation and export of lesser known species must be raised and the implementation of this policy be adequately complemented by supporting management and market research for the promotion of the lesser known species;
(c) A minimum annual processing allocation of production for all companies be set at 60% in case of those with poor stocking areas and 80% for those operating on well stocked rich forests;
(d) Local processing of wood must be encouraged by proper incentives with special emphasis on processing of lesser known species;
(e) In preparation for the long term future compensation of the depletion of the natural forests, fast-growing forest plantations must be established in areas which are economically accessible and where suitable land can he found and made available. Planting in suitable savanna areas be encouraged as opposed the present practice of locating reforestation sites in high forest areas which most often involves the felling and replacement of almost natural matured species adaptable to our environment with foreign introduced exotic species. The northern Lofa where the savanna is expanding due to the sahelian movement would be one of the ideal sites;
(f) Shifting cultivation on virgin forest areas be prohibited and farmers be encouraged to adopt permanent farming practices. This step must be implemented in coordination with the Ministry of Agriculture.

14.2 Forest inventory

The preparation of forest resources inventories at ten (10) years interval must be accorded priority. This is essential because inventory data on the quantity; quality and condition of the forest resources are necessary for the appropriate development of forest policies and programmes.

14.3 Forestry protection

Intensified efforts be made to reduce and prevent forest losses from fire, insects, diseases, animals and human beings. Programmes of integrated protection of the forest involving the judicious use of biological, chemical, mechanical and legal controls be encouraged and

enforced; education of the rural population and the entire citizency be promoted for this will essentially contribute to the success of the implementation of this policy instrument.

14.4 Forestry taxation

Forestry taxation has been government intended policy gears towards the maximization of government revenue from the exploitation of forest resources. However, this policy has not brought fruitful gain to government. Forest taxes are insignificant as compared with FOB and local prices earn on wood and wood products by concessionaires. Concessionaires are reluctant to pay their matured taxes consequently government books are filled with high accumulated tax arrears. The forest taxation system must, therefore, be streamlined and the revenue collection procedure be improved. At the beginning of every year all active companies must deposit a certain amount of money to be gradually reduced in accordance with monthly assessed revenue on their production. All new companies be obliged to also pay in advance after six months of operation.

14.5 Forestry investment incentives

Incentives for mere logging operation must be biased; the granting of incentives must be directly related to the degree of processing and the level of integration. Moreover, adequate and-preferential incentives be granted to concessions engage in the processing of lesser known species rather than high value primary species. Last, but not least, the granting of incentives must also be viewed in terms of development such as education, health and employment a concession would bring to its area of operation. This, of course, has to be assessed at least periodically to ascertain achievement

14.6 Export market and trade

The Liberia domestic market is small hence the promotion of foreign trade is of paramount importance. Sub-regional and regional wood and wood product trade within the African Timber Organization and continental Africa must be encouraged and promoted. Trade negotiations on the government level be fostered with: Algeria, Morocco, Egypt and other Arabic countries where very interesting wood demanding project exist. Joint ventures in logging and processing industries establishment with these countries would be negotiated for the maximum sharing of benefits.

However, as a prerequisite for Liberia to viably benefit from her wood trade on the international market, the Forestry Development Authority must train some of its potential employees in international wood specifications, grading rules, trade names, quality regulations and contract forms analysis. These are important elements in the promotion and development of international wood and wood products marketing and trade.

14.7 Forestry for local community development

Rural community forestry is presently non-existent in Liberia. This facet of any national forestry programme is very essential for its timely promotion minimizes or reduces the burden on the natural forests in terms of supplies of fuelwood, building poles, folder and other tree products for the use of the rural people. Such a programme slows down the degradation of the environment. In Liberia, the contribution of forestry to rural community will be greater and

appreciated where appropriate ways and means in terms of programmes are identified and developed.

In Liberia, to put any community level forestry programme on the proper footing it must be viewed and planned as a situation which will intimately involve the local people for their (rural people) direct benefit. At the heart of any community forestry development, therefore, must be the involvement and direct participation of the local people. Such programmes may be implemented at two levels, namely:

a) Native authority forest – this would be created and managed at the regional (county) level; and
b) Communal forest – would be created and managed at the village or town level.

14.8 Forestry extension

Appropriate institutional structure essentially contributes to the successful implementation of any planned programmes. Therefore, the first step for the promotion of rural community forestry in Liberia must he the creation of an extension arm with ability to work with the rural people/villagers, learn their needs and aspirations and constraints. This requires skills in communication and extension. For the promotion of worthwhile rural forestry community programme, the Forestry Development Authority must therefore, without delay create an Extension Service, the staff of which. must be trained and prepared to serve in an advisory capacity at the regional/village level and assist in the following:

(a) The establishment, development and management of tree farms;
(b) Agri-silviculture;
(c) The establishment of small-scale forest industries, e.g. mobile sawmills producing materials for building joinery and furniture at the village or town level;
(d) Processing of forest products at household, artisan or small-scale industrial level; and
(e) Promotion of forestry cooperatives concerned with planting trees and harvesting the produce, processing and marketing.

14.9 Forest research

A strong research arm of any institution is vital, especially in terms of policy formulation and the decision-making process. Progress in forestry administration and efficient resource management can be gained through research. Therefore, appropriate basic and applied research programmes must be promoted and supported. Coordination of efforts and assimination of information with forestry research institutions outside Liberia must be encouraged.

14.10 Training

The shortage of trained and skilled manpower is one of the major constraints which impedes progressive development of the Liberia forestry sector. In order to appropriately maintain the Liberia forest estate control and develop plantations, and efficiently utilize wood supply, it is of importance that the Forestry Development Authority be potentially equipped in terms of trained and qualified personnel.

The efficient administration and monitoring of the forestry activities depend entirely on the ability of the Forestry Development Authority. To be effective, the FDA must obtain the necessary professional and technical staff for execution of its functions. Relevant training needs must be identified and a comprehensive programme formulated with emphasis on such specialized areas as logging and sawmillng engineering, pathology, economics, statistics silviculture, research, extension sawdoctoring and mechanics (Appendix 8).

14.11 Forestry statistics

The Liberia forest sector is faced with the paucity of adequate statistical data. The gathering of reliable statistical information on actual log export, total processed wood production, actual export and local consumption and in fact on all other forestry activities is really not an easy task. This prevailing state of affair cannot allow systematic policy formulation and decision making for a sensible development planning of the forestry sector.

There is no doubt that the appropriate development of the forestry sector, in terms of scientific and efficient management, to a large extent depends on the availability of accurate and useful statistical information. Therefore, for improvement in statistical information gathering and subsequent analysis and building up appropriate data bank, the Forestry Development Authority must in addition to relevant existing forms (tally sheets, production summaries and waybill) make the completion of other essential data reporting formats (Appendix VIII) mandatory.

