A STRATEGIC FORESTRY DEVELOPMENT PLAN

FOR THE

WESTERN AREA OF SIERRA LEONE

by

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Thesis presented for the degree of Master of Science
in Forestry at the University of Stellenbosch

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August 1996

DECLARATION

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

8th August 1996
Date

SUMMARY

This study comprises forecasting the demand for sawnwood, construction poles (mostly *Anisophyllea laurina*) and *Funtumia africana* logs for utilization in the Western Area of Sierra Leone. Trend analysis of production, sales and consumption of the three products covering the period 1985 to 1995, form the basis of the demand forecasts for the period 1996 to 2005. The trend of each of fifteen data sources for the three products are initially analysed using seven different regression models on a comparative basis. The compound growth model described the trend better than the other six and was therefore used in projecting the future demand for most data sources and products. The possible effects of demand shifters are taken into account and the initial forecasts are amended accordingly. Both Quattro-Pro (version 3.0) and Statgraphics (versions 3.0 and 6.0) are used in the initial trend analysis. The demand forecasts to the year 2005 are used to develop short-, medium- and long-term project proposals aimed at the satisfaction of these demands. The environmental limitations of the Western Area are taken into account in the development of the project proposals. Social, physical and logistical constraints are considered in the drafting of the strategic forestry development plan for the Western Area of Sierra Leone.

OPSOMMING

Hierdie studie behels die vooruitskatting van die vraag na gesaagde hout, pale vir konstruksie (meestal *Anisophylles laurina)* en *Funtumia africana*-blokke vir benutting in die Westelike Gebied van Sierra Leone. Tendensontleding van produksie, verkope en verbruik van die drie produkte gedurende die periode 1985 tot 1995, vorm die basis van die vooruitskattings van die vraag vir die tydperk 1996 tot 2005. Die tendens van elk van vyftien databronne vir die drie produkte word ontleed deur gebruik te maak van sewe verskillende regressiemodelle op 'n vergelykende basis. Die saamgestelde groeimodel het die neigings beter beskryf as die ander ses en is gevolglik in geval van die meeste datsbronne en produkte vir tendensontleding gebruik. Die moontlike uitwerking van vraagverskuiwers word in aanmerking geneem en die aanvanklike vooruitskattings word dienooreenkomstig aangepas. Quattro-Pro (weergawe 3.0) sowel as Statgraphics (weergawes 3.0 en 6.0) word vir die aanvanklike tendensontleding gebruik. Die vooruitskattings van die vraag tot by die jaar 2005 word gebruik vir die ontwikkeling van kort-, medium- en langtermyn projekvoorstelle wat gemik is op die bevrediging van hierdie vraag. Die omgewingsbeperkings van die Westelike Gebied word in aanmerking geneem tydens die ontwikkeling van die projekvoorstelle. Sosiale, fisiese en logistieke beperkings word oorweeg tydens die opstelling van die strategiese bosbou-ontwikkelingsplan vir die Westelike Gebied van Sierra Leone.

PREFACE

The Government of Sierra Leone with the support of donors and technical assistance agencies, is now at the project implementation phase of the Tropical Forestry Action Programme (TFAP) cycle.

As strongly re-iterated by the forestry sector review mission in 1988/1989, there is an acute paucity of data for planning the development of the sector. This study is aimed at the provision of data in the area of forecasting the demand for three major forest products for use by the newly established Forestry Planning Unit. In order to adequately address all the crucial problem areas of this sector, more studies need to be done. The availability of funds for future research and training programmes is therefore of paramount importance for forestry development planning in Sierra Leone.

It is in this vein that I express my sincere gratitude to the Food and Agriculture Organization of the United Nations and the United Nations Development Programme for their unreserved support.

I am indebted to Dr H J E Uys, my study leader, for his constructive criticism, patience and understanding which translated this dream into reality. The valuable contributions of the Chief and the Acting Chief Conservators of Forests of Sierra Leone, laid the foundation for this achievement. Finally to Olive and Emmaneth, I appreciate your patience and understanding during the difficult times when I was away in pursuance of knowledge. To all friends and colleagues, who have contributed to the success of my studies in diverse ways, I am deeply indebted.

Note: Throughout this document, a comma (,) is used as a thousand marker and a full stop (.) for decimals.

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LIST OF ACRONYMS

ASMP	Agricultural Sector Master Plan
BSL	Bank of Sierra Leone
CDC	Commonwealth Development Corporation
CRO	Chief Regional Officer
CSO	Central Statistics Office
CSSL	Conservation Society of Sierra Leone
DAF	Department of Agriculture and Forestry
DBH	Diameter at breast height
DIARD	Department of Internal Affairs and Rural Development
DLHE	Department of Lands, Housing and the Environment
DNDEP	Department of National Development and Economic Planning
FAO	Food and Agriculture Organization of the United Nations
FD	Forestry Division
FIC	Forest Industries Corporation
GDP	Gross Domestic Product
HEP	Hydro Electric Power
ICBP	International Council for Bird Preservation
IMF	International Monetary Fund
ITTO	International Tropical Timber Organization
IUCN	World Conservation Union (formerly International Union for the Conservation of nature)
LHA	Louis Heyl Associates
MW	Megawatts
NEAP	National Environmental Action Plan
NFAP	National Forestry Action Plan
NGO	Non Governmental Organization
NPRC	National Provisional Ruling Council
OLS	Ordinary Least Squares
RFO	Regional Forest Officer
RSPB	Royal Society for the Protection of Birds

SILETI	Sierra Leone Timber Company
SLMICO	Sierra Leone Match Industrial Company
TFAP	Tropical Forestry Action Programme (formally Tropical Forestry Action Plan)
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
WB	World Bank
WCS	World Conservation Strategy
WWF	World Wide Fund for Nature

1. INTRODUCTION

1.1 Statement of the problem

The Sierra Leone Government, through the support of various funding agencies, and in collaboration with FAO, responded to the deteriorating forestry situation in the country by instituting a forestry sector review during 1987/1988. That review entailed the identification of forestry development problems in the broad areas of forestry in landuse, forest economy and industries, forestry institutions and forestry research. The proposed remedial action plans were translated into forestry development programmes and projects in tune with the problem areas indicated above (Allan, 1990). The first project following the review, established a Forestry Planning Unit aimed at the collection or regeneration of the much-needed baseline data for forestry development planning. The sector review and related projects were under the auspices of the Tropical Forestry Action Plan (TFAP). The high annual deforestation and low replanting rates coupled with regionalised scarcity of some forest products, further underscored the need for future forestry sector planning. Between 1987 and 1994, three related plans with strong collaborative links with the TFAP were prepared:

(a) The National Conservation Strategy for Sierra Leone (NCSSL);

(b) The National Environmental Action Plan (NEAP) and

(c) The Agricultural Sector Master Plan (ASMP).

While the TFAP is an ingredient of plans (b) and (c), the NCSSL contributed to the development of the TFAP which is being implemented in Sierra Leone as the National Forestry Action Plan (NFAP).

This study (A Strategic Forestry Development Plan for the Western Area of Sierra Leone), is supported by the Capacity Building Project of the NFAP. It entails the determination of the demand for various forest products for the Western Area. In addition, the study briefly assesses the role of the forests of the Western Area in catchment and soil protection. Although the study mainly focuses on the Western Area (refer to Figure 1.1) the forest products investigated, are obtained from various regions of the country.

Figure 1.1: Political map of Sierra Leone (Source: Adapted from UNDP-FAO, 1993).

Planning of the sustainable supply of these products from these regions to the study area, accords the study some national importance.

Demand and supply studies of forest products in general, often provide the essential ingredients for the planning of future supply of these products. In Sierra Leone, however, there has been little or no detailed demand and supply studies on the products mentioned below. The external trade on forest products and their substitute or complimentary products has not been intensively investigated in the past. This trade influences the national economy, in terms of import substitution and its effect on the supply of products for local consumption. On the contrary, firewood production, consumption and marketing, have been investigated by Atlanta Industries (1979); Kamara (1986); Massaquoi (1985); and World Bank/UNDP (1987). Because of the popularity of and the quantum of biomass used as firewood, this commodity is treated in a separate but closely related study (Conteh, 1995).

1.2 Objectives of the study

The broad objectives of this study are to:

(a) Determine the demand for sawnwood, construction poles and *Funtumia africana* logs in the Western Area of Sierra Leone.

(b) Prepare a Strategic Forestry Development Plan for the Western Area based on the findings from (a) above.

The specific objectives of this study are to:

(a) Examine the effect of population increases on the future demand for these products over the projected period;

(b) Examine the effect of changes in the major economic indicators on the past and future consumption patterns of these products;

(c) Determine the effects of external trade in forest products and their substitute and complimentary products on the future demand for the products being investigated;

(d) Determine the availability of appropriate land for plantation establishment or for the management of natural stands to satisfy the future demand for the products,

(e) Identify and assess suitable plantations within the Western Area for the provision of alternative tree species for the production of construction poles and *Funtumia* logs for match splint production and

(f) Identify areas of the low-lying Western Area forest reserves for trial plantings of indigenous pole-producing species for the construction industry and *Funtumia* for match splint production.

1.3 The delimitations of the study

This study is limited to the Western Area in general and to Freetown in particular, due to the generally poor security situation in the country and restrictions imposed by funding, manpower, time and logistics.

Investigations into the past production, sales and consumption patterns of the products was affected by the following major constraints:

(a) The general paucity of sales and stock delivery records,

(b) Respondents unwillingness to provide information on the nature of their businesses, probably due to fear of taxation and

(c) The general lack of interest in research, in general, especially in the case of illiterate respondents.

Attempts at quantifying the volume of forest products smuggled into and out of the country by land, air and sea had very limited success.

The instability in the sawnwood and pole markets, and the construction industry in general made the data-collection exercise tedious. While about 15 construction businesses had either moved or changed management, a few new ones emerged and a few old ones went into liquidation between 1991 and 1995.

Certain construction companies (about 4%) registered under false addresses while up to 20% merely registered in anticipation of future rehabilitation contracts following the end of the civil conflict.

Due to funding and time constraints, the study concentrated on demand and not supply of the products covered.

1.4 Structure of the study

Chapter 2 covers the geographical and demographical features of the country and highlights the gravity of the deforestation problem. It particularly focuses on the history of deforestation in the study area and describes the capability of the Forestry Division in the implimentation of forestry programmes.

Chapter 3, reviews relevant literature in order to examine what has been done in the area of demand and supply studies of forest products. It also reviews the role of forests in the national economy and underscores the relevance of planning especially in the forestry sector. Research methodologies in demand trend forecasting and the relationships between research methods and objectives of study were highlighted.

Chapter 4 considers data sources, collection, analysis and the value and problems associated with the use of questionnaires.

Chapter 5 provides the results according to production, consumption and sales categories with respect to the various data sources.

Chapter 6 covers the effects of demand shifters such as, changes in building sizes, designs and the substitution of materials, the effect of the installation of a new government, rehabilitation needs for forest products and the expected economic recovery. The results are discussed in light of the recent conflict, economic performance of the country and the political change.

Chapter 7 deals with the framework of the strategic plan, the time frame, logistics involved, the execution of the plan and analyses the supply strategy for all products. It also considers the value of external trade in forest products on the local supplies and

the nation's foreign reserves. The chapter ends with some recommendations for further research.

Chapter 8 provides the list of bibliography used in this research.

1.5 The relevance of this study

This study is of significance to future forestry sector planning in Sierra Leone, due to the following reasons:

(a) The study focuses on sawnwood, construction poles and *Funtumia africana* logs which, unlike firewood, have not been investigated in any detail by previous researchers. The baseline data so produced will form the basis for future research work in the area of forestry economics.

(b) Focusing on Freetown in particular and on the Western Area in general, further underpins the relevance of the study. Freetown, the nation's capital, now has an estimated population of about 1.2 million (26% of the national population), and is the seat of government, an important commercial centre and harbours both sea and airports.

(c) Industrial poles are currently being harvested from marginal lands which are not subjected to any form of scientific management. The north-central, north-western and northern regions which currently supply most of these poles are also prone to annual bushfires which are virtually fuelled by the grass type of vegetation which is typical of these areas. In order to avoid both the overcutting and depletion of the young *Anisophyllea laurina* stands by fire, extension support to these communities will be essential. The results of this study will draw the attention of the Forestry Division and the pole vendors to the need for the sustainability of pole production. *A. laurina* according to this study, is currently the most popular construction pole species in the Western Area.

(d) An indication of the fairly large difference between the volume of sawnwood on the market and that of roundwood sold to sawnwood merchants, has already underscored the need for both intensive and extensive monitoring of the forest estates (refer to Table 1.1). The volume of sawnwood that was illegally

Year	Vol. harvested by Panguma Sawmills (m^3)	Vol. harvested by F.I.C. (m^3)	Total vol. recorded by mills (m^3)	Total vol. recorded by F.D. (m^3)	Vol. apparently unrecorded (m^3)
1985	3,574.4	12,608.5	13,856.7	16,183.2	2,365.5
1986	8,651.7	10,320.4	9,852.7	18,972.1	9,119.4
1987	12,618.1	7,390.8	20,008.9	10,653.4	9,355.5
1988	10,589.5	5,056.3	15,645.8	7,819.8	7,826.0
1989	8,715.7	5,056.7	13,772.4	6,978.0	6,794.4
1990	5,500.9	1,983.7	7,484.6	732.4	6,752.2
1991	-	1,734.3	1,734.3	483.9	1,250.4
1992	2,232.9	1,387.4	3,620.3	2,212.9	1,407.4
1993	4,760.7	1,809.7	6,570.4	3,280.7	3,289.7
1994	-	2,673.7	2,673.7	2,033.3	640.4
1995	-	2,673.7	2,673.7	-	2,673.7

Table 1.1: Comparison of roundwood volume sold to volume harvested by two mills.

harvested from the Western Area, which is strictly a protection forest reserve (Forestry Division, 1990), in 1995, further re-iterated the need for effective surveillance.

(e) The perceptions of the sawmill industry on the future of forestry in general as determined during the study has provided some ingredients for sectoral planning.

(f) The anticipated increased demand for construction poles, especially for mud-and-wattle buildings in the provinces, following the end of the civil conflict, necessitates the search for alternative pole species. The situation is likely to affect pole supplies to Freetown and therefore pole prices in Freetown.