Also, in view of the need for a comprehensive Forestry Statistical Data Bank, a National Forestry Statistical Council is proposed. The concessions and all FDA Regional Foresters must be fully represented on the council. The ministries of Planning, Agriculture, Finance and the College of Agriculture and forestry must become members.

14.12 Funding of proposed plantation programme

Liberia, like any developing country, is faced with the scarcity of foreign exchange to implement needed development programmes. Notwithstanding, possible alternative sources of local mobilization of funds can be identified and explored for the implementation of essential programmes.

In the forestry sector, reforestation fee assessed and collected can finance any conceived reasonable plantation programme. For instance, actual collection of assessed reforestation revenue based on a minimum annual harvest of 400,000 m^3 during twenty years (20 yrs) would be adequate to support a fifty years (50 yrs) plantation programme (Appendix X).

In fact, with appropriate reforestation funds collection and control system, surpluses, (i.e. on average $13,140/yr) for contingency would be available during the fifty years. Therefore, the foremost factors needed for the realization of such programme (forestry plantation) would be to a large extent the “political will” and the commitment of those entrusted with the implementation. Once we established our plantation development programme on this footing, our “partners in progress” may not hesitate relative to extending their moral and financial support just as supplement.

Appendix I: SPECIES OF LIBERIA FOREST

CLASS I SPECIES SCIENTIFIC NAME	IN.	CM.	TRADE NAME	
1. Afzelia spp.	27	70	Afzelia; Doussie, Apa	E*
2. Chlorophora excelsa	35	90	Trado, Odoum, Kambala, African Teak	E
3. Entandrophragma spp.				
3a. E. angolense	35	90	Tiama, Ejinam, Cedo, Mohor Bodongo Mahogany	F
3b. E. candollii	35	90	Heavy Sapele, Kosipo, Mahogany	F
3c. E. cylindricum	35	90	Sapele, Sapele Mahogany	F
3d. E. utile	30	100	Utile, Sipo, Mahogany	P
4. Guarea spp.	31	80	Guarea, Bosse, Pink African cedar	F*
5. Guibourtia chie (Copaifera chie)	24	60	Amazakous, Shedua, Bubinga (see also No. 26)	G
6. Heritiera utilis (Tarrietia utilis)	24	60	Whismore, Wishmore, Niangon, Ogoue	P
7. Khaya spp.	27	70	Kyaya, Acajou-blanc, African Mahogany	P*
8. Lovoa trichilioides	27	70	African Walnut, Dibetou Lovoa, Tigerwood	F
9. Mansonia altissima	24	60	Kotc, Kyere, Ake	P
10. Pterygota macrocarpa (P. bequaertii)	24	60	Kotc, Kyere, Ake	P
11. Tetraberlinia tubmaniana	24	60 50	African Pine, Sekon, Rose Wood	P
12. Tieghemella heckelii (Dumoria heckelii) (Mimusops heckelii)	39	100	Makore, Douka	G*

CLASS II SPECIES	IN.	CM.	TRADE NAME	
13. Ciaris africans	24	60	Ako, Akede, Barkcloth Tree	P
14. Canarium schweinfurthii	31	80	Aiele, White Mahogany	P
15. Gilbertiodendron (Macrolobium preussii)	24	60	Limbali, African or Red Oak	P
16. Mitragyna spp.	31	80	Abura, Bahia	P*
17. Nauclea spp.	31	80	Opepe, Bilinga, Kusia, Brimstone	E*
18. Pycnanthus angolensis	27	70	Pycnanthus, Iomba, Walele False Nutmeg, White Cedar	P
19. Terminalia spp.	27	70		
T. ivorensis			Idigbo, Emeri, Framire, Black Afara	G*
T. superba			Afara, Dimba, White Afra (Black & White refer to bark colors only)	P*
20. Triplochiton scleroxylon	35	90	Obeche, Wawa, Samba, African white wood, Ayons	P*
21. Turreanthus Africanus.	31	80	Avodine, Apaya	P*

Appendix I (continued)

	CLASS III SPECIES	IN	CM	TRADE NAME	
22.	Alstonia boonei	27"	70	Alstonia, Emien, Patterwoo	P
23.	Brachystegia leonensis	35"	90	Okwen, Naga, Akume	F
24.	Ceiba pentandra	35"	90	Ceiba, Cottontre, Fromger	P
	(Bombax pentandrum)	27"	70		
	(Eriodendrum guineense)	27"	70		
25.	Daniella spp.	27"	70	Ogea, Faro, Gum Copal (Commercial group - Tchitola)	P
26.	Didelotia idea	24"	60	Broutou (miscalled African pine	G
	(D. unifoliata)			Bubinga (see also No.5)	
27.	Erythrophloeum spp.	31"	80	Tali, Sasswood, Alui, Landa	E *
28.	Gossweilerodendron balsamiferum			Apba, Tola	F
29.	Lophira alata	31"	80	Azobe, Ekki, Ironwood	E
30.	Mammea Africana	24"	60	African Apple/Apricot, Mammy-Apple	G
31.	Nesogordonia papaverifera (Cistanthera p.)	24	60	Kotibe, Danta	G
32.	Piptadeniastrum africanum (Piptadenia africana)	31	80	Dabhoma, African Greenheart, Dabema	P *
	(Cylicodiscus gabunensis is also called African Greenheart because of the similarities of both the bark and the wood)				
33.	Sacoglottis gabunensis	27	70	Osouga, Cherry, Akouano	
34.	Symphonia globulifera (S. gabonensis)	24	60	Ossol, Osol	

APPENDIX II

	01	02	03	04	05	06	07	08	09	10	11	12
A	FAO/ECA/UNIDO FIRG Computer Model for Management of Tropical Forests											
B												
C	Liberia											
D	Year	***1980	***1985	***1990	***1995	***2000	***2005	***2010	***2015	***2020	***2025	***2030
E												
F	FORESTS, Mha											
G	undistu	0.90	0.70	0.60	0.28	.03	0.00	0.00	0.00	0.00	0.00	0.00
H	logged	0.41	0.49	0.57	0.66	0.77	0.96	0.62	0.60	0.30	.06	-0.35
I	Tot Pro	1.31	1.20	1.05	0.95	0.60	0.62	0.44	0.24	.04	-0.16	-0.39
J	Unpro	0.67										
K	Pro+UnP	1.98										
L	Undtlogd Mm3		0.95	1.00	1.10	1.25	1.84	0.25	-0.11	-0.53	-0.14	-0.95
M	COMRCL TIM, Mm3											
N	undistu	13.50	10.63	7.62	4.31	0.58	-4.60	-5.04	-4.73	-3.24	-2.90	-0.46
O	logged	2.05	2.29	2.44	2.38	1.84	2.20	-2.53	7.43	-34.10	-80.61	-130.05
P	Tot Cti	15.55	12.92	10.07	6.69	2.43	-2.40	-7.36	2.70	-37.34	-83.71	-130.51
Q												
R	COMRCL TIM/ha											

	01	02	03	04	05	06	07	08	09	10	11	12
R	COMRCL TIM/ha				15.02	16.30	13.83	13.15	13.14	12.78	12.60	13.56
S	undistu	15.00	15.00	15.00	3.56	2.39	2.29	-2.83	12.20	-113.17	-1235.9	364.59
T	logged	5.00	4.84	4.85	7.02	3.01	-3.82	-16.71	10.83	-747.08	523.24	333.67
U	Tot/ha	11.87	10.75	9.27	***1995	***2000	***2005	***2010	***2015	***2020	***2025	***2030
V	Year	***1980	***1985	***1990								
W	EXTRACT Mm3/yr				0.85	1.10	1.40	1.70	2.10	2.50	3.00	3.50
X	Total	0.50	0.55	0.65	0.54	0.26	2.68	1.16	-3.67	0.21	0.10	.01
Y	undistu	0.43	0.45	0.49	0.30	0.83	-1.28	0.53	5.77	2.38	2.89	3.46
Z	logged	.06	.09	0.15								
AA												
AB	DEFORES THha/y				12.60	15.30	15.90	16.50	17.10	18.00	19.60	19.60
AC	undistu	9.30	9.90	11.40	29.40	35.70	37.10	36.50	39.90	42.00	46.20	46.20
AD	logged	21.70	23.10	25.60	42.00	51.00	53.00	53.00	57.00	60.00	66.00	65.00
AE	Tot def	31.00	33.00	36.00								
AF												
AG	DEFORES Mm3/yr				0.18	0.24	0.28	0.21	0.28	0.23	0.25	0.26
AH	undistu	0.13	0.14	0.17	0.10	.08	.06	-0.10	0.48	-4.71	-57.09	16.84
AI	logged	0.10	0.10	0.11	0.29	0.33	0.30	0.10	0.71	-4.48	-55.64	17.11
					8+AI8				12+AI12			

	01	02	03	04	05	06	07	08	09	10	11	12
AK												
AL	GROWTH Mm3/yr											
AM	undistu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AN	logged	.03	.03	.03	.03	.02	.04	-.04	.06	-0.52	-0.85	-2.24
AO	Tot Grw	.03	.03	.03	.03	.02	.04	-.04	.06	-0.52	-0.85	-2.24
AP												
AQ	MER Mm3/yr											
AR	Tot MER	0.24	0.20	0.15	.09	.02	-.05	-0.13	.02	-0.58	-0.90	-2.25
AS												
AT												
AU												
AV												

```
      18       19       20       21       22       23       24       25       26       27       28       29
A FAO/ECA FIAG Computer Model for Management of Tropical forests
B Liberia
C ==========================================================================
D Plantation Programme
E                Share   Rotat      MAI    ThCut   FinCut
F Spec Ex          %      yrs    m3/y/a    m3/ha    m3/ha
G   Pinus        .30    20.00     25.00   150.00   350.00
H Termina      0.25     30.00     12.00   110.00   250.00
I   Tripl        .20    40.00      8.00   100.00   220.00
J   Khaya        .15    50.00      5.00    50.00   200.00
K  Makore        .10    60.00      4.00    40.00   200.00
L
M
N
O
P
Q
R Required plant THha/y

      18       19       20       21       22       23       24       25       26       27       28       29
S          ***1980***1985***1990 ***1995***2000***2005***2010***2015***2020***2025***2030
T      Sp1    0.60     0.66     0.76     1.02     1.32     1.68     2.04     2.52     3.00     3.60     4.20
U      Sp2    0.69     0.78     0.90     1.18     1.52     1.94     2.36     2.91     3.47     4.15     4.66
V      Sp3    0.62     0.68     0.81     1.06     1.37     1.75     2.12     2.62     3.12     3.75     4.37
W      Sp4    0.60     0.65     0.78     1.02     1.32     1.68     2.04     2.52     3.00     3.60     4.20
X      Sp5    0.41     0.45     0.54     0.70     0.91     1.16     1.41     1.75     2.08     2.50     2.91
Y      Tot    2.93     3.22     3.81     4.99     6.45     8.22     9.98    12.33    14.68    17.61    20.55
Z
AA
AB
AC
AD
AETot cum plant area THha
AF     Sp1    0.60     3.00     6.30    10.20    15.30    21.90    30.30    40.50    53.10    68.10    86.10
AG     Sp2    0.69     3.47     7.29    11.80    17.70    25.34    35.06    46.87    61.45    78.81    99.65
AH     Sp3    0.62     3.12     6.56    10.62    15.93    22.81    31.56    42.18    55.31    70.93    89.68
AI     Sp4    0.60     3.00     6.30    10.20    15.30    21.90    30.30    40.50    53.10    68.10    86.10
AJ     Sp5    0.41     2.06     4.37     7.08    10.62    15.20    21.04    28.12    36.87    47.29    59.79
(S+X20)+AJ20                    +X24)+AJ24                       +X28)+AJ28

      18       19       20       21       22       23       24       25       26       27       28       29
AK     Tot    2.93    14.68    30.82    49.91    74.67   107.16   148.27   198.16   259.84   333.24   421.33
AL
AM
AN
AO
APEst. yield THm3/y
AQ     Sp1    0.00     0.00    90.00    99.00   327.00   354.00   471.00   609.00   768.00   956.00 1164.00
AR     Sp2                             76.38    84.02    99.30   303.47   359.02   439.58   554.85   702.77
AS     Sp3                                      62.50    66.75    81.25   106.25   275.00   328.25   391.25
AT     Sp4                                               30.00    39.00    51.00    66.00   204.00
AU     Sp5                                                        16.56    18.93    21.56    28.33    36.66
AV     Tot    0.00     0.00    90.00   175.38   473.52   582.05   905.38 1131.60 1555.24 1941.44 2496.69
AW   Exist    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
AX  Gr Tot    0.00     0.00    90.00   175.38   473.52   582.05   905.38 1131.60 1555.24 1941.44 2496.69
AYNew Und    13.50    10.63     7.62     4.65     1.48    -1.48     3.28     4.47     5.33     2.91     1.07
AZNew Log     2.05     2.29     2.44     2.49     2.24     2.36    -7.54   -13.57   -23.02    -5.68   269.61
BANew Tot    15.58    12.92    10.07     7.14     3.73     0.87    -4.26    -9.09   -17.68    -3.77   270.69
BBNew MER     0.24     0.20     0.15     0.10      .05      .00     -.07     -0.15    -0.25     0.40     4.18
BCNew Ext     0.58     0.55     0.56     0.67     0.62     0.81     0.79     0.96     0.94     1.05     1.00
BDNew UnX     0.43     0.45     0.42     0.43     0.24    -1.39    -0.81    -0.47    -0.26    -1.11      .00
BENew LoX      .06      .09     0.13     0.23     0.37     2.21     1.40     1.44     1.22     2.16     0.99
BFNew Grw      .03      .03      .03      .03      .03      .01     -0.19    -0.23    -0.34     0.34     4.17
```