(g) The current security situation especially along the highways resulted in the temporary suspension of the operations of the Sierra Leone Match Industrial Company in November 1995. There is consequently a need for a suitable alternative tree species within the Western Area to save the company from permanent closure.

2. BACKGROUND TO SIERRA LEONE

2.1 Geographical and demographical features

Sierra Leone lies between latitudes 6° 55'N and 10° 00' N and between longitudes 10° 14'W and 13° 17'W, occupying a total area of 72,000 km^2 The four main physical regions of the country are coastal plains, plateau, hills and mountains (refer to Figure 2 1) A mean annual rainfall of 3000mm to 5000mm experienced on the coast decreases inland to about 2000mm in the drier northern sector (refer to Figure 2.2). The two distinct seasons (wet and dry) fall from May to October and November to April respectively The mean annual temperature fluctuates very little from 27°C with March and April being the hottest months The country's population was estimated at 4 2 million in 1990 with an annual growth rate of 2 5% (Central Statistics Office, 1993). It is administratively divided into the Western Area (formerly the colony) and 12 districts belonging to three provinces (refer to Figure 1 1)

2.2 General trends of deforestation.

About 60% of the country's total land area of 72,000 km^2 was covered with closed high forests, just over six decades ago, but only 5% of that now remains About 6,000 ha of various types of forests were depleted annually between 1981 and 1985 (Sayer, Harcourt and Mark-Collins, 1992) The depletion of the closed forests over the period continues to increase the forest regrowth area where most of the shifting cultivation is practised. The current proportion of this forest type in relation to the others, as indicated in Table 2.1, reflects the severity of the deforestation problem.

Forest type	Area ('000ha)
Closed forests	365
Secondary forests	261
Forest regrowth	377.4
Savanna woodlands	16'.9
Mangroves and associated forests	21.6
Plantations	4*
Overall tree cover	6309

*(Located within forest estates, hence its inclusion in the totals results in a double count.)

Table 2.1: Forest types by area in Sierra Leone (Source: Allan, 1990).

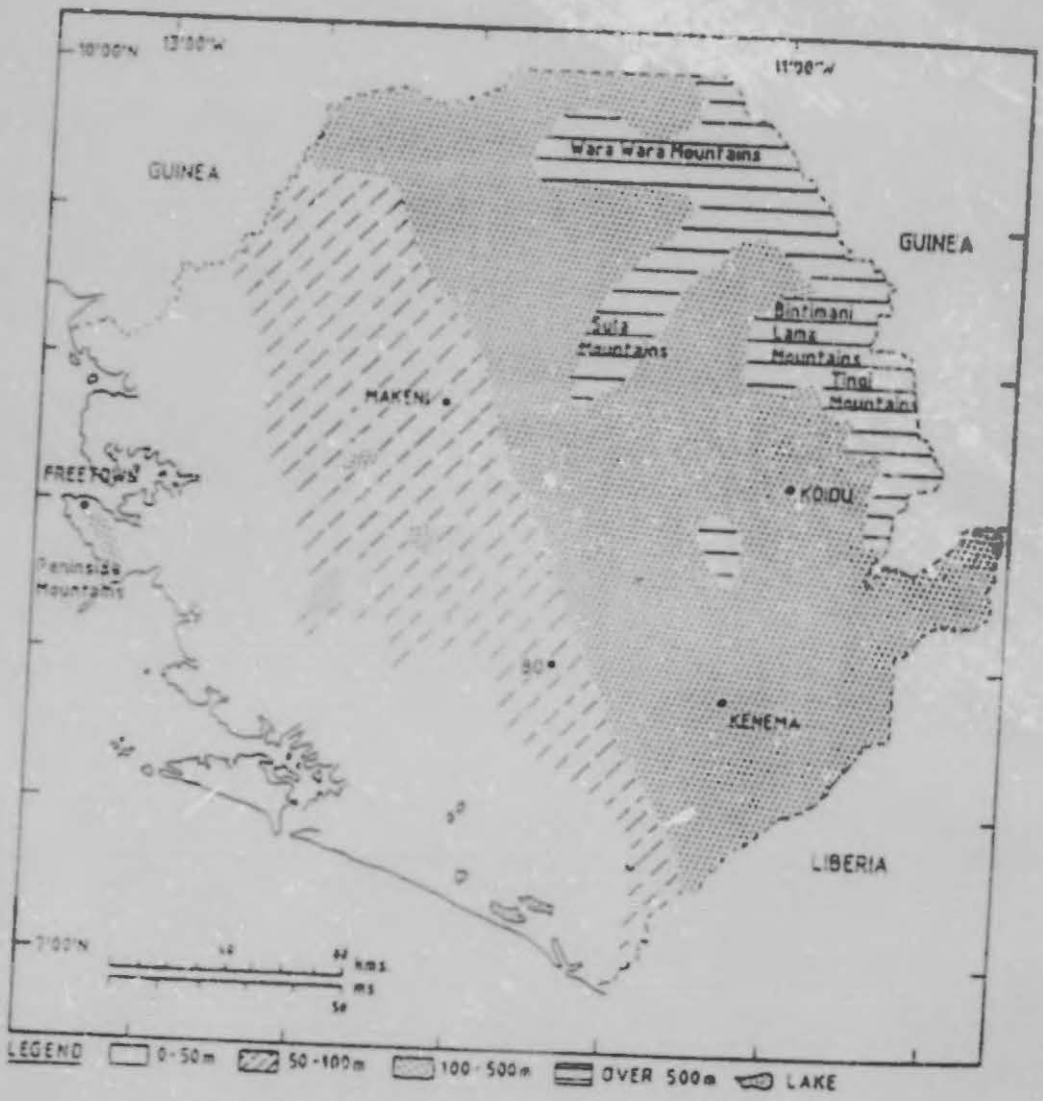

Figure 2.1: Physical map of Sierra Leone (Source: ABCO/Minster Agriculture, 1993)

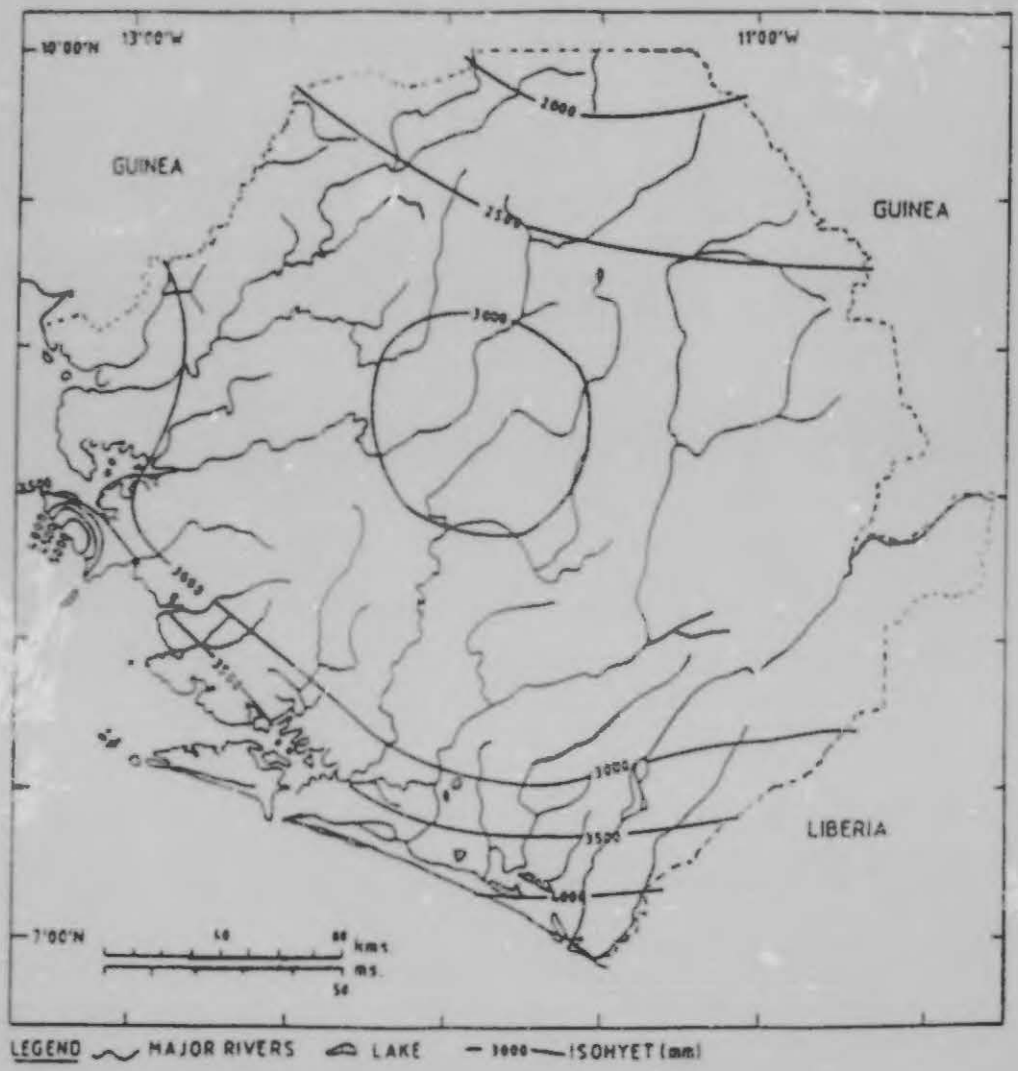

Figure 2.2: Average annual rainfall distribution in Sierra Leone (Source: ABCO/Minster Agriculture, 1993).

This trend will continue mainly due to the causes and reasons explained in Paragraph 2.3

2.3 Causes of deforestation

The major causes of deforestation are shifting cultivation; firewood harvests; logging for timber and mining of diamonds (alluvial), bauxite, rutile and gold. The population density of 58 persons per km^2 in 1990, could be higher in the mining districts and urban areas. About 72% of the entire population is rural-based. The rates of deforestation over the years tend to be directly proportional to population densities and the types of life-sustaining activities of the local communities residing within or in close proximity to these forests. This results in a regionalised deficit of firewood in particular (Koroma, 1995). The rebel war which is now affecting about 70% of the population has created firewood deficits around refugee and displaced camps.

2.4 The Western Area

The Western Area of Sierra Leone, occupies an area of $600km^2$ with an estimated population of about 554,000 and an annual growth rate of 2.9% in 1985. The area includes Freetown, the country's capital, and the four rural district councils, namely: Koya, Waterloo, York and Mountain. The estimated projected population of 637,000 for the area for 1995 (Central Statistics Office, 1993) is expected to have exceeded one million due to the migration of about 800,000 internally displaced into the city (refer to Table 2.2).

Most of the study area is hilly with mountain ranges between 183m and 888m above mean sea level (refer to Figure 2.3). Nine important forest reserves occupying a total area of 17,687ha mostly serve a protection function. Important areas benefitting from effective forest cover include the Guma, Babadori, and Congo catchments. The role of these, mostly natural forests, in the provision of wildlife, medicinal plants, firewood, poles and wild foods is crucial to the development of both the rural and urban communities. Major towns in the Western Area include: Waterloo, Newton, Songo (part of the town), Paloko, Tombo, Hastings, Kossoh Town, Regent, Goderich, Gloucester and Leicester (refer to Figure 2.4). Main activities include: coastal fishing, vegetable gardening, firewood sales, subsistence farming and cultivation of cash crops mainly in low-lying areas.

Origin (district)	Number of family heads	Total number of persons
Kailahun	18,983	133,336
Kenema	8,631	68,038
Kono	8,820	55,364
Bo	7,756	58,615
Bonthe	5,907	36,568
Moyamba	17,560	89,932
Pujehun	6,516	38,017
Koinadugu	2,639	14,508
Kambia	1,198	10,045
Portloko	21,289	138,938
Tonkolili	14,189	114,448
Total	113,488	758,009

Table 2.2: Total number of displaced families in Freetown between July and December, 1995 (Source: Department of Internal Affairs and Rural Development, 1996).

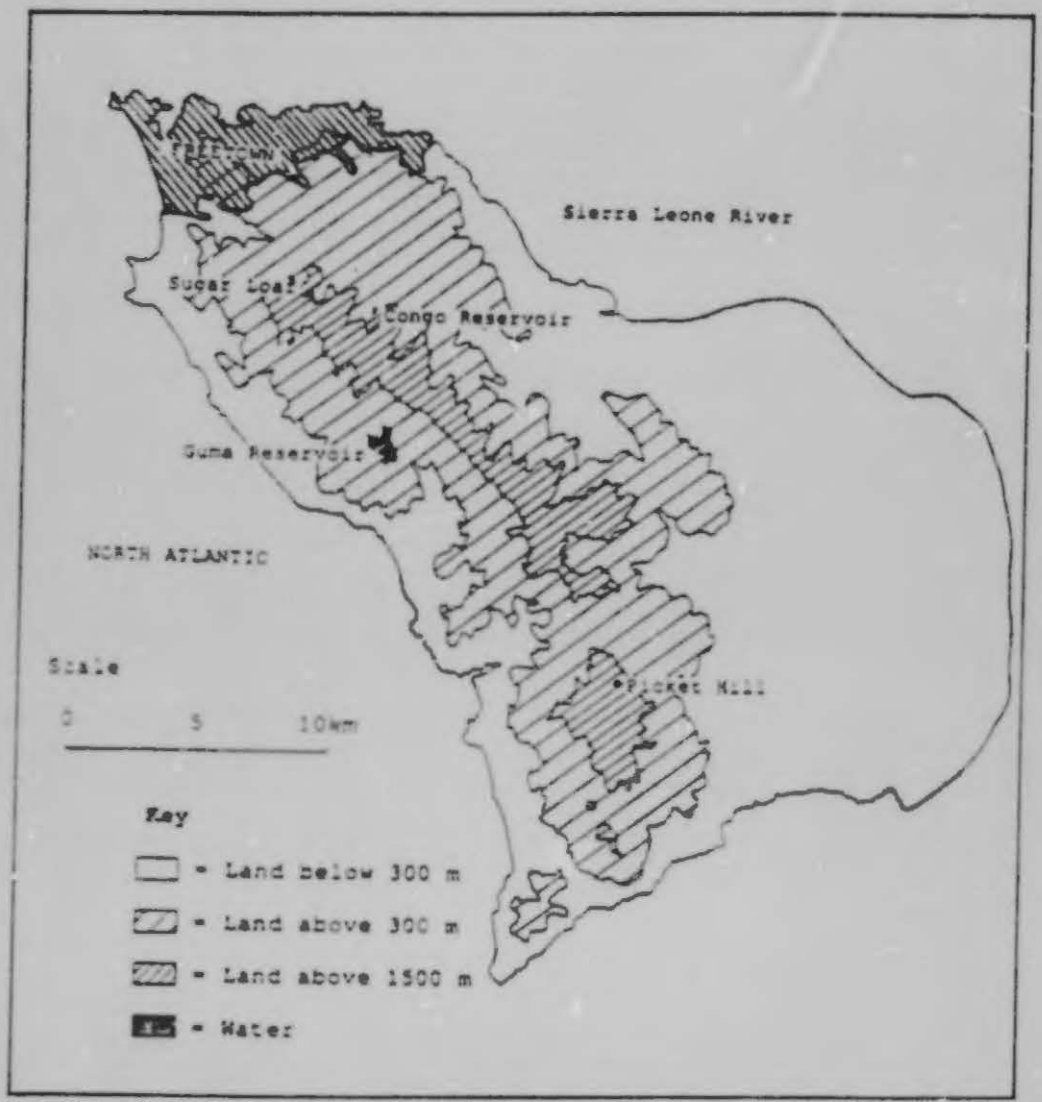

Figure 2.3: Geography of the Western Area (Source: Adapted from Wood and Ausden, 1990).