B Estimated annual hectares clear by bush type and household

Year	No. of rural households	Bush type clear by household			Hectare per bush types			Annual ha deforested
		Young bush 20%pop	Medium bush 50%pop	High bush 30%pop	ha/20% pop	ha/50% pop	ha/30% pop	
1975	117	23	59	35	6	41	14	61
1980	132	26	66	40	7	46	17	70
1985	149	30	75	44	8	53	18	79
1990	167	33	84	50	9	59	21	89
1995	187	37	94	56	10	66	24	100
2000	206	41	103	62	11	73	26	110
2010	241	48	121	72	13	85	30	128
2020	265	53	133	79	15	93	33	141
2025	270	54	135	81	15	95	34	144

4. (Lanly): 50% high bush is closed forest and 50% 2nd growth above 12 years; hence hectares of closed forest in high bush cleared annually is shown as follows:

a. Cleared ha of closed forest in high bush and effect of rural population on deforestation rate

Year	Annual ha of high bush deforested	Closed Forest share at 50%	2nd growth above 12 yrs share at 50%	Rural Pop%	Effect of rural pop% on on deforestation rate (closed forest)
1975	61	31	30	7	31
1980	70	35	35	67 6 1/	33
1985	79	40	39	63 6 1/	38
1990	89	45	44	59 6 1/	42
1995	100	50	50	55 7	42
2000	110	55	55	51 7	51
2010	128	64	64	44 14	55
2020	144	71	70	37 16	69
2025	144	72	72	34 8	66

5. Assumption. % Distribution of deforestation/yr

Undisturbed-------- 30

Over logged -------- 70

Year	Annual deforestation	Undisturbed forest 30%	Overlogged forest 70%
1980-1985	33	10	23
1985-1990	38	11	27
1995-2000	42	13	29
2005-2010	57	17	40
2015-2020	63	19	44
2020-2025	66	20	46

Appendix IV: Production, designated and actual, export and determination of local consumption

Gross value of sale (1000m3 and $1000) and unit assessment and unit FOB per m3 ($)

Year	Total (a) Production (r)	Designated (b) Export (r)	Actual (c) Export (r)	Apparent processed wood in round log equivalent (a-b+b-c) = d
1978	775	309	356	(775-309) + (309-356) = 419
1979	756	475	389	(756-475) + (475-389) = 367
1980	745	484	470	(745-484) + (484-470) = 275
1981	451	239	255	(451-239) + (239-255) = 196
1982	389	206	226	(389-206) + (206-226) = 163

Year	Total apparent (a) processed wood (r)	Apparent local round consumption (b) sawntimber equiv (s)	Designated export (s) (c)	Actual export (s) (d)	Apparent local consumption (s) (e) (b-c) + (c-d) = e
1978	419	189	46	46	(189-46) + (46-46) = 143
1979	367	165	47	57	(165-47) + (47-57) = 108
1980	275	124	42	46	(124-42) + (42-46) = 78
1981	196	88	27	26	(88-27) + (27-26) = 62
1982	163	73	19	18	(73-19) + (19-18) = 55

N.B. - Only designated export sawn timber (processed wood) data reached the Central Office for export tax assessment; total production is normally not known hence is here computed per year.

- Recovery rate used is forty-five (45) per cent.

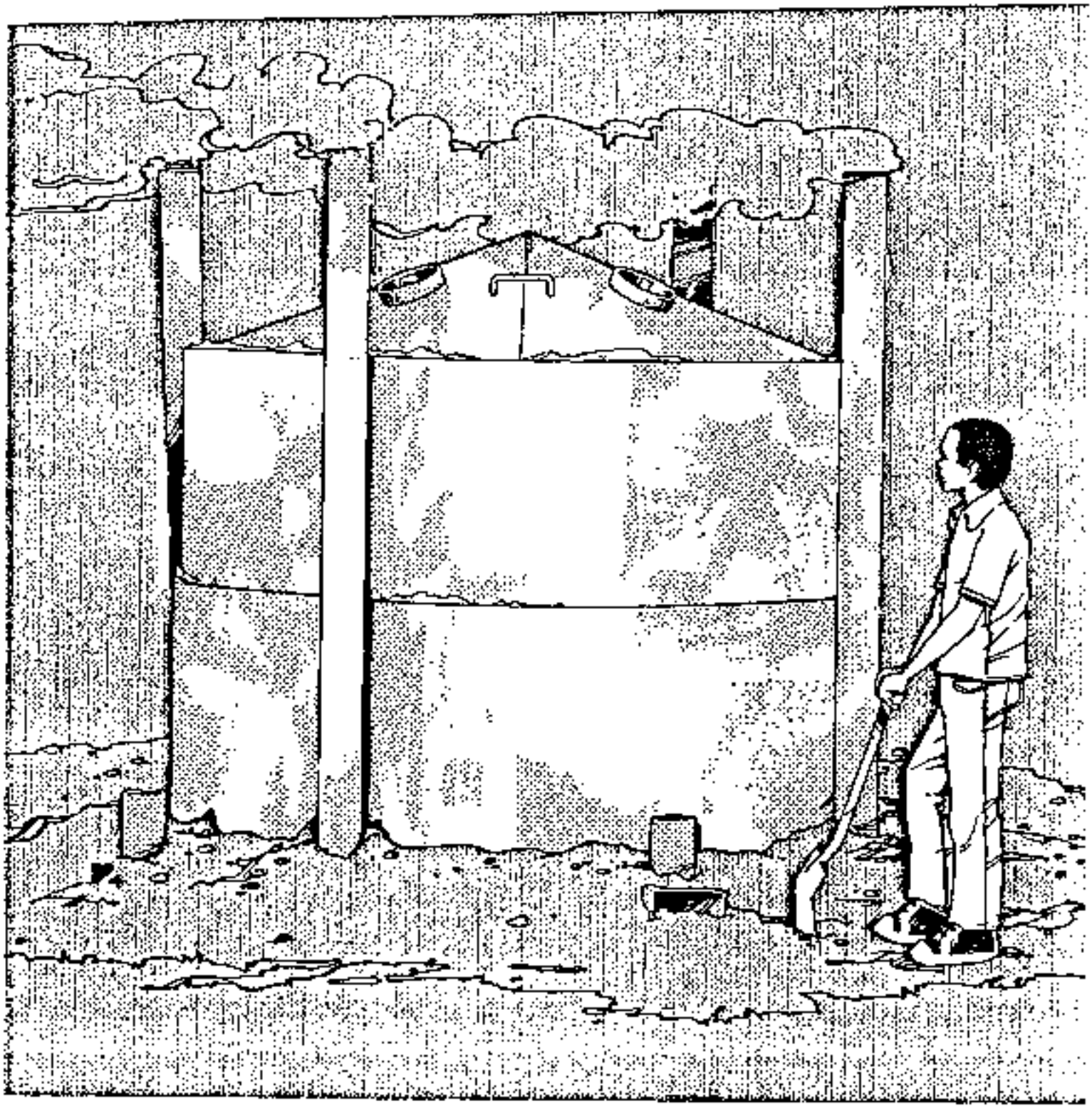
C Production and unit assessment $/m3

Year	Production (000 m3)	Gross assessment $ ($000)	$/m3
1976	607	7,160	12
1977	599	7,511	13
1978	775	12,777	16
1979	756	13,156	17
1980	745	15,828	21
1981	451	10,453	23
1982	389	7,552	19

D Gross FOB Value of Actual Export Volume (000 m3 and $ 000)

Year	Logs (r) (a)	Sawntimber log equivalent (r) (b)	Total (a+b)	FOB$ (r) (d)	FOB$ (s) (e)	Total FOB$ r + s f=(d+e)	Unit/FOB/m3 (f)/(c) =g
1976	342	93	435	37,834	7,542	45,376	104
1977	318	96	414	38,086	8,890	46,976	113
1978	356	102	458	49,552	9,707	59,259	129
1979	389	127	516	58,318	13,809	72,127	140
1980	470	102	572	84,096	11,012	95,108	166
1981	255	58	313	46,213	7,571	53,784	172
1982	226	40	266	34,751	4,909	39,660	149

Appendix V: TRANSPORTABLE METAL KILN



Source: Rural Technology Guide 12, 1980

APPENDIX VI: Determination of Fuelwood and charcoal Production and consumption Estimates

1.

a. Production Parameters (estimates)

- Fuelwood production per head[1/] = 1.2306 m^3
- Charcoal production per head[1/] = 0.1411 MT
- 1 Metric ton (1000 Kg) charcoal= 6 m^3 fuelwood

Year	Total Pop (1000)	Fuelwood 1.2306m^3	Charcoal 0.1411 MT	Charcoal Fuelwood Equivalent 6m^3	Total Production Fuelwood Equivalent
1950	758	933	107	642	1,575
1960	1004	1236	142	852	2,088
1970	1393	1714	197	1182	2,896
1975	1653	2034	233	1398	3,432
1980	1967	2421	278	1668	4,089
1985	2355	2896	332	1992	4,890
1990	2821	3472	398	2388	5,860
1995	3370	4147	476	2856	7,003
2000	4002	4925	565	3390	8,315
2010	5471	6733	772	4632	11,365
2020	7097	8734	1001	6006	14,740
2025	7897	9718	1134	6684	16,402

1/ FAO Yearbook of Forest Products (1981)

APPENDIX VII

MODEL FOR DEVELOPMENT OF FOREST INDUSTRIES - LIBERIA

VII.1 Assumptions

VII.1.1 Basis of wood and wood products projection (all in million)

POPULATION			GROSS DOMESTIC PRODUCTS		
YEAR	TOTAL POPULATION	POPULATION GROWTH RATE	TOTAL G. D. P.	G.D.P. GROWTH RATE	GDP/CAPITA
1970	1.39	-	408	-	294
1980	1.97	-	1455	-	739
1985	2.28	1.03	1315	0.98	576
1990L	2.65	1.03	1250	0.99	472
1990H	2.65	1.03	1517	1.029	573
1995L	3.07	1.03	1189	0.99	387
1995H	3.07	1.03	1725	1.026	562
2000L	3.56	1.03	1189	1.000	334
2000H	3.56	1.03	1990	1.029	559

VII.1.2 Export Development of wood and wood products (1980-2000) - 1.O.P/a

a

MAIN PRODUCT	DEM: ELASTICITY
SAWNWOOD	1.0
PLYWOOD	1.2
VENEER	1.2

PERIOD	SAWNWOOD	PLYWOOD	VENEER	LOG
1980/85	1.00	1.00	1.00	1.00
1985/90L	0.8	0.8	0.8	0.8
1985/90H	0.8	0.8	0.8	0.6
1990/95L	0.8	0.8	0.8	0.6
1990/95H	0.8	0.8	0.8	0.6
1995/2000L	0.8	0.8	0.8	0.6
1995/2000H	0.8	0.8	0.8	0.6

N.B. RECOVERY RATE

(a) Sawnwood 45%
(b) Plywood 50%
(c) Veneer 50%

VII.2 Determined per capita consumption (1000 m^3/Capita)

VII.2.1 Per capita consumption of sawnwood plywood and veneer round log equivalent and sawlogs (1970-2000) - 1000 m^3

YEAR	POPU-LATION MILLION	SAWNWOOD (000m^3)		PLYWOOD (000 m^3)		VENEER (000m^3)		SAW + VENEER LOG	
		Total Log Equivalent	m^3/Capita	Total Log Equivalent	m^3/Capita	Total Log Equivalent	m^3/Capita	Total Log Equivalent	m^3/Capita
1970	1.39	76	55	-	-	-	-	76	55
1980	1.97	278	141	10	5	-	-	288	146
1985	2.28	212	93	8	4	-	-	220	97
1990L	2.65	238	90	8	3	-	-	247	93
1990H	2.65	289	109	10	4	-	-	299	113
1995L	3.07	227	74	8	3	-	-	235	77
1995H	3.07	329	107	12	4	-	-	341	111
2000L	3.56	227	64	8	2	-	-	235	66
2000H	3.56	360	107	15	4	-	-	395	111

VII.2.2 Per capita consumption of processed wood (sawnwood, plywood and veneer) at their recovery rate: 45 & 50

YEAR	POPU-LATION MILLION	SAWNWOOD (000m^3)		PLYWOOD (000m^3)		VENEER (000m^3)		TOTAL PER CAPITA (SAWNWOOD + PLYWOOD + VENEER)
		Total	m^3/capita	Total	m^3/capita	Total	m^3/capita	
1970	1.39	34	24	-	-	-	-	53
1980	1.97	125	63	5	3	-	-	66
1985	2.28	95	42	4	2	-	-	44
1990L	2.65	107	40	4	2	-	-	34
1990H	2.65	130	49	5	2	-	-	51
1995L	3.07	102	33	3.93	1	-	-	34
1995H	3.07	148	49	6.13	2	-	-	50
2000L	3.56	102	29	3.93	1	-	-	30
2000H	3.56	171	48	7.28	2	-	-	50

VII.3 SUMMARY

VII.3.1 Production Export, Import, Sawlogs available for local processing and domestic consumption (log equivalent (1000 m^3) - Actual 1970 to 1980 and projection 1980 - 2000