Figure 2.4: Western Area: Settlements, roads and the extent of the forest reserves of the Freetown Peninsula (Source: Wood and Ausden, 1990).

2.5 History of forest use in the Western Area

The forests of the area belong to the Upper Guinea Forest Block which stretches from Ghana to Guinea. Deforestation is believed to have reduced this block to only 13% of its former area (refer to Figure 2.5). Record of deforestation in the Western Area dates as far back as 1787, when the forests were cut for fuelwood and timber. A considerable portion of the forest was selectively cut during the Second World War to obtain strong dense timber for marine construction (Wood and Ausden, 1990). A government sawmill operating at No. 2 River about the same time, harvested roundwood from the forests. However, in the absence of any sawmill currently operating in the region, most of the wood-cutting is due to the supply of firewood to Freetown and also for fish-smoking in the coastal villages. Due to the generally rugged terrain, farming is not a major cause of deforestation, except in the low-lying areas where settlements are concentrated (refer to Figure 2.3). It is also in these low-lying areas that there are relatively high incidences of seasonal bush fires which contribute significantly to deforestation especially in the arid northern districts of the country.

In addition to fish protein, "bushmeat" protein is popular amongst the local communities and the various hunting societies which kill wild animals during traditional ceremonies and festive occasions. The most common targets are duikers, which are usually dazzled and shot at night. Monkeys are also commonly shot but mostly during the day. In addition, the following products are obtained from the forest either for sale in Freetown or for local consumption: the edible pods of *Parkia bigloboosa*; the fruits of *Parinari excelsa* (Plum) and the seeds of *Dialium guineensis* (Black tumbler) (Wood and Ausden, 1990). Common medicinal plants include: *Cassia siberina* and *Cassia siamea* used to cure malaria.

2.6 The Forestry Division

The Forestry Division is one of the three divisions of the Department of Agriculture and Forestry (DAF), the others being the Agriculture and Livestock Divisions. The sector comprises of the Rubber Development Branch (now privatised), the Wildlife Branch and the Forestry Conservation Branch, which is the largest of the three. Like the rest of DAF, operational activities of the sector have now been decentralised to the

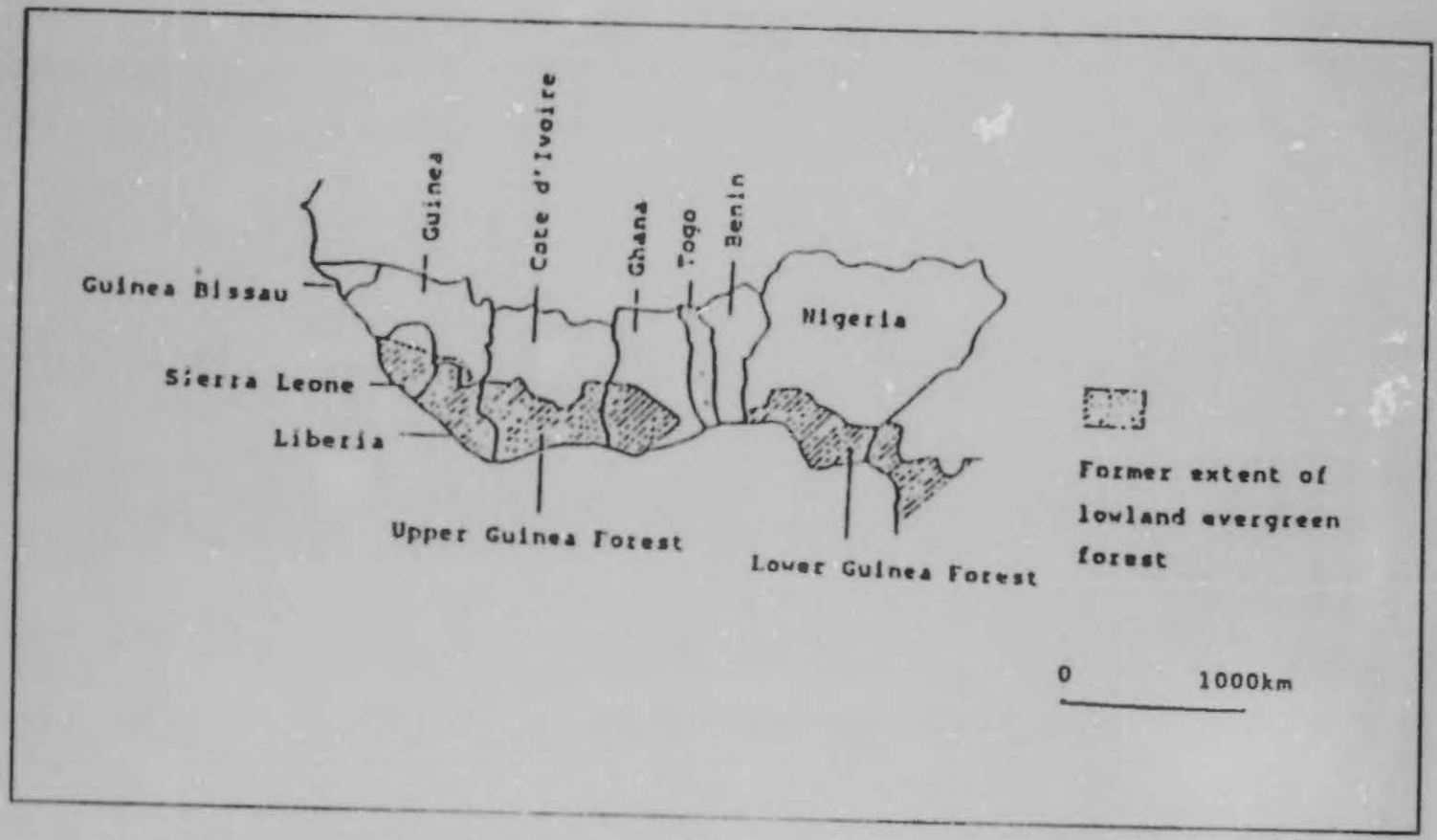

Figure 2.5: The nations of West Africa and the extent of the Upper Guinea Forest Block (Source: Wood and Ausden, 1990).

seven agricultural regions with the Chief Regional Officer (CRO), as administrative head of the region (Koroma, 1995). Each of the regions is assigned a Regional Forest Officer (RFO), who implements policy at regional level with the support of his staff, but under the immediate supervision of the CRO.

The sector, though understaffed, has a core of 13 professionals (an additional nine professionals in allied fields are undergoing specialist forestry training abroad), seven sub-professionals, 150 technical personnel and about 400 other employees (Koroma, 1995). A few NGOs in environmental conservation could assist with some environmental education extension delivery in future. The technical forestry staff in the seven regions are in direct contact with farmers who benefit from extension packages in the areas of agroforestry, community forestry in general, wildfire management, and general environmental management. In addition, DAF is now moving towards the institution of a unified extension system involving all three sub-sectors. If properly implemented, the Forestry Sector could benefit from the additional technical staff in the dissemination of forestry extension messages.

The sector works in close collaboration with the Department of Lands, Housing and the Environment (DLHE) in the area of sustainable landuse in the Western Area (Palmer, 1995). Also, collaboration with DLHE and the Department of Internal Affairs and Rural Development (DIARD) in the area of wildfire management has set the pace for future collaborative efforts in natural resource management. The sector has been implementing the NFAP with donor support since 1987.

3. REVIEW OF THE RELATED LITERATURE

3.1 National development planning

3.1.1 The role of forestry in national development

The forestry sector and its associated industries significantly contribute to national development in the provision of construction materials, paper, food, shelter, energy, medicines, and environmental stability. Socio-economic analysts, however, downgrade these vital roles by neglecting the intangible benefits and its inter-sectoral importance, probably due to quantification problems (Wardle, 1990 and Tahir, 1990).

According to the World Bank (1991), the forestry sector in the developing countries alone made a direct economic contribution of US$ 35 billion to their GDP towards the end of the 80's. In Sierra Leone, for instance, the sector contributed about 6% to 7% to the GDP in the late 80's (Allan, 1990; Bank of Sierra Leone, 1995). In Sierra Leone, however, over 90% of the roundwood removed is used as firewood which is the popular energy source for about 85% of the population. This contribution is normally not adequately accounted for in GDP computations (Hunter, 1989). The utilization of roundwood for poles and firewood in the rural communities is hardly recorded, as they are collected freely by the users.

In addition, the forestry sector often provides employment and other associated services to both urban and especially rural communities. Andrua (1990), for instance estimates that Uganda requires one million cubic meters of construction poles and another 14 million cubic meters of fuelwood annually. He further estimates that about 2,000 people are engaged in the pitsawing industry and about 3,000 in charcoal production. In Zimbabwe, about 9% of the forests are managed for pole production (Mabvurira, 1990).

According to Johnson (1995), the total value of Malaysia's 1992 sawnwood exports was US$ 1.34 billion (free on board) consisting 67% of the total International Tropical Timber Organization's (ITTO) producer member exports. He further estimates that the 26 ITTO's producer members employ well over a million people directly in the

sawmilling industry In Sierra Leone, however, 1.5% of the total roundwood removals comprises of sawlogs, 4% of construction and utility poles and 94 5% of fuelwood (Allan, 1990). Thus, forestry plays a vital role in the energy sector

The provision of hydro-energy for industrial development is another example of the sector's contributions that are not often quantified in terms of GDP. Out of the 24 hydro-electric power (HEP) sites in Sierra Leone, only one, namely Goma has been harnessed since 1988 while Bumbuna, with a capacity of 305MW, is under construction

Both the urban and the rural Western Area communities depend on the forests of the Freetown Peninsula for the provision of food, traditional medicines, shelter, energy, drinking water and other services A few streams in the Western Area could be harnessed for hydro-energy generation.

2 1 2 Sectoral planning in national development

The World Conservation Strategy (WCS), launched in 1980, probably laid the foundation for the development of national and regional conservation strategies in many countries Subsequent to that, " Caring for the Earth" launched in 1991 and lately the Agenda 21 of the Earth Summit, are sectoral plans of global importance to natural resource managers Various regional and country programmes with the support of technical and funding agencies, have virtually maintained the spirit of the WCS (Carew-Reid, Prescott-Allen, Bass and Dalal Clayton, 1994) Despite slight variations in nomenclature, these national and regional plans essentially build on the respective sectoral and sub-sectoral plans which are supportive of sustainable resource management

In Sierra Leone, the Tropical Forestry Action Programme (TFAP), the National Environmental Action Plan and Health For All By The Year 2000, are all essential ingredients of the National Development Plan

The sectoral plans themselves usually re-examine the sectors to which they relate with the view to identifying problems, constraints, and solutions aimed at ameliorating the situation. The national development plans then collate these sectoral plans, in light of

the logistics, human resource capability and appropriate institutional support for a holistic implementation. The TFAP is an example of a sectoral plan for implementation at national level, but of global importance.

In order to enable planners to project into the future, all plans require information on the demand for and supply of goods and essential services. In developed countries, information on relevant data sources could be sought from adverts, telephone directories and other publications. The use of questionnaires could be facilitated by high literacy levels. In the developing world, however, the collection and collation of disaggregated information from various sources could be expensive and tedious, due to low literacy levels, generally poor record-keeping practice and the paucity of information on data sources (Bass, 1993).

In most planning processes, the careful choice and analysis of the issues and objectives and their link with the policy framework are important (Carew-Reid *et al*, 1994). Until this is done it will be difficult to evaluate the resulting programmes and projects.

Sectoral plans on natural resource management should fully address all the major concerns of the local communities concerned, if they are to succeed. Clearly (1992), for instance cited the lack of integrating socio-economic factors into project design and the ignorance of socio-economic aspects at all stages of the project cycle as major concerns in forest management in the Amazon region.

3.1.3 Strategic planning in the forestry sector

According to Steiner and Miner (1977), the following factors underpin the need for strategic planning in general:

(a) Rate of technological change;

(b) Mounting complexity of the managerial job;

(c) Increasing complexity of the external environment and

(d) Long time lapse between current decisions and their future results.

Strategic planning is important especially in the forestry sector where mistakes in

investment are more difficult and expensive to correct In order to sustain the vital role of forests and associated industries therefore, foresters need to plan. The following peculiarities necessitate strategic planning in forestry:

(a) Long-term nature of the investment,

(b) Keen competition for land from agriculture and other landuse sectors,

(c) Limited funding of the sector in comparison to other allied sectors,

(d) Difficulty of predicting the behaviour of the market during the long investment period and

(e) Influence of climate and natural disasters on resource supply (Bass, 1993 and Fernando-Razetto, 1995)

According to Smit and Cronje (1992), strategic or long-term planning which is essentially aimed at addressing the uncertainties in the business world, requires constant adaptation to the environment It should be implemented by top management while the functional (medium-term) and operational (short-term) plans can be operated by middle and lower level management respectively The planner in the forestry sector, in particular, needs to be aware of certain factors, which influence the demand for and supply of forest products and take cognisance of them The elasticity of demand for sawnwood, for instance, is still increasing in the developing world although it has virtually stagnated in the developed world This is due to a stable population growth and the production of large quantities of housing units after the Second World War Changes in building construction styles may have also contributed to the stagnation in the demand for sawnwood in the developed world (Ewing and Chalk, 1988)

Forestry sector planners need to consider all possible parameters that influence the development of the sector as part of the planning process The Strategic Forestry Development Plan for South Africa (SFDPSA), for instance, considered the following main areas:

(a) History of forestry and forest industry development,

(b) Influence of the economy and land availability on the expansion of the forest

estate and

(c) Influence of transport, research, and the import-export trade on future forecasts

From this information, the annual planting targets were proposed in order to reduce the deficit between demand and supply forecasts for a 30-year period (Van der Zel, 1989).

At global, regional and national level, the TFAP was launched in 1985 to

(a) Increase awareness of the problem of deforestation and to commit all levels of society in addressing it,

(b) Introduce or strengthen inter-sectoral planning strategies for the generation of effective policy measures to ameliorate the situation and

(c) Mobilise national and international resources for the implementation of plans in a co-ordinated manner (FAO, 1991)

National Forestry Action Programmes (NFAPs) which are aimed at sustainable forest management to satisfy both local and national needs, have been implemented in many countries since 1985 The United Nations Conference on Environment and Development in 1992, further underscored their importance and invited countries to develop them Major constraints to NFAP implementation include, continuous deforestation pressure, weak national institutional capacities, inadequate project planning and implementation and the lack of political support (Clément, 1995)

In light of these constraints, the objectives of the TFAP were revised to emphasise national leadership, multi-disciplinary approach, and the involvement of forest-dependent people in NFAP implementation The five-step approach ranging from the appointment of national co-ordinators to Round Table IV is aimed at effective implementation through monitoring and evaluation Mostly co-ordinated by FAO, NFAPs build upon existing national development programmes to ensure their

integration and effectiveness (Van der Zel, 1996)

3.1.4 Forestry development planning in Sierra Leone

The Forestry Department of Sierra Leone was established in 1911. Forestry development planning became necessary and evident after independence in 1961. About this time, the management objective was modified from a purely protection function to include timber production as well. Various studies laid the foundation for planning the sector. The first was by Philipson (1979), on Wildlife Conservation and Management. Later, Atlanta Industries (1979) and Kingston (1986) independently, discussed Forestry Development in Sierra Leone.

The sector review referred to earlier in Paragraph (1.1) entailed the use of international specialist consultants to study the following areas under the aegis of the TFAP:

(a) Forest industries and wood processing,

(b) Forest research and agroforestry,

(c) Forestry institutions and their strengthening,

(d) Watershed management,

(e) Forest products marketing,

(f) Forest industry and management,

(g) Review of the forest economy and

(h) Conservation of forest resources

Local consultants were used in the case of (h) above

Action programmes addressing all these issues, were developed in the form of project proposals for subsequent funding and implementation (Allan, 1990). With the assistance of funding and technical assistance agencies, Sierra Leone is now at the project implementation stage of the TFAP implementation cycle. The Capacity Building Project (SIL/92/006) is already laying the foundation, mostly in terms of staff training and data generation, for the implementation of the mid- and long-term

projects.

The Sierra Leone G ment is presently finding it difficult to implement actual national development plans, instead, short-term *ad hoc* plans are executed under the IMF's structural adjustment programme (Sovula, 1995) The following negative impacts of this strategy may have accelerated the rate of deforestation.

(a) Restrictions on employment, wage increases and promotions,

(b) Removal of subsidies from the prices of essential commodities and

(c) A generally poor economic performance (Hunter, 1939 and Bank of Sierra Leone, 1995)

According to Sesay (1995), however, the following positive economic indicators could ameliorate the gloomy situation

(a) A drop in budget deficit from 10% to 7% of GDP,

(b) The rate of money supply slowed down from about 140% to 35%,

(c) The spread between the commercial and parallel market exchange rates narrowed to less than 5% in 1994 and

(d) The *per annum* inflation decelerated from 115% to 35% during 1992 and then to 12 5% in early 1994

It is however, very doubtful whether these positive signs will significantly influence the customer's purchasing power especially for sawnwood

Human resources development, mostly for forestry sector planning, which started in 1992 will continue to 1997, when the last batch of trainees will take up positions in the Forestry Planning Unit. Thus, the Forestry Division's enhanced capability and capacity could ensure the implementation of plans as efforts are being made by government to improve the working environment.

2.1.5 Community participation in forestry development

Community participation in forestry development is well documented (Shepherd, 1992; IUCN/UNEP/WWF, 1991 and Chowdhry, 1992) Once communities continue to realise direct benefits from the resources to be protected, they are often willing to police such resources at little or no cost to management

The intricate relationships between life-sustaining activities and forest resources is often revealed by Participatory Rural Appraisal (PRA) techniques PRA results influence the mode of community participation in forest management as their concerns and inputs will be incorporated To be successful, projects should fully involve local communities as more strongly emphasised by recent publications (Jackson, Nurse and Singh, 1994 and Johnson, Johnson and Edwards, 1993)

In Cameroon, for instance, the communities residing within and around the Kilum Forest, voluntarily instituted forest protection laws focusing on the theft of trapped wildlife, zoning of forests into family areas, restriction of new users, the prohibition of the cutting of live trees and the prohibition of hunting with dogs (Nurse, McKay, Young, and Asanga, 1995) The local Senegaleese communities in the Senegal River valley have developed forest management strategies through the use of supervisory teams These teams essentially guarantee the protection of matured trees and young growth against cutting, fire and browsing livestock (Diouf, 1995) In Nigeria, according to Dunn (1995), the local communities instituted the following conditions in the management of the Gashaka Gumti National park

(a) Restriction on the allocation of land to newcomers,

(b) Control of the movement of livestock between the uplands and the flood plains, to prevent overgrazing,

(c) Control of commercial hunting by outsiders, and

(d) Early burning of foliage to ensure sufficiency of forage

In Sierra Leone, the management of the Tiwai Island Game Sanctuary is effected by a standing committee comprising of local communities and five other parties. The local communities provide free labour and materials for construction projects on the island, and also operate a handicraft centre (Koroma, 1995) The chairmen of the four rural districts of the Western Area, collaborate with the Forestry Division in the management of the Western Area forests This entails the endorsing of licences by both parties in order to avoid forgery, tree planting by the local communities; the recruitment of honorary forest guards by the communities and the prompt reporting of offences to the forest service personnel (Palmer, 1995)

3 1 6 The role of forests in rural development

Rural communities especially in West Africa, rely on forests for food, traditional medicines, building materials, energy, water for domestic use and handicrafts. Its contribution to rural development in terms of food security especially in the third world could be crucial during the rainy season According to FAO (1990), about 2,000 tonnes of snails are eaten in the Bongouanou region of Ivory Coast and about 2,000 tonnes of bushmeat are eaten annually in Cameroon where it provides 70% to 80% of the animal protein consumed The provision of cheap animal protein on a near-sustainable basis supports rural health significantly in the third world countries Bushmeat, for instance, provides 70% of the animal protein in Southern Ivory Coast; 80% to 90% in Liberia and 55% in Sierra Leone (FAO, 1990) The availability of bushmeat in *Trypanosomysis*-prevalent West Africa is very crucial as the raising of non *Trypano*-resistant cattle which seem to be adapted to the area, could be a problem. *Trypanosomysis* is a sleeping sickness which is responsible for high death rates in cattle. The parasite is distributed by the tse-tse fly which is common in the humid tropics

In Sierra Leone, where the *per capita* annual firewood consumption is 1 63 m^3 the rural communities probably consumed 5.8 million m^3 of firewood annually in the early 90's The sawmilling industry employed over 2,000 people, constructed over 200 miles of roads and maintained up to 400 miles of roads mostly in remote areas of the country About 72% of

the population is rural-based and utilise mostly bush poles, ropes, canes, palm fronds and grasses in the construction of traditional houses and huts. The crucial role of forests in food security in rural Sierra Leone lies in the fact that the so-called hungry season foods are available and affordable mostly during the rainy season. During this time, which is off season for agricultural crops, accessibility to and affordability of imported food is affected by impassable road conditions and serious cash limitations. In addition, rural children obtain some of their Vitamin C supply from the plums of *Spondias mombin*, *Anisophyllea laurina*, *Cola laterita* and *Parinari excelsa*. A common source of protein during the dry season is from the roasted seeds of *Pentaclethra macrophylla* and *Parkia occidentalis*. Most of the rural communities depend on traditional herbs in place of modern drugs which are either unavailable or unaffordable. In the Western Area of Sierra Leone in particular, FAO (1990) cites the value of forests as follows.

(a) Seventy plant species were identified for the treatment of cholera, dental infections, dysentry, leprosy, measles, tetanus, boils, worms and cough by the Gloucester village community.

(b) The bark of *Rhyzophora racemosa* produces red dye, the seeds of *Garcinia kola* produce orange dye, the bark of *Leucaena sp.* is used to produce pink dye used in the handicraft industries and

(c) The 15 fish-smoking enterprises in Sussex village area consume approximately 70 tonnes of fuelwood a year. An average of 27.3 kg of fuelwood is used per fish-drying session using mostly *Ochthocosmus africanus*, *Anisopyhllea laurina*, *Vitex doniana*, coconut husks and palm fronds.

3.2 Forecasting methods and applications

3.2.1 Research methodologies in demand trend forecasting

Many researchers have used historical data of past consumption records, over a period of time, to forecast future consumption trends for a specific or a group of products. Buongiorno and Gilless (1982), LHA Consultants (1985, 1987 and 1992), Louis Heyl Associates (1982), United Nations (1984), FAO (1986), Meier

(1986); Siddayao (1986); and Buongiorno, Harou, Omoluabi and Ogundare (1994), have all used this method in various instances These authors, however cautioned about the following limitations or deficiencies of the method:

(a) The reliability of historical data collected for purposes quite different from one's own,

(b) The effect of future price changes on the future demand to be predicted;

(c) The limited guarantee in the extrapolation of future demand trends in developing countries with unstable economies,

(d) The influence of substitution and complimentary products on the future demand projection;

(e) Technological advances resulting in reduced structural material requirements for buildings and

(f) The number of years for which one can safely predict into the future

In addition, the demand for any particular commodity could be affected by a number of determinant factors In any period of time, the demand function for a commodity X, is the relationship between various amounts of X purchased and the determinants of those amounts In relating energy demand to economic growth in developing Asian countries, for instance, Siddayao (1986) specifically cited the following determinants as crucial in influencing demand

(a) Possible price of commodity X;

(b) Prices and availability of closely related commodities, both substitutes and complements,

(c) Prices of other commodities that compete for the buyer's disposable income;

(d) Disposable income of buyers,

(e) Buyers tastes and preferences,

(f) Prices and income expectations and

(g) State of technology

Due to these uncertainties, the accuracy and reliability of long-term forecasts have been questioned by many authors In the absence of any hard and fast rules, in the choice of forecasting methods, Page (1982) suggested the following guides

(a) Do not trust any particular method regardless of how convincing it may seem,

(b) Consider the true significance of recent events and use foresight and

(c) Look for reasons and implications of why your forecast could be wrong.

Generally, the determinant factors in the choice of method include, time and funds available, preferred accuracy required, the scope (coverage) of the operation; and the frequency of review of the forecast However, Fildes and Howell (1979) warn that model sensitivity to data error and misspecification are as important as the ability to recognise specification error in the chosen model

Blin, Stohr and Bagamery (1979) related method to scale and value of the forecasting operation and recommended as follows

(a) Low-cost time series for simple forecasts,

(b) Sophisticated time series models for increased accuracy and

(c) Full-fledged econometric models for a corporation, industry or the national economy

The information available to the forecaster needs some critical examination prior to analysis and interpretation Steece (1982), for instance, considered the length of the series; the pattern of data and type of forecasting relationship as crucial The uncertainties of the future markets and the unreliability of forecasting methods inspired a few researchers to consider a combination of methods. McNees and Perma (1982);

Steece (1982) and Davidson and Ayers (1982), had all used a combination of methods to achieve a " best guess " forecast The relationship between demand for individual products of an aggregate and macro-economic indicators such as Gross Domestic Product (GDP) does not always indicate a positive correlation This is because the individual disaggregated products may be differently affected by the economic performance of the country Louis Heyl Associates (1982), for instance, in a demand prediction exercise for the forestry sector of South Africa, found that the average demand for roundwood increased by 2 2% while GDP grew at 3 2% *per annum* between 1970 and 1980 They found roundwood demand to fluctuate more widely than GDP growth at 15% and 8% respectively over the period They also predicted the demand for transmission poles to increase at the rate of 1 8%, guard rails by 3.8%; fencing poles by 2 0%, telephone pol by 1 9% while the overall demand for poles could increase by 1 8% *per annum* from 1980 to 2000

However, the macro-economic variables generally describe the overall economic climate which in turn shapes consumer psychology and business attitudes This is because sales depend not only on the firm's prices, production and marketing strategies, but on real disposable incomes of all consumers The situation may not be the same for Sierra Leone with a *per capita* GDP of less than US$ 350 in 1991 and about US$ 200 in 1995 In Sierra Leone, personal disposable incomes are low and mostly irregular coupled with a high rate of inflation (Bank of Sierra Leone, 1995) In fact the large difference between the selling price of sawnwood and workers' incomes had depressed the demand for sawnwood in Sierra Leone by the late 80's (Kamau, 1988) Hunter (1989) had noted that for a large proportion of the Sierra Leone population, the marginal propensity to save was probably zero About 2 8 million Sierra Leoneans (68% of the population) lived below the poverty line in 1990 and about 85% of the population is now displaced as a result of the on-going rebel war Hence, sustenance issues superceed infrastructural development for the majority of Sierra Leoneans, especially the displaced

3 2 2 Variations of research methodologies

The examples in the following paragraphs reflect the variability of methodology with

objective of study.

In South Africa, for instance, the Department of National Planning (1981), estimated the future supply of forest products for a period of 30 years by simply multiplying the mean annual increment by the area of each respective plantation in the country. This accounted for the supply estimate for the various categories of forest products. They calculated supply as total yield while demand was the input figures rendered by roundwood processors in the 1979/1980 survey. Necessary area adjustments were done to account for deficits or surpluses, as applicable.