	SAWNWOOD				PLYWOOD				VENEER				SAW+VENEERLOG			Logs Available for processed wood	Domestic Consumption
	Prod.	Exp.	Imp.	Cons.	Prod.	Exp.	Imp.	Cons.	Prod.	Exp.	Imp.	Cons.	Prod.	Exp.	Imp.		
1980	124	46	47	125	7.00	2.00	-	5.00	2.00	2.00	-	-	745	451	-	294	288
1985	141	46	-	95	6.00	2.00	-	4.00	2.00	2.00	-	-	550	200	-	330	220
1990L	122	15	-	107	5.00	1.00	-	4.00	1.00	1.00	-	-	437	191	-	283	246
1990H	145	15	-	130	6.00	1.00	-	5.00	1.00	1.00	-	-	373	74	-	336	299
1995L	107	5	-	102	4.14	0.21	-	3.93	0.21	0.21	-	-	259	24	-	247	235
1995H	153	5	-	148	6.34	0.21	-	6.13	0.21	0.21	-	-	356	15	-	353	341
2000L	104	2	-	102	4.00	0.07	-	3.93	0.07	0.07	-	-	240	5	-	239	235
2000H	173	2	-	171	7.35	0.07	-	7.28	0.07	0.07	-	-	400	4	-	399	395

VII.3.2 Summary of processed wood round log Equivalent (1970 - 2000) (000 m^3)

	PRODUCTION			EXPORT			IMPORT			DOMESTIC CONSUMPTION			TOTAL			
	Sawnwood	Plywood	Veneer	Sawnwood	Plywood	Veneer	Sawnwood	Plywood	Veneer	Sawnwood	Plywood	Veneer	Production	Export	Import	Dom. Consumption
1970	76	-	-	2	-	-	2	-	-	76	-	-	76	2	2	76
1980	276	14	4	102	4	4	104	-	-	278	10	-	294	110	104	288
1985	314	12	4	102	4	4	-	-	-	212	8	-	330	110	-	220
1990L	271	10	2	33	2	2	-	-	-	238	8	-	283	37	-	246
1990H	322	12	2	33	2	2	-	-	-	289	10	-	336	37	-	299
1995L	238	8	0.42	11	.42	.42	-	-	-	227	8	-	247	12	-	235
1995H	340	13	0.42	11	.42	.42	-	-	-	329	12	-	353	12	-	341
2000L	231	8	0.14	4	.14	.14	-	-	-	227	8	-	239	4	-	235
2000H	384	15	0.14	4	.14	.14	-	-	-	380	15	-	399	4	-	395

VII.3.3 Total round log production, export and apparent processed wood export import and domestic consumption 1970-2000 (000m^3)

YEAR	ROUND LOG			Apparent Local Processed Export, Import, and Domestic Consumption		
	Production	Export	Total Apparent Log Available for Processed Wood	Apparent Processed Wood Export	Apparent Processed Wood Import	Apparent Local Processed Wood Consumption
1970	220	144	76	2	2	76
1980	745	451	294	110	104	288
1985	530	200	330	110	-	220
1990L	437	154	283	37	-	246
1990H	373	37	336	37	-	299
1995L	259	12	247	12	-	235
1995H	356	3	353	12	-	341
2000L	240	1	239	4	-	235
2000H	400	1	399	4	-	395

VII.4 DETAILS: Conversion of processed wood production, export, import and domestic consumption to round log equivalent

VII.4.1 Round Log Equivalent of Sawnwood, Plywood and Veneer Production 1970-2000 (000m^3)

	SAWNWOOD PRODUCTION		PLYWOOD PRODUCTION		VENEER PRODUCTION		Total Saw & Veneer Logs Equivalent
	Sawnwood Equivalent	Log Equivalent	Plywood Equivalent	Log Equivalent	Veneer Equivalent	Log Equivalent	
1970	34	76	-	-	-	-	76
1980	124	276	7.00	14	2.00	4.00	294
1985	141	314	6.00	12	2.00	4.00	330
1990L	122	271	5.00	10	1.00	2.00	283
1990H	145	322	6.00	12	1.00	2.00	336
1995L	107	238	4.14	8	0.21	0.42	247
1995H	153	340	6.34	13	0.21	0.42	353
2000L	104	231	4.00	8	0.07	0.14	239
2000H	173	384	7.35	15	0.07	0.14	399

VII.4.2 Conversion of Export Processed Wood to Round Log Equivalent (1970 - 2000) m^3

	SAWNWOOD		PLYWOOD		VENEER		Total Processed Wood Roundlog Equivalent
	Sawnwood Equivalent	Log Equivalent	Plywood Equivalent	Log Equivalent	Veneer Equivalent	Log Equivalent	
1970	1	2	-	-	-	-	2
1980	46	102	2	4	2	4	110
1985	46	102	2	4	2	4	110
1990L	15	33	1	2	1	2	37
1990H	15	33	1	2	1	2	37
1995L	5	11	.21	.42	.21	.42	12
1995H	5	11	.21	.42	.21	.42	12
2000L	2	4	.07	.14	.07	.14	4
2000H	2	4	.07	.14	.07	.14	4

VII.4.3 Conversion of Import of Processed Wood to Round Log Equivalent (000 m^3)

	SAWNWOOD		PLYWOOD		VENEER		TOTAL ROUND LOG EQUIVALENT
	Sawnwood Equivalent	Round Log Equivalent	Plywood Equivalent	Round Log Equivalent	Veneer Sheet Equivalent	Round Log Equivalent	
1970	1	2	-	-	-	-	2
1980	47	104	-	-	-	-	104
1985	-	-	-	-	-	-	-
1990L	-	-	-	-	-	-	-
1990H	-	-	-	-	-	-	-
1995L	-	-	-	-	-	-	-
1995H	-	-	-	-	-	-	-

VII.4.4 Conversion of Domestic Consumption of Processed wood to Round Log Equivalent (000 m^3)

	SAWNWOOD		PLYWOOD		VENEER		TOTAL ROUND LOG EQUIVALENT
	Sawnwood Equivalent	Round Log Equivalent	Plywood Equivalent	Round Log Equivalent	Veneer sheet Equivalent	Round log Equivalent	
1970	34	76	-	-	-	-	76
1980	125	278	5	10	-	-	288
1985	95	212	4	8	-	-	220
1990L	107	238	4	8	-	-	246
1990H	130	289	5	10	-	-	299
1995L	102	227	3.93	8	-	-	235
1995H	148	329	6.13	12	-	-	341
2000L	102	277	3.93	8	-	-	235
2000H	171	380	7.28	15	-	-	395

Appendix VIII: Proposed 20 years "Training Scheme" to be financed by $0.50/m^3$ Levy