For the assessment of firewood demand and supply in a pre-defined area, for example, micro-surveys which are usually inexpensive, and of short duration, and easily managed could suffice. Such surveys are, however limited in terms of extrapolation to cover national or regional populations. Due to their short duration, they may not adequately reflect seasonality in resource use (Leitmann, 1989). The availability of firewood, for instance, could be affected by seasonality, resulting in price variations which in turn affect supply and demand. Whatever the situation, Fildes and Howell (1979), argue that even when a researcher has clear objectives and direction, no "best" method exists. Instead, he must consider the cost effectiveness of the various methods. The nature of the product (aggregate or intermediate), or the type of demand to forecast (derived or direct) could affect the method.

Siddayao (1986), in estimating the derived demand for energy in developing Asian countries, used the following relationship:

$$\log Q = a + b \log P + c \log Y + d \log Z \qquad (3.1)$$

where:

Q = quantity demanded;

P = price;

Y = the income in the case of final consumption or output in the case of intermediate demand, and

Z = a vector of other variables.

Estimates of (b) and (c), measure price and income elasticities respectively.

In order to reflect the effect of GDP on energy consumption, she used a simple log-linear expression of the energy-GDP relationship:

$$\ln E = a + b \ln GDP + u \qquad (3.2)$$

where:

E = aggregate energy consumption,

GDP = gross domestic product and

u = stochastic variable.

Using a similar approach, Meier (1986), used the Process and Econometric approaches in demand projection:

(a) Process approach:

$$c = \frac{d.n.s}{e} \qquad (3.3)$$

where:

c = fuel consumption,

d = basic energy demand (identifies how much useful energy is required for each household);

n = number of households;

s = saturation (the fraction of households that require the enduse in question) and

e = device efficiency.

(b) Econometric approach

$$Q_t = f(A, Y_t) \qquad (3.4)$$

where

Q_t = fuel demand at time t,

Y_t = household income and

A_t = price of the energy form in question.

However, where constant elasticity is assumed, the equation could be amended thus:

$$\log Q_t = k + d \log Y_t + \beta \log A_t \qquad (3.5)$$

where

d = income elasticity,

β = price elasticity and

k = constant.

In order to establish the effects of income, household size, actual time devoted to firewood collection and the distance walked, Kamara (1986) fitted an ordinary least squares regression to the data to test the variants of the model

$$Q = (Y, N, L, D) \qquad (3.6)$$

where

Q = kilogrammes of firewood collected by the household,

Y = total household income,

N = number of persons in the household,

L = actual time devoted to collecting firewood in hours per kilogramme and

D = average distance walked to collect firewood in kilometers.

In his study on firewood energy production, marketing and household use patterns in Sierra Leone, he adjusted income to include gifts and home production as well, due to the difficulties in obtaining data on income. Due to variations in energy use by various members of the household, he used consumer equivalent factors which relate the

consumption capacity of an individual to an arbitrarily picked standard consumption factor. He found firewood consumption to increase with household income giving rise to a steeply oriented curve with an income elasticity greater than unity. As income further increased, however, other energy sources entered the household budget and income elasticity of firewood consumption may be reduced to a very small level. This is clearly not the case for sawnwood which is over 10 times more expensive on a volume to volume basis and could be virtually prohibitive for the average Sierra Leonean. Unlike firewood for which demand is on a daily basis, demand for sawnwood is periodic and often very infrequent for the average person.

FAO (1986), in projecting the consumption of forest products on a global scale, used the 1982 base level and applied growth rates up to the periods 1990, 1995 and 2000 in the following equation:

$$RC_t = D(RY_t) + T \qquad (3.7)$$

where:

RC_t = the growth rate of consumption for period t,

RY_t = the projected growth rate of GDP for that period,

D = elasticity of demand and

T = time trend.

The parameters D and T are estimated by least squares with a linear model of the logarithms of the variables.

In the case of wood-based panels, consumption is correlated with value added by the construction sector. The growth in GDP (RY_t) is calculated from the "low scenario" of the FAO compendium of macro-economic indicators and according to FAO, from the Chase Econometrics Long Term International Forecast. Elasticity of demand (D) was estimated separately for four groups of countries and in addition for the USA and for Japan the largest consumers. Countries were grouped by *per capita* GDP in 1981 expressed in 1980 dollars.

(a) Under US$ 2,000, (b) US$ 2000 to US$ 4,000, (c) from US$ 4,000 to US$9,000 and (d) over US$ 9,000.

The projected consumption of newsprint, printing and writing paper, other paper and paperboard, sawnwood and wood-based panels was calculated individually for each country similar to the growth in consumption.

Growth in production in each time period (RP_t) is related to growth in gross fixed capital formation for that period ($R_g F_c F_t$) by a stastically estimated output elasticity. The output elasticity capital formation is estimated for four ratios of production to consumption and for selected supplies in each product category. For projection, countries are classified into four groups based on the ratio of base period production to consumption.

(a) less than 0.8, (b) between 0.8 and 1.0, (c) between 1.0 and 1.2 and (d) greater than 1.2.

The level of production equals the base period production plus the growth in production. Growth in gross fixed capital formation ($R_g F_c F_t$) is calculated again, from the Chase Econometrics Long Term International Forecast. In a country with *per capita* GDP of less than US$ 2,000, growth in consumption of sawnwood can be formulated as:

$$RC_t = 0.929(RY_t) - 0.8 \qquad (3.8)$$

In countries where production exceeds consumption, growth in $GDP(RY_t)$, is substituted for growth in capital formation ($R_g F_c F_t$) in the projection. Sources of uncertainty with this method include the following:

(a) Model error (the inherent inability of the model to predict the past perfectly) and

(b) Projections based upon independent forecasts of macro-economic indicators (the projections mirror and magnify errors in the economic forecasts).

This model is best suited for projecting world trends where errors are minimal but less suitable for regional and country projections.

Buongiorno and Gilless (1987), in forecasting the demand and price of wood for the Wisconsin pulpwood market, used a series of amendments to the standard structural equations in order to improve accuracy. The following equations were initially used:

Demand: $D_t = a + bK_t + U_t$ (3.9)

Supply: $S_t = c + dP_t + V_t$ (3.10)

Equilibrium: $D_t = S_t$ (3.11)

where:

D_t = the quantity of pulpwood demanded in year t;

P_t = the price of pulpwood;

S_t = the quantity of pulpwood supplied;

K_t = the capacity of pulpmills in Wisconsin;

a, b, c and d are unknown parameters and

U_t and V_t are random disturbances.

They amended these sets of equations about six times with the aim of correcting or minimising the following sources of error:

(a) Random disturbances, U_t and V_t, which make the equations less precise;

(b) Predictions of the exogenous variable K_t;

(c) Estimation of the parameters of the reduced-form equation;

(d) Forecasting of the disturbances U_t and V_t;

(e) Autocorrelation of the residuals and unequal variances and

(f) The effect of increases in oil prices on pulp production.

The initial results indicated that variations in mill capacity appear to account for 90% of the variance in quantity of pulpwood demanded but only 60% of the variance in price. When they used the logarithmic values of price and mill capacity, however, they found the elasticity of pulpwood demand with respect to capacity as 2.73 and a 95% confidence interval of 2.45 to 3.41. It was also found that the elasticity of pulp price with respect to capacity is 0.74 with a 95% confidence interval of 0.48 to 1.00.

The accuracy of the forecasts they got, depended on the quality of the model developed and on the accuracy of forecast of the exogenous variables.

Buongiorno, Harou, Omoluabi and Ogundare (1994), in forecasting the demand and supply of timber in Nigeria up to the year 2010, used international consumption functions due to the scarcity or variability of consumption and production data in Nigeria. The data came from 37 countries, most richer than Nigeria and were used to estimate the following consumption functions:

$$\ln(C_i) = a + b \ln(Y_i) + U_i \qquad (3.12)$$

where:

the subscript i, refers to a particular country and year, and C_i and Y_i are consumption and income *per capita*, respectively. The logarithmic transformation was used to reduce the differences in the variances of U_i, at low and high levels of consumption. Therefore, the parameter b, is the elasticity of consumption with respect to income *per capita*. Using equation (3.12) for forecasting assumes that cross-sectional differences between countries reveals how consumption adjusts to longterm changes to income and population. Once the elasticity b, is known, the expected *per capita* consumption after n years is:

$$C_n = C_0 (1 + b(A_y / y))^n \qquad (3.13)$$

where:

C_0 = the initial consumption and

A_y / y = is the rate of growth of income *per capita*

The data was pooled from countries with a population of at least 10 million people in 1985 and a *per capita* income of US$ 500. Production, import and export statistics were taken from FAO (1986).

They found that elasticities of consumption with respect to income varied from -0.01 (not significantly different from zero) for other industrial roundwood and 1.79 (±0.26) for particleboard. Consumption rose with income for all products but firewood, for which consumption decreased (elasticity of -0.62 ±0.20) and other industrial roundwood for which consumption was independent of income. The goodness of fit statistic clearly showed that other variables influence consumption. In order to address the uncertainties in forecasting population income *per capita*, high and low projections based on standard errors of 0.5 for population, and that of the elasticities for each of the forest products was done. Based on the assumed changes of income and population, fuelwood requirements were expected to increase from 100 million m^3 in 1990 to 111 million m^3 in 2010 while requirements for poles, pilings and posts would increase linearly between 1990 and 2010.

For the timber forecast, current and potential timber production on a sustained yield basis, were predicted. Then the investment in timber was considered under the present management system. The analysis was done by state and the data were then aggregated to obtain national forecasts. The authors cited the following sources of error:

(a) Poor knowledge of current consumption;

(b) Inaccuracies of the elasticities used;

(c) Uncertainties regarding future population and income and

(d) The forecast of requirements by state were more uncertain due to the inaccuracy of data on current population, income and consumption by state.

The type of forecasting method influences the result of the forecast. Louis Heyl and Associates (1982) found slight differences in the average forecast growth for paper and board consumption in South Africa from three different methods as indicated in Table 3.1.

Method	Average forecast growth (% *per annum*)
End-use market analysis	4.6
Per capita consumption	5.1
Historic trend analysis	4.8

Table 3.1: Variation of forecasts with forecasting methods (Source: Louis Heyl and Associates, 1982)

They, however, selected the near-average growth of 4.8% to be more realistic for the medium to long term on the basis of earlier forecasts.

Most of the previous research methods described used the linear regression method of least squares based on the general relationship:

$$Y = a + bX + a_1 b_1 X_1 \ldots a_n b_n X_n \qquad (3.14)$$

The "a" and "b" values are computed from a sample of observations according to the criteria of minimising the sum of the squared residuals. Marshall, Szikszai, Le May and Kozeth (1995), in testing the distributional assumptions of the least squares linear regression method emphasised that for the above equation to be reliable, the observations must be representative of the target population. All important variables must be included in the model and the assumptions of the least squares linear regression method must be met. Although the first two requiremants can be met by adequate sampling and proper modelling, the last requirement can be tricky. They stated that the impact of violating one or more assumptions is conditional and not easily obvious. The following assumptions must be met:

(a) Linearity (the model assumes that each observation of the dependent variable may be written as a linear function of the independent variable plus an error term);

(b) Assumptions about the independent variable (there should be no exact linear relationship among any of the independent variables);

(c) Assumptions about the errors (distributional assumptions) (the error terms in the regression model are assumed to be normally distributed, not correlated with one another and to have identical variances) and

(d) The implicit assumption is that all observations are equally reliable and should play an equal role in determining the least squares results.

While assumptions (a), (b) and (d) can be observed from the data or tested, the distributional assumptions can be sources of error which are often neglected, despite the availability of test procedures for its detection.

According to Marshall *et al* (1995), violating the normality assumptions will not be too detrimental as long as the sample size is not small. However, the least square estimates of the coefficients can be influenced by extreme deviations occuring with low probablity. If the regression errors have unequal variances, (heteroskedastic) "a" and "b", remain unbiased and consistent but they will not be efficient. The estimated variances of the coefficients are biased so that significant tests and confidence intervals are invalid. The direction of the bias depends on the correlation between the residual variance and independent variables. If the variance is positive, the variance of the regression coefficients will be underestimated. If the errors are autocorrelated, (i.e. not independent of one another) as with most time series data, the regression coefficients again remain unbiased and consistent but inefficient. Normal probablity plots of the residuals may be used to check for violation of the normality assumption.

3.2.3 Effects of demand shifters on forecasts

The forecasts of the demand for all commodities are often affected by demand shifters to varying degrees. Forecasts of forest products in particular, according to Ewing and

Chalk (1988), Kwak (1994), and Arnold (1993), could be affected by changes in:

(a) Technology in the wood using industry;

(b) Culture, tastes and traditions;

(c) Demographic factors;

(d) Price of wood and that of competitive or complimentary materials

(e) Economic growth of countries;

(f) Worker's disposable incomes;

(g) Demand for secondary or derived products;

(h) Price of forest products and

(i) Rural-urban migration.

Ewing and Chalk (1988), cite stable population growth and changes in building technology as possible reasons for the stagnation in the demand for sawnwood in the developed world (refer to Paragraph 3.1.3).

In South Africa, Louis Heyl and Associates (1982), relate changes in economic growth, urbanization and the proposed expansion of three large pulp mills as factors likely to affect the future demand for roundwood. They predicted a 5% to 6% annual growth in roundwood demand to the year 2000 assuming an average annual economic growth rate of 6% to 7% for the South African economy.

Despite the desired attributes of strength, natural durability, stability and decorative appearance, plastics have affected the use of sawnwood in window frames. In boat building, both sawnwood and plywood have been replaced extensively by fibreglass. In Korea, a recent renewal of interest in the production of timber-frame housing is expected to increase the market size for board industries. This will create additional uses for walling, panelling, sub-flooring, sheathing and other processed products (Kwak, 1994).

Siddayao (1986) cited the effects of demand shifters for commodities in general (refer to Paragraph 3.2.2).

Arnold (1993) stated that wood products are used in applications and markets where their use appears to have been approaching maturity. This seems to be the case in the housing industry in most of Europe, North America and Japan. Improvements in the durability, quality and efficiency of wood products tend to extend their useful life and therefore slow replacement rates. He also cited the efficiency in the wood using industry resulting in decreased demand for wood.