Basic assumptions

(a) Minimum annual harvest *= 400,000 m^3

(b) Proposed training levy = 0.50/m^3

(c) Annual assessed levy = 200,000

(d) 20 years assessed levy = 4,000,000

(e) 20 years training target = 5,400

Proposed Training Level and Corresponding Expenditure

Training Level	Monthly Cost	Number of Trainees	Annual Cost	20 Years Cost
Master programme	$ 250	4	12,000	240,000
University Programme	150	8	14,400	288,000
Ranger Programme				
(a) Logging	75	32	28,800	576,000
(b) Sawmilling	75	32	28,800	576,000
Surveyor	50	32	19,200	384,000
Sawdoctoring				
(a) Logging	50	32	19,200	384,000
(b) Sawmilling	50	32	19,200	384,000
Mechanics				
(a) Logging	50	32	19,200	384,000
(b) Sawmilling	50	32	19,200	384,000
Extension workers	50	32	19,200	384,000
Tools custodian	33.33	2	(799.92) 800	(15,998.4) 16,000
GRAND TOTAL	883.33	270	200,000	4,000,000

Appendix VIII (continued)

Number of persons to be trained by the "Training Levy Schemes" within 20 yrs

Training Level	Number of Proposed Trainees per Year	20 Years Total	R E M A R K S
Master programme	4	80	Specialized areas, pathology, logging and sawmill engineering, silviculture economics statistics, policy and planning(resource administration) - Abroad preferably African countries
University programme	8	160	General forestry (Bsc) Local (U.L)
Ranger programme			
(a) Logging	32	640	Manor River Union Training Institute (Local): only high-school graduates
(b) Sawmilling	32	640	- DITTO -
Surveyor	32	640	MRUTI and/or Ministry of Land Survey School only high-school graduate
Sawdoctoring			
(a) Logging	32	640	MRUTI, High school drop-outs but completed 9th grade
(b) Sawmilling	32	640	- DITTO -
Mechanics			
(a) Logging	32	640	- DITTO -
(b) Sawmilling	32	640	- DITTO -
Extension workers	32	640	Rural Development Institute Bong County: high school graduate
Tools custodian	2	40	MRUTI, 9th grade completion
Total		5,400	

Apper. IX Statistical Data Reporting Format

Apper. IX.1 Stock and Actual Export Monthly Report (for logs only)

Region: _____ Port: _____ Month: _____ Year: _____

Species	Quantity in stock (M^3)	Haulage (M^3)	Total Volume at the Port (i.e. S+H) M^3	Quantity Shipped (M^3)	FOB Value ($)	Balance in Stock (i.e. S+H-Shipped) (M^3)	REMARK		
							Producer	Buyer Exporter	Destination

Compiled by: _____ Checked by: _____ Approved by: _____

Port scaler Port Senior Officer Regional Forester

N.B. S+H: Means stock plus haulage

Fuelwood and charcoal consumption estimates

Year	Total Production Fuelwood + Charcoal (000 m^3) (a)	Rural Pop % (b)	Consumption Rural Pop (c)	Bal (a-c) Charcoal Fuelwood Equivalent (m^3)	Charcoal MT
1950	1,575	84%	1323	252	42
1960	2,088	80	1670	418	70
1970	2,896	74	2143	753	126
1975	3,432	71	2437	995	166
1980	4,089	67	2740	1349	225
1985	4,890	63	3081	1809	301
1990	5,860	59	3457	2403	401
1995	7,003	55	3852	3151	525
2000	8,315	51	4241	4074	679
2010	11,365	44	5001	6364	1061
2020	14,740	37	5454	9286	1548
2025	16,402	34	5577	10825	1804

Comparison of Estimated Production and Consumption to determine surplus/deficit - Fuelwood (000m^3) and Charcoal 000MT

Year	Fuelwood m^3			Charcoal (000MT)		
	Production	Consumption	-or+	Production	Consumption	- or +
1950	933	1323	-390	107	42	65
1960	1236	1670	-434	142	70	72
1970	1714	2143	-429	197	126	71
1975	2034	2437	-403	233	166	67
1980	2421	2740	-319	278	225	53
1985	2898	3081	-183	332	301	31
1990	3472	3457	15	398	401	-3
1995	4147	3852	295	476	525	-49
2000	4925	4241	684	565	679	-114
2010	6733	5001	1732	772	1061	-289
2020	8734	5454	3280	1001	1548	-547
2025	9718	5577	4141	1114	1804	-690

Appen. IX.2 : Stock and Actual Export Monthly Report(for Processed wood only)

Region: _____ Port: _____ Month: _____ Year: _____

Species	Quantity in Stock (M^3)	Haulage (M^3)	Total Volume at the Port (i.e. S+H) (M^3)	Quantity Shipped (M^3)	FOB Value ($)	Balance in Stock (i.e. S+H-shipped) (M^3)	REMARK		
							Producer	Buyer Exporter	Destination

Compiled by: _____ Port Scaler

Checked by: _____ Port Senior Officer

Approved by: _____ Regional Forester

N.B: S+H - Stock plushaulage

Appen. IX.2.1 (details): Stock and Actual Export Monthly Report (for degree of processed wood only)

Region: _____ Port: _____ Month: _____ Year: _____

Species	Quantity in Stock (M^3)			Haulage (M^3)			Total Stock (S + H)		
	Sawn T&T	Square Edged Undressed	Square Edged Dressed	Sawn T&T	Square Edged Undressed	Square Edged Dressed	Sawn T&T	Square Edged Undressed	Square Edged Dressed

Quantity Shipped (m^3)			FOB Value ($)			Balance S+H Shipped (m^3)			REMARKS		
Sawn T&T	Square Edged Undressed	Square Edged Dressed	Sawn T&T	Square Edged Undressed	Square Edged Dressed	Sawn T&T	Square Edged Undressed	Square Edged Dressed	Producer	Exporter or Buyer	Destination

Compiled by: _____ Port Scaler

Checked by: _____ Port Senior Officer

Approved by: _____ Regional Forester

N.B. S+H - Stock plus haulage

Appen. IX.3 : Stock and Actual Local Consumption (sale) Monthly Report

Region: _____ Company/Sawmill: _____ Month: _____ Year: _____

Species	Quantity in Stock (M^3)	Haulage (M^3)	Total Volume at Sawmill (S+H) M^3	Quantity Processed for Consumption M^3	Quantity Consumed sold M^3	Total Value ($) of Quantity Sold	Balance: At Sawmill S+H- QPFC	QPFC- QC/S	R E M A R K S

Compiled by: _____ Sawmill Scaler

Checked by: _____ District Forester

Approved by: _____ Regional Forester

N.B. S+H stock + haulage
S+H = QPFC = stock + Haulage minus quantity processed for local consumption
QPFC - QC/S= Quantity Processed for Consumption minus Quantity Consumed/sold