Lyke and Brooks (1995) cited the following factors as demand shifters:

(a) Population, economic growth and urbanization (*per capita* consumption of goods and services increase with urbanization);

(b) Technological changes that involve the saving of wood (these are mostly the use of laminated timber and recycling of paper);

(c) Substitute products could decrease the demand for wood (plywood substitutes sawnwood while reconstituted panels substitute plywood. Aluminium in doors and windows, steel in construction, plastic in packaging and petroleum-based synthetic fibres all substitute wood in a variety of applications) and

(d) Standards, tastes and perceptions could affect the demand for specific wood products (environmental lobbying could sometimes weigh against tropical timber from poorly managed forests).

It is therefore imperative for planners to take cognisance of these demand shifters in forecasting the demand for forest products, their substitutes and complimentary products. This consideration could guard against under- or over-estimation of forecasts.

4. RESEARCH METHODOLOGY

4.1 Data types and sources

The following data mostly covering the period 1985 to 1995 were obtained from the sources indicated below:

(a) Employment profiles for daily-rated employees (Department of Labour, 1995);

(b) Behavior of key macro-economic variables (Bank of Sierra Leone, 1995);

(c) National population estimates and projections to the year 2010 (Central Statistics Office, 1995);

(d) Rainfall and dam level data for the Guma Dam and catchment (Guma Valley Water Company, 1994);

(e) Number of buildings registered annually by the Freetown City Council;

(f) Number of registered deaths per year (Central Statistics Office, 1995);

(g) The proposed housing project of the Department of Lands, Housing and the Environment for the period 1997 to 2007 (Department of Lands, Housing and the Environment, 1995);

(h) List of carpenters registered at the Freetown employment exchange between 1992 and 1995 (Department of Labour, 1995);

(I) Total number of houses by walling and roofing materials in 1985 (Central Statistics Office, 1985) and

(j) Total number of households in the Western Area in 1985 (Central Statistics Office, 1993).

4.1.1 Data on major timber products

A survey of all known entrepreneurs and organizations presently involved in the consumption and sale of sawnwood and construction poles, in the Western Area, was

carried out Secondary data sources indicated above, were also contacted in order to cross-check the survey findings prior to the enumeration exercise. Due to the prevailing security problems, information on the production of construction poles was only sought from the merchants, while the two operating sawmills were contacted by mail for their production outputs.

Sawnwood production records by the defunct mills, namely Kenema Sawmills, Sierra Wood Industry and the operational Kasewe Sawmills were obtained from the literature. Sierra Leone Timber Company (SILETI) which closed in 1983 was excluded from this study as its operational period lies outside the survey period.

The Sierra Leone Match Industrial Company (SLMICO) was contacted directly to ascertain its intake of *Funtumia elastica* logs, as well as details on match production, changes in staff strength, constraints in match production and prospects for the future.

Data source (h) above, had to be abandoned due to the difficulties in locating addresses most of whom had moved Instead, a ground survey of existing carpentry workshops was conducted Ten 100ha to 150ha plots located systematically over Freetown were laid on a map and carpentry sheds in those areas identified by asking the residents of areas visited The located groups then identified the others on the same or neighbouring streets. The total number of carpenters was then estimated on the basis of this sample estimate on a proportional areal allocation assuming a fairly random distribution in the entire city

Information from (e) above was used to estimate the total number of poles and sawnwood used in the construction of the registered buildings. According to Tengbeh (1995), and a few private architects interviewed, 20% of the building construction business is controlled by construction companies while the "jobbing" contractors and do-it-yourself efforts account for 80% of the buildings. Twenty percent of the buildings erected annually are exempted from valuation and are therefore not included in the list obtained from the council. These are mainly: places of worship, educational institutions, meeting places, burial grounds and crematoria, government offices and those exempted by the resolution of council subject to presidential approval. For this reason, the consumption figure for poles and sawnwood obtained from the construction companies (ie 20% of the registered buildings per year) was added back to the quantities obtained from quantity calculations on the basis of the number of houses registered per year.

The buildings erected by the "jobbing" contractors (about 80% of the total) had to be estimated because, unlike the companies which keep records, this category had scanty or no reliable records. The quantity estimates were based on the standard three-bedroom, low-cost housing estimates. This could slightly underestimate the quantities for the pre-1990 buildings but may be about right for the current building styles with relatively low demand on materials due to the need to cut costs. The quantities of materials used for walls and roofs of buildings were estimated on the basis of the 1985 survey (refer to Tables 4.1 and 4.2).

Data on external trade in forest products was obtained from the Central Statistics Office (CSO) which had developed a database on same, using entries from the Customs and Excise Department, which is yet to computerise its records.

4.1.2 Data on minor timber products

Using information referred to in Paragraph 4.1(a-i) and also from mini-surveys, the following estimations were possible:

(a) Pole utilization in refugee or displaced camp construction

The number of dwellings, latrines and kitchens in both refugee and displaced camps were enumerated and the quantities of poles used in their construction, on a per unit basis, obtained from the contractors. The total quantity of poles involved was then computed according to the quantity estimates per structure. The Grafton, Clay Factory, and Ross Road displaced camps and the Waterloo Refugee camp were the only camps located in the Western Area at the time of the field survey. The total quantity of poles was 15,500, 16,000 and 52,570 in 1992, 1993 and 1995 respectively. There was no camp construction in 1994.

(b) Poles in market stalls

Nine out of about 40 markets in the Western Area were sampled to ascertain the following:

(i) The number of market stalls per market;

(ii) Average pole consumption per stall;

Area	Type of walling material						
	All structures	Cement	Asbestos	Zink	Plank	Mud	Others
Freetown	26,998	16,995	176	7,259	1,995	556	17
East I	2,680	1,673	17	716	197	55	2
East II	3,250	2,069	21	856	241	67	4
East III	6,537	4,115	43	1,759	483	134	3
Central I	2,270	1,424	15	613	168	49	1
Central II	1,392	880	9	374	102	26	0
West I	2,979	1,813	18	779	307	60	2
West II	4,104	2,583	28	1,103	303	84	3
West III	3,798	2,438	25	1,059	1,059	81	2
% of total	100	62.9	0.7	26.9	7.4	2.1	0.1
Rural Districts	8,720	2,691	35	19	484	5,478	15
Koya	1,814	476	10	4	107	1,214	3
Mountain	678	209	7	3	38	419	2
Waterloo	3,756	1,157	15	8	209	2,363	4
York	2,472	849	3	4	130	1,480	6
% of total	100	30.9	0.4	0.2	5.6	62.8	0.2

Note: 21% and 28.7% sampling intensities were used for Freetown and the Rural Districts respectively.

Table 4.1: Estimated dwelling structures by walling material for Freetown and the Rural Districts (Source: Central Statistics Office, 1985).

Area	Type of roofing material					
	All structures	Concrete or tile	Asbestos	Zink	Thatch	Others
Freetown	26,998	2,315	348	24,108	72	155
East I	2,660	232	33	2,372	6	17
East II	3,258	287	41	2,886	9	35
East III	6,537	571	84	5,845	16	21
Central I	2,270	194	29	2,032	7	8
Central II	1,392	122	23	1,240	4	3
West I	2,979	252	35	2,668	8	16
West II	4,104	348	55	3,657	13	31
West III	3,798	309	48	3,408	9	24
% of total	100	8.6	1.3	89.3	0.3	0.6
Rural Districts	8,720	102	43	7,870	644	61
Koya	1,814	18	12	1,631	139	14
Mountain	678	8	9	612	46	3
Waterloo	37,556	32	17	3,396	284	27
York	2,472	442	5	2,231	175	17
% of total	100	1.2	0.5	90.3	7.4	0.7

Note: 21.5% and 28.7% sampling intensities were used for Freetown and the Rural Districts respectively.

Table 4.2: Estimated dwelling structures by roofing material for Freetown and the Rural Districts (Source: Central Statistics Office, 1985).

(iii) Average duration of stalls (to ascertain their replacement rates) and.

iv) The dominant tree species used in stall construction.

Table 4.3 indicates the markets surveyed in the Western Area.

(c) Quantity of poles in the structures of buildings, latrines and kitchens

Based on the Central Statistics Office (1985) estimate of 85% and 72% of the dwellings in Freetown using outdoor kitchens and latrines respectively, the quantity of poles used in their construction per year, was calculated on the basis of the number of buildings registered per year (refer to Table 4.4). A standard material requirement for 35 poles per room of an average mud-and-wattle house, according to the average for west Africa (FAO, 1990) was used in the computation.

(d) Poles used in burials and vigils

The average number of poles used in Muslim burials was estimated at 6, based on information obtained from grave diggers with the assumption that 50% of the registered deaths per year were Muslim deaths. Muslims generally use poles while Christians use caskets, to protect the bodies from the soil, in burials. The study also estimated about 18 poles per vigil for shed construction for 50% of all burial ceremonies. This estimate was based on actual counts of the quantities of poles per shed in 40 cases . Total annual pole consumption for this data source was then computed (refer to Table 4.5).

(e) Quantity of poles used as pestles

A mini-survey aimed at determining ownership of mortars and pestles per household was conducted covering 10 households each in 8 wards of Freetown. The average demand for pestles was projected on the basis of future population and household projections. The 1985 estimate of 9.2 and 6.7 persons per household for Freetown and the rural Western Area respectively was used (refer to Table 4.6). The per household pestle requirement, for the rural Western Area, was based on 3.66 obtained for the Gola Forest area by Davies and Richards (1991). However, the average of 3.0 obtained from the mini-survey was used for Freetown (refer to Table 4.7). Using a replacement rate of 5 years, being an average computed from the mini-survey, the population figures and pestle requirements for 1980 formed the basis for replacements starting from 1985 (refer to Table 4.8).

Market	No. of stalls using poles	Mean no. of poles per stall	Total no. of poles used
Bombay Street	160	18	2,880
Guard Street	196	20	3,920
Dan Street	430	21	9,030
Congo Town	208	26	5,408
Victoria Park	630	31	19,530
Wellington	269	16	4,304
Calaba Town	231	24	5,544
Govt. Wharf	311	27	8,397
King Jimmy	129	18	2,322

Mean no. of poles per market = 6815

Therefore, 40 markets used 272,600 poles within the last five years i.e. 54520 poles per year.

Table 4.3 Pole consumption by selected markets.

Analysis of pole needs	Number of new structures and pole consumption per year										
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
No. of new buildings:											
Rural Area	200	234	242	248	255	262	269	176	184	192	299
Freetown	619	613	563	624	468	482	475	602	621	678	720
Total no. of buildings	819	847	805	872	723	744	744	678	905	970	1019
No. of poles in buildings	50,905	55,292	54,162	57,617	52,482	54672	54,755	60,842	62,669	65,611	68,225
No. of buildings using latrines	580.7	609.8	579.6	627.8	520.6	535.7	535.7	632.2	651.6	698.4	733.2
No. of buildings using kitchens	682.8	720.0	684.3	741.2	614.5	612.4	632.4	746.3	769.2	824.5	868.2
No. of poles used in kitchens and latrines:											
Latrines (24 poles each)	14,152.8	14,635.2	13,910.4	15,067.2	12,494.4	12,856.8	12,856.8	15,172.8	15,638.4	16,761.6	17,596.8
Kitchens (36 poles each)	24,033.6	25,920.0	24,634.8	26,683.2	22,122.0	22,708.4	22,708.4	26,866.8	27,691.2	29,682.0	31,183.2
Total no. of poles used	39,086.4	40,555.2	38,545.2	41,750.4	34,616.4	35,623.2	35,623.2	42,039.6	43,329.6	46,443.6	48,780.0
Plus 10% for repairs	3,808.3	4,055.5	3,854.5	4,175.0	3,461.6	3,562.3	3,562.3	4,203.9	4,332.9	4,644.4	4,878.0
Total for kitchens and latrines	42,905.0	44,611.0	42,400.0	45,925.0	38,078.0	39,186.0	39,186.0	46,244.0	47,663.0	51,088.0	53,658.0

Table 4.4. *Pole consumption in the construction of buildings, kitchens and latrines.*

Types of deaths	Pole consumption according to number of deaths per year (units)										
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Total no. of deaths	6,248	6,609	6,530	6,127	5,497	5,548	6,151	6,800	6,420	6,242	6,424
Number of Muslims	3,124	3,304	3,265	3,063	2,748	2,774	3,075	3,400	3,210	3,121	3,212
Number of Christians	3,124	3,305	3,265	3,063	2,749	2,774	3,076	3,400	3,210	3,121	3,212
Pole consumption in:											
Funerals (18 poles each for 50% of all burials)	56,232	59,481	58,770	55,143	49,473	49,932	55,359	61,200	57,780	56,178	57,816
Muslim burials (6 poles each)	18,744	19,824	19,590	18,378	16,488	16,464	18,450	20,400	19,260	18,726	19,272
Total pole consumption (units)	74,976	79,305	78,360	73,521	65,961	66,576	73,809	81,600	77,040	74,904	74,088

Table 4.5: ***Western Area: Annual pole consumption in funeral ceremonies.***

1985 Census		
Area	Population	Households
Freetown	469,776	70,373
East I	43,480	6,961
East II	57,060	8,524
East III	108,392	17,105
Central I	34,679	5,940
Central II	19,226	3,641
West I	62,555	7,534
West II	93,175	11,522
West III	51,169	9,146
Average no. of persons per household	6.7	
Rural Western Area	84,467	9,170
Koya	12,133	1,700
Mountain	3,070	636
Waterloo	48,328	3,515
York	20,936	3,319
Average no. of persons per household	9.2	

Table 4.6: Total population and households in the Western Area in 1985 (Source: Central Statistics Office, 1995).

Ward	Mean no. of pestles	Mean age of pestles	Mean no. of mortars	Total no. of mortars
East I	3.21	3.97	2.2	15,314
East II	3.44	4.45	2.1	17,048
East III	2.91	5.16	1.9	32,500
Central I	3.25	4.74	1.6	9,504
Central II	2.82	4.86	1.5	5,462
West I	3.02	4.89	1.9	6,918
West II	2.72	4.71	1.8	20,740
West III	2.61	4.72	1.4	12,804

Total number of mortars = 120,290

Mean number of pestles = 2.99

Mean age of pestles = 4.69 years

Total volume of wood used in mortar production = 83,121m ^ 3

Table 4.7: *Mean pestle and mortar ownership per household and age in Freetown.*

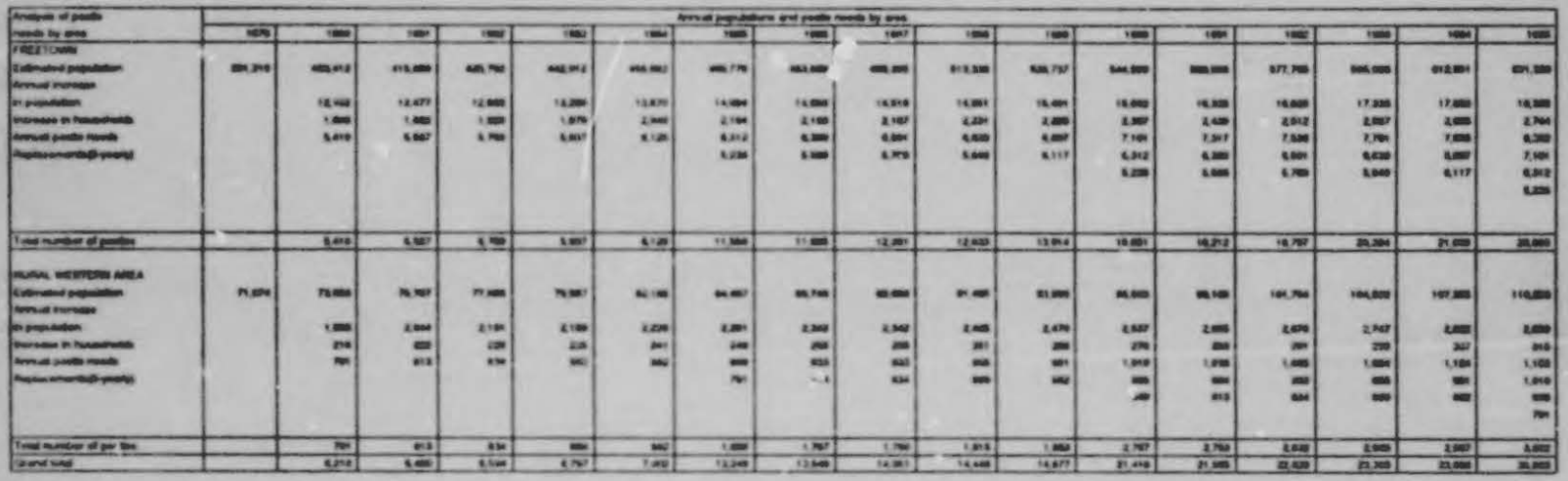

Table 4.8: *Estimated household pestle requirements for the Western Area between 1980 and 1995.*

4.2 Data collection procedure

After a test-run, the final version of the questionnaires were distributed to the following categories of data sources:

(a) Sawnwood merchants;

(b) Construction pole merchants;

(c) Construction companies;

(d) Carpentry companies and relevant government departments or institutions;

(e) Carpentry workshops;

(f) Operational sawmills and

(g) Some registered architects and building designers.

4.2.1 Structure of the questionnaires

The complete set of questionnaires were classified into production, consumption, sales and external trade categories with the following areas of investigation:

(a) Production of sawnwood by sawmills:

(i) Variations in staff and labour strengths (also for (b));

(ii) Date of establishment of the enterprise (also for (b) and (c));

(iii) Types, quantities and capacities of machinery;

(iv) Quantity and type of tools and vehicles;

(v) Average log recovery rate over the years;

(vi) Quantity of product sold in the Western Area and

(vii) Constraints in production.

(b) Consumption of sawnwood by carpentry companies and workshops

(i) Quantity of forest products consumed per year;

(ii) Proportion of whitewood to redwood used in industry;

(iii) Major suppliers of sawnwood or poles;

(iv) Constraints in the use of forest products and

(v) Address of the next carpentry shop

In Sierra Leone, sawnwood is broadly graded into redwood (grade A) which is high value furniture timber and whitewood (grade B) for construction and rough work.

(c) Product sales by pole and sawnwood merchants:

(i) Quantity by dimension of current stock (during visit);

(ii) Proportion of dominant tree species in current and previous stocks;

(iii) Source (Chiefdom and District) of past and current stocks;

(iv) Quantity by dimension sold or delivered to store annually and

(v) Address of next sawnwood or pole merchant

(d) External trade in forest products and substitutes:

(I) Quantity of wood products (all categories) imported annually;

(ii) Quantity of wood and wood products (all categories) exported annually and

(iii) Quantity of wood substitute products imported annually.

4.2.2 The significance of the questions

In categories (a) to (c), the dates of establishment indicated the experience of the entrepreneur and therefore the quality and quantity of data expected of him or her

For the production and consumption enterprises, the general economic performance and any variations in production was partly reflected in variations in staff and labour strength. The quantity of products sold or consumed annually, gave some indication of the economic performance of the enterprise. The yield of the sawmills was a useful guide in the conversion of the total sawnwood volume to roundwood volume, as a timber supply assessment strategy

The indication of major suppliers of products identified additional merchants who were not located during the survey. Some sales data was even obtained from some of these customers who were willing to reveal more details (refer to Tables 4.9 and 4.10)

For the furniture companies and carpenters who were equally engaged in both furniture manufacture and building construction, it was necessary to indicate the proportion of sawnwood by colour used for the two main categories of consumption. The constraints involved in the use of both products was relevant in planning the co-ordination of their sales in the future

The frequency of stock delivery was intended to give an idea of the business turnover which was consistently withheld for reasons indicated in Paragraph 1.3(b). This also reflected the effect of the rebel ambushes along the highways on the free flow of goods

It was necessary to determine both the dominant and substitute pole species because the high frequency of rebel ambushes created the need to search for alternative species. In an effort to ascertain the sustainability of sawnwood and pole production from communal lands, the sources of the products were investigated. At the end of the enumeration exercise, the Forestry Division records were checked against the popular pole and timber producing areas

The indication of the next shop or store was included amongst the questions to locate shops and stores which were not identified initially

Constraints in the delivery of all products influence their landed price in Freetown. Hence the value of the question.

Name of merchant	Volume of sawnwood sold per year (m^3)								
	1986	1987	1988	1989	1990	1991	1992	1993	1994
J.S.Kargbo								120	
Nomo sawmill		150					100	48	
Jusu Rahall								95	
Panguma Trade Co.		80						591	
Paul Kamara							24		
Gen. Marketing								1,808	2,855
A. M.Carpenter	572	120	70		150			375	
B&H Trading Co			40	240				177	
Coastal Trading Co.				922					
George Anthony			150	248		170			
Kenema Sawmill				640	50				
Alie Mugnie				2,182					
Stallion store			200		50	3,641	3,095	2,250	
EE Stallion					266				
Maleme sawmill			500		710	2,800	1,440	2,050	
Panguma sawmill							250	114	120
Alhaji Samba						80	149	20	100
Ibrahim Badeway				162	1,046	430			55
Samuel Samura					174				
JAS Khoury					565				
Abess Kamara						153			
Adama Turay							242		
Bassam Jaward							76		
Gold Lion Ent.							29		
M.S.Conteh							114		
Ahmed El-Ali								254	
Osman Dumbuya								123	
Jonathan Fomba								62	
Our Prince Store								283	
Jungle Man								81	
Quimette W-Taylor								30	
Abdul Sankoh									312
Mohamed Kallon									499
Dill Sawn Timber									178
Braima P.K.Conteh									168
Ansu Kargbo									114
Sampsey Carpentry									
Sullay Barkarr									
Abdul R. Bangura									
Alie Fahour									
Ibrahim Turay									
Total volume sold (m^3)	572	350	960	4,394	3,011	7,274	5,519	8,481	4,401

Table 4.9: Volume of sawnwood sold to Sierra Construction Systems and Decor-Furniture (1986 to 1994).

Name of merchant	Quantity of poles sold per year (units)									
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Sam Babari	936	84	144	96						
Abu Sesay								156	168	180
Lamin Turay	120	108	96	156	120					
Amadu Kamara	252	156	228	108	180	84		120		240
Mohamed Turay	96	132	84		72	240	96	192	240	108
Phelix Onyen	108	60			96		72			
Fayala Barri									240	
Amadu Sesay									222	
Alie Sesay									816	
Mohamed Mansaray									150	
Monamed Bangura									192	
Total quantity sold	1,512	540	552	360	468	324	168	468	2,028	528

Table 4.10: Quantity of poles sold to Sierra Construction Systems by other merchants (1985 to 1994).

External trade in forest products was included because of its influence on the amount of foreign currency at the country s disposal It also effects the quantities of the commodity that should be supplied for local consumption after accounting for exports and imports

4 2 3 The determinant factors in sampling the data sources

Most of the construction and carpentry companies were listed in the Sierra Leone Gazette and in the "Petal Pages" In addition, displayed signboards, signplates, and showrooms were helpful in the identification of these companies, carpentry workshops and sawnwood merchants The survey team specifically collected information on the date of establishment of these enterprises for planning the sampling exercise Once the data source had been listed by the team, the following determinant factors influenced the sampling procedure for the respective data sources

(a) Construction companies

The classification by Sierra Leone Government (1992) into three financial classes, on basis of each company's declared assets and capability, were instrumental in the choice of samples In addition, the duration of the company's unbroken operation was used to measure its experience in the building industry Samples were distributed to cover all the years covered by the survey Since only a few companies were in operation between 1985 and 1987, a 96% sampling intensity was used for those years while 85% sampling intensity was used for the period 1988 to 1995 (refer to Tables 4 11 and 4 12) As 20% of them were established in 1995, there was no need to sample more of them since most were not fully operational then

(b) Carpentry companies

All 20 carpentry companies operating in 1995 were sampled However, data was not available for all the years before 1995 because the companies were established at different times over the survey period (refer to Table 4 13) This situation is common to most other data sources

Analysis of sampling	Sawnwood consumption per year (m^3)										
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Number of companies operating in year	20	22	25	25	29	34	36	40	44	46	46
Number of companies sampled	19	21	24	21	25	29	31	36	38	40	40
Number of responses	11	11	15	14	15	20	20	23	26	26	27
Number of no responses	8	10	8	7	10	9	11	13	12	14	13
% response	57.9	52.3	62.5	66.6	60	68.9	64.5	63.8	68.4	65	67.5
Sampling intensity (%)	95	95.4	96	84	86.2	85.3	86.1	90	86.3	86.9	86.9
Number of companies not found	1	1	1	4	4	5	5	6	6	6	6
Number of companies excluded from sample	8	10	8	7	10	9	11	13	12	14	13
Response total (m^3)	676.9	503.0	548.9	621.7	839.4	1,209.0	1,330.6	1,445.8	1,391.5	1,383.7	1,708.9
Total consumption (m^3)	1,231	1,006	915	1,110	1,623	2,055	2,395	2,514	2,355	2,448	2,911

Table 4.11: Analysis of sawnwood consumption by construction companies.

Analysis of sampling	Pole consumption per year (units)										
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Number of companies operating in year	20	22	25	25	29	34	36	40	44	46	46
Number of companies sampled	19	21	24	21	25	29	31	36	38	40	40
Number of responses	11	11	15	14	15	20	20	23	26	26	27
Number of no responses	8	10	8	7	10	9	11	13	12	14	13
Number of companies using metal scaffolds	0	0	1	1	1	1	1	2	2	2	2
% response	57.9	52.3	62.5	58.6	60	68.9	64.5	63.8	68.4	654	67.5
Sampling intensity (%)	95	95.4	96	84	86	85	86.1	90	86.3	87	87
Number of companies not found	1	1	1	4	4	5	5	6	6	6	6
Number of companies excluded from sample	8	10	8	7	10	9	11	13	12	14	13
Response total (units)	8,374	7,963	9,982	9,782	10,529	16,270	18,440	19,010	19,179	19,274	21,866
Total consumption (units)	15,225	15,926	16,637	17,468	20,356	27,659	33,192	33,061	32,457	34,100	37,253

Table 4.12: Analysis of pole consumption by construction companies.

Analysis of sampling	Sawnwood consumption per year (m^3)										
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
No. of companies operating	12	14	14	14	15	18	18	19	19	20	20
No. of companies enumerated	12	14	14	14	15	18	18	19	19	20	20
Sampling intensity (%)	100	100	100	100	100	100	100	100	100	100	100
Total consumption (m^3)	1,872	2,525	2,610	2,713	2,862	3,001	3,006	3,028	3,185	3,821	3,853

Table 4.13: Analysis of sawnwood consumption by carpentry companies.

(c) Carpentry workshops

Carpentry workshops unlike the carpentry companies, are not compelled by law to register with the appropriate authorities The workshops normally consist of a few professionals and apprentices operating under sheds with basic manual tools These often operate on a small scale due to funding, space and manpower limitations. Unlike the carpentry companies, their clients are mostly individuals.