Appen . IX.4 : Quarterly Coupe Report

Region: _____ Month: _____ Year: _____

Company	District	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Annual Coupe	
		ACRE	M^3 Extracted	ACRE	M^3 Extracted	ACRE	M^3 Extracted	ACRE	M^3 Extracted	ACRE	M^3 Extracted

Compiled by: _____
Senior Forest Management Officer

Verified by: _____
Regional Forester

Approved by: _____
Head, Concessions Operation

Appen. IX.5 : Quarterly Reforestation Achievement Report

Month: _____ Year: _____

Project/ Activities	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Annual Total		Annual Backlog	REMARKS
	Target	Achieve-ment	Target	Achieve-ment	Target	Achieve-ment	Target	Achieve-ment	Target	Achieve-ment	(Target Achieve-ment)	
1. Bonni Hills Activities												
2. Avalla Activities												
3. Yekepa Activities												
4. LFC Activities												
5. TIPP Activities												

Compiled by: _____ Deputy Head, Reforestation

Verified by: _____ Project Manager

Approved by: _____ Head, Reforestation Programme

Appendix X Plantation development and proposed financing (Expenditure) - 50 years acre and dollar

Basic assumptions[1/]

(a) $750/ha/20 yrs or $1,355.50/acre/20 yrs

$ 37.50/ha/yr or $93($92.775)/acre/yr

(b) Minimum annual harvest = 400,000 m^3/yr

(c) Reforestation fee per cubic meter = $3.00

(d) Annual assessed reforestation fee = $ 400,000 m^3x$3 = $1,200,000

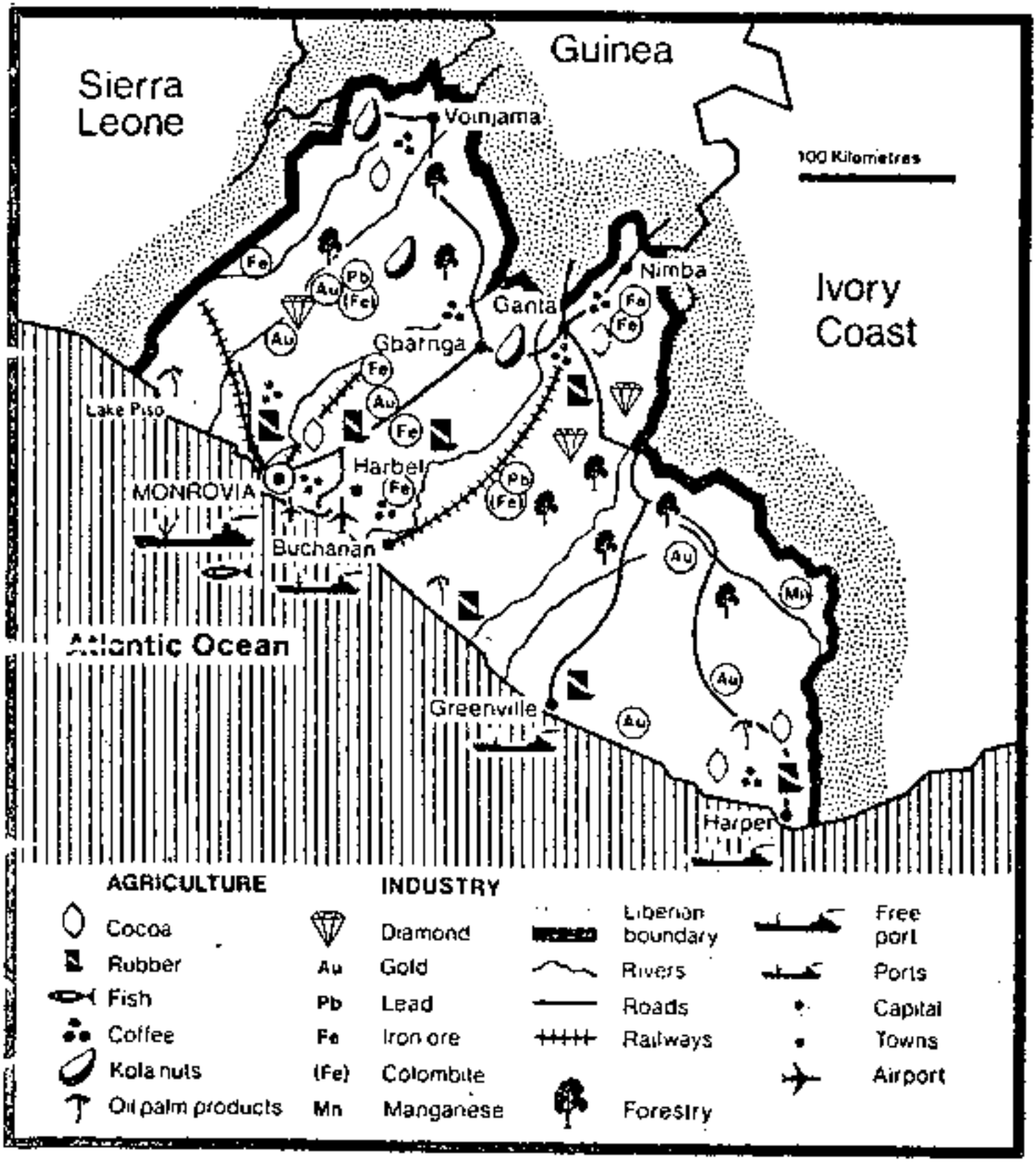
(e) 20 yrs assessment based on minimum annual harvest = 400,000 m^3x$3 x 20 yrs = $24,000,000 [2/]

Period	Number of Year (a)	Annual Target/ Acreage (b)	Total 5 years Acreage (c)	Annual Cost (d)	Total 5 years Cost	Cost/acre/yr ($\frac{d}{b}$) or ($\frac{e}{c}$)
1980-1985	5	2000	10,000	$186,000	$ 930,000	$ 93
1985-1990	5	2000	10,000	186,000	930,000	93
1990-1995	5	2400	12,000	223,200	1,116,000	93
1995-2000	5	3200	16,000	297,600	1,488,000	93
2000-2005	5	4000	20,000	372,000	1,488,000	93
2005-2010	5	5000	25,000	465,000	2,325,000	93
2010-2015	5	6000	30,000	558,000	2,790,000	93
2015-2020	5	7200	36,000	669,600	3,348,000	93
2020-2025	5	8600	43,000	799,000	3,999,000	93
2025-2030	5	9800	49,000	911,400	4,557,000	93
Total	50 yrs	50,200	251,000	4,668,600	23,343,000	93

1/ World Bank determined cost for development of one hectare plantation for 20 yrs

2/ 1980/85-1995/2000, i.e. 20 yrs reforestation assessed revenue will amount to $24,000,000 which is $657,000 in excess of the total 50 yrs cost of $23,343,000. This means, that between 2000 and 2015, likely depletion time of natural forest accumulated reforestation fund will still be available for programme continuation

MAP OF LIBERIA



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