For this category, the experience of the team and the age of the workshop influenced sampling as all the years covered by the survey had to be equally represented In the end, more carpentry groups were interviewed from 1990 to 1995 because there were fewer workshops or groups established before or around 1985 (refer to Table 4.14). The other determinant factor was the manpower level at the workshop as it influenced output and also the availability of respondents in the absence of the group leader A few sheds which were persistently found empty were not enumerated, especially in cases where the owner operated only on a part-time basis Out of a sample size of 52, between 50% and 90% were operating from 1985 to 1992 and 94% to 100% were operating between 1993 and 1994

(d) Technical institutions

All technical institutions currently offering joinery or wood work practicals were sampled (refer to Table 4 15)

(e) Sawnwood merchants

For the sawnwood merchants, the age of the business, size and location of store influenced sampling in that descending order of importance It was necessary to acquire at least five data entries for each of the 11 years covered by the survey Again, more entries were recorded for the last five years as fewer stores were established before 1990 In fact over 60% of the stores were established from 1993 onwards Preliminary discussions with merchants revealed that the location of the business and size of store were major determinant factors in its expansion A 100% sampling was done for stores operating from 1985 to 1988, 93% for stores operating in 1989, 85% for 1990, 86% for 1991; 80% for 1992, 74% for 1993, 75% for 1994 and 67% for 1995 (refer to Table 4 16)

(f) Casket production

All the funeral homes and government departments producing caskets were surveyed as analysed in Table 4 17

Analysis of sampling	Sawnwood consumption per year (m^3)										
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
No. of workshops sampled	26	31	37	42	44	46	46	48	49	52	52
No. of workshops operating as % of the 1995 total	50.0	60.0	71.2	80.8	84.6	88.5	88.5	92.0	94.2	100.0	100.0
Sample total (m^3)	350.1	444.4	504.7	556.9	586.6	644.2	665.6	667.1	745.0	781.9	788.3
No. of all workshops operating in year	130	155	185	210	220	230	230	239	245	260	260
Mean consumption per workshop (m^3)	13.0	14.3	13.6	13.3	13.3	14.0	14.5	13.9	15.2	15.0	15.2
Consumption by all workshops for year (m^3)	1,690	2,217	2,516	2,793	2,926	3,220	3,335	3,222	3,724	3,900	3,952

Table 4.14: Analysis of sawnwood consumption by carpentry workshops

Analysis of sampling	Sawnwood consumption per year (m ^ 3)										
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Number of institutions running in year	7	8	8	8	9	9	9	10	10	11	11
Total volume of sawn-wood consumed (m ^ 3)	17	20	19	22	51	41	52	50	67	57	127

Table 4.15: Analysis of sawnwood consumption by technical institutions

Analysis of sampling	Sawnwood sales per year (m^3)										
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Number of merchants operating in year	9	11	12	13	16	20	23	26	31	41	52
Number of merchants sampled	9	11	12	13	15	17	20	21	23	31	35
Number of responses	7	8	8	9	12	13	15	16	19	27	30
% response	77	72	66	69	80	76	75	76	82	87	85
Number of no responses	2	3	4	4	3	4	5	5	4	4	5
Number of merchants not sampled	0	0	0	0	1	3	3	5	8	10	17
Number of merchants excluded from sample	2	3	4	4	3	7	8	10	12	14	22
Response total (m^3)	3,060.5	3,223.6	3,292.9	3,065.9	3,471.8	3,438.1	3,981.4	4,290.5	4,120.5	5,716.6	6,739.2
Response mean (m^3)	437.2	402.9	411.6	343.9	289.6	264.5	265.4	268.1	216.8	211.7	224.6
Sampling intensity (%)	100	100	100	100	93	85	86	80	74	75	67
Total sawnwood sales (m^3)	3,935	4,432	4,939	4,472	4,633	5,291	6,105	6,972	6,723	8,681	11,681

Table 4.16: Analysis of sawnwood sales by merchants.

Analysis of sampling	Sawnwood consumption per year (m^3)									
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Sampling intensity (%)	100	100	100	100	100	100	100	100	100	100	100
Total consumption (m^3)	118	151	134	131	130	129	150	153	158	180	226

Table 4.17: Analysis of sawnwood consumption in casket production

(g) Pole merchants

In this case, the seller's experience and permanence at a particular location were crucial in determining the choice of sample With a substantial number of *ad hoc* pole merchants in the business, the length of stay at a particular sales depot was important as the builders who normally buy in large quantities would have known the location over the years. Only few of the newly established depots, especially those starting in 1995, were sampled as most were not fully operational All stores operating in 1985 to 1989 and in 1991 were enumerated, while 87% of those in operation in 1990 were surveyed In addition, 82% of those operating in 1992 and 85% of those operating in 1993 were enumerated. Fifty-six percent of stores operating in 1994 and 63% of those operating in 1995 were enumerated (refer to Table 4.18)

4 2 4 Survey procedure and behavior of respondents

For all the building companies, sawmills and most of the registered carpentry companies, the questionnaires were completed by top management but often after repeated visits and calls Data on sawnwood and pole sales were mostly entered by the author with the assistance of the proprietor(ess) and his (her) assistants In the case of interviews, precautions recommended by Foddy (1993) and Nathan (1986) were observed

Out of the 35 respondents to the sawnwood sales questionnaires, six provided estimates based on their memory, six actually provided sales figures for the various dimensions; 20 provided delivery figures while three completed the forms themselves

Delivery records for the last 5 to 7 years were generally well kept but not so well kept before About 60% of the delivery records were relatively easily comprehensible Entries were accepted in the standard (imperial) sawnwood dimensions and converted to metric units later

Time constraints, illiteracy and general apprehension were mainly responsible for the respondents reluctance to complete the forms themselves

Since tax is normally assessed on turnover, there was a general unwillingness to release sales figures as opposed to price quotations which were very willingly provided Respondents who relied on memory were allowed sufficient time to consult sales assistants, business partners and even members of the family when present. Such respondents generally remembered "good" and "bad" years as yardstick of measurement of sales Where available,

Analysis of sampling	Pole sales per year (units)										
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
No. of merchants operating in year	3	3	4	4	4	8	9	14	17	24	36
Number of merchants sampled	3	3	4	4	4	7	9	12	14	15	20
Number of responses	3	3	4	4	4	7	8	11	12	15	19
Number of no responses	0	0	0	0	0	0	1	1	2	0	1
% response	100	100	100	100	100	100	88	91	86	100	95
Number of merchants not sampled	0	0	0	0	0	1	0	2	3	9	16
Number of merchants excluded from sample	0	0	0	0	0	0	1	3	5	9	17
Sampling intensity (%)	100	100	100	100	100	87	100	85	82	63	56
Response total (units)	15,262	14,920	16,622	15,800	16,468	47,914	49,038	73,618	73,610	92,430	111,748
Response mean (units)	5,087.3	4,973.3	16,622.0	3,950.0	4,117.0	6,844.8	6,129.8	6,692.5	6,134.1	6,162.0	5,881.4
Total pole sales (units)	15,262.0	14,920.0	16,622.0	15,800.0	16,468.0	54,758.0	55,168.0	93,696.7	104,280.0	147,888.0	211,730.0

Table 4.18: Analysis of pole sales by merchants

the product delivery records were carefully and painfully checked sometimes in the absence of the recorder. In the absence of delivery records, reference to good and bad years was the only means of achieving a reasonable estimate

There was a general tendency to underestimate sales records probably out of fear of taxation Whenever varying estimates were given in reference to the same venture, an average figure was accepted. Shop assistants generally tended to estimate slightly higher figures than the actual owners of the ventures

The survey of professional architects was later abandoned for fear of double counting - they often design for individuals and construction companies at once. They claim to supervise "jobbing" contractors whose contribution was calculated in terms of poles and sawnwood in registered buildings However, information on the distribution of building contracts between the companies and the "jobbing" contractors was collected from 10% of the 80 registered members contacted

The Department of Customs and Excise sometimes failed to indicate the quantity of imports but provided value in "Leones" In these cases, the quantity was estimated based on the quantity per value figures indicated for the same trade zone and commodity, in similar records

4.3 Data treatment and analysis

The choice of forecasting method (described in Chapter 6) is trend projection. The forecasting methodology entailed the study of the secular trend in the production, sales and consumption of forest products over an 11-year period The analysis was done by applying the least squares technique of regression analysis

The following models were employed in regression analysis with Quattro-Pro version 3 0 and Statgraphics versions 3 0 and 6 0

Linear	$Y = a + bX$
Quadratic	$Y = a + bX^2$
Logarithmic	$\log Y = a + b \log X$
Exponential	$Y = \exp(a + bX)$
Reciprocal	$1/Y = a + bX$
Multiplicative	$Y = aX^b$
Compound growth	$Y = a(1 + b)^x$

where:

a and b = coefficients of the equation,
Y = dependent variable and
X = independent variable

It was found that the compound growth model gives a better fit than the others and it is the chosen model for all trend determination in Chapter 5. The forecast was limited to only ten years to ensure it's validity and accuracy.

5. RESEARCH RESULTS

5.1 Importance of forests and forest products

5.1.1 Use of products

Sawnwood which is crudely graded into "white" and "red" is used in both the construction and furniture industries with the latter using about 60% of red and 40% of white (refer to Paragraph 4.2.1(b) The former uses about 80% white for shuttering, props, platforms, formwork and about 20% for doors and internal decorations Due to the chronic lack of seasoning facilities, and the generally poor stacking within the stores, some of the sawnwood in the local market is of low quality The severity of degradation is higher in the rainy season than in the dry season Kamau (1988) estimates that up to 20% of the sawnwood could be damaged because of this non seasoning problem. A few sawnwood merchants actually transact business outdoor on an empty lot irrespective of season Some of these small-scale merchants can not easily afford proper storage facilities for their stock

It was found that *Anisophyllea laurina* poles are widely used both in households and in the construction industry in Sierra Leone Specifically, they are used as follows

(a) Scaffolds, structures, and props in building and shelter construction,

(b) Boundary demarcators and in the protection of property (mostly for crops, lots and building),

(c) To protect bodies from coming into direct contact with the soil in most Muslim burials,

(d) Pestles for pounding food items and traditional medicines in wooden mortars,

(e) Poles for the display of banners and posters and

(f) Crop supports.

Other less popular indigenous pole species presently used in the building industry include. *Pentadesma butyraceae*, *Phyllantus discoides*, *Harunguna madagascariensis* (mostly debarked and used as paulines and rafters in roofs of buildings), *Xylopia aethiopica* and *Diospyros heudelotii*. Of all the stores surveyed, 78.1% of the species were *A. laurina*;

13.8% P. *butyraceae*, 5.8% X. *aethiopica* and 2.3% D. *heudelotii* and P. *ascoides* combined. The low taper of A. *laurina*, termite resistance, resistance to splitting on nailing, and a relatively low density (Savill and Fox, 1967) makes it suitable for multiple use. Recent studies also indicate that it is still very widely distributed in the country (Lebbie, 1988 and Sannoh, 1993)

Telegraphic and transmission poles, both of which are currently imported into the country, are excluded from this study which concentrated on construction poles. The first two types of poles are of larger dimensions than the latter and need pre-treatment prior to use.

The current industrial use of *Funtumia africana* logs is in the production of match splints by the Sierra Leone Match Industrial Company (SLMICO) Traditionally, it is used in the carving of statues, native spoons, wooden trays, devil masks and as clothes paddles especially for the laundering of tough and heavy clothing *Funtumia africana* is widely distributed in the south, east and west of the country (Savill and Fox, 1967)

5 1 2 Sources and delivery of products

Forest products are transported to the Western Area from nearly all over the country For this reason, their delivery was seriously affected by the escalation of rebel ambushes along the highways during August to September 1995 This situation naturally put a lot of pressure on the nearby Portloko District for the supply of these products

Out of the 30 sawnwood merchants interviewed, for instance, 36% received sawnwood from Portloko District, 27% from Kenema District, 20% from Moyamba District, 12% from Bo District, 3% from Bombali District and 2% from Kambia District Of the 20 pole merchants interviewed, 47% received poles from Portloko District, 26% from Moyamba, 16% from the Western Area, and 11% from Bo District

Over 40,000 poles utilised in the construction of the Clay Factory, Grafton and the Ross Road displaced camps were supplied directly to these sites outside the normal marketing system Such direct deliveries of sawnwood and poles by large consumers with transport facilities, is fairly common and may have been responsible for an underestimation of the sales outputs for both products Prior to the escalation of rebel ambushes on the highways, forest products from the provinces were delivered into Freetown through the Mile 38 and

Rokel checkpoints. During the survey period however, the Peninsula road had been increasingly used to deliver mostly fuelwood, poles and lately even sawnwood. The Regent-Freetown route also experienced an increase in vehicular traffic for the delivery of products right into the centre of Freetown.

The savannah vegetation which is typical of the Portloko District can hardly continue the production of construction poles at the 1995 levels, on a sustained basis. Annual bush fires coupled with unfavourable edaphic and climatic factors will not favour vigorous growth of the species. Most of the poles from this source were of medium to small sizes. *Terminalia* and *Gmelina* timber from communal lands have been virtually exhausted. Plantations in forest estates are often affected by annual fires. The establishment of well managed plantations of these two species could ameliorate the situation.

At least 8 boat landings received poles, sawnwood and mostly firewood during the study period. There was no record of *Funtumia* delivery at any of the boat landings mainly due to the fact that the products were mostly collected from the Portloko District where the species does not thrive well. Savill and Fox (1967) also claim that *Funtumia* is not found in savannah regions. The match factory was therefore operating at low capacity until mid November 1995 when operations were suspended due to the lack of raw material.

5.1.3 Forests of the Western Area in environmental protection

The forests of the Western Area, despite their subjection to deforestation pressure (refer to Paragraph 2.5) have played a vital role in the protection of catchments and vulnerable hilltops typical of the region over the past decades (refer to Paragraph 2.4 and Table 5.1). Over the last decade in particular, there has been no drastic changes in both the Guma dam level and rainfall intensity and distribution around the catchment (refer to Tables 5.2 and 5.3). The annual drop in the level of the dam over the period, 1980/81 to 1992/94 ranged from 5.1% to 8.5% with a mean of 6.2% as indicated in Table 5.4.

Total annual rainfall over the period 1982/83 to 1993/94 ranged from 3,994.60mm in 1986/87 to 7,451.46mm in 1993/94.

Name of reserve	Area (ha)	Public notice number	Year of constitution
Western Area	14,090	1	1916
John Obey	207	211	1947
Kent Extension	644	52	1947
Leicester Peak	52	3	1922
Moku Hills	137	3	1937
Moku Hills Extension	10	48	1948
No. 2 River	699	150	1946
Freetown Waterworks	1,134	51	1955
Waterloo	85	95	1948
Fabaina	382	74	1973
Total area (ha)	17,440		

Table 5.1 *Forest reserves of the Western Area (Source: Forestry Division files, 1996)*

Year	Month ending reservoir levels (m)												
	November	December	January	February	March	April	May	June	July	August	September	October	Date spilled
1981	257.12	256.36	252.83	250.32	247.14	243.75	240.18	239.14	251.47	260.64	260.08	258.09	7[illegible] August
1982	256.81	256.03	252.93	250.89	243.39	245.66	242.90	242.98	251.48	260.75	260.44	260.28	28 August
1983	259.05	257.14	256.72	240.04	251.76	249.42	246.96	247.02	260.98	260.68	260.50	260.34	31 August
1984	260.39	257.37	256.46	253.74	250.41	247.82	245.18	243.79	254.71	254.71	257.46	256.75	-
1985	256.76	253.80	251.81	249.62	247.02	244.28	241.25	240.13	256.02	256.02	259.04	258.37	-
1986	257.32	255.46	253.27	250.86	248.73	246.04	243.72	241.81	4260.41	260.42	260.56	260.48	27 August
1987	259.14	257.01	254.93	252.83	260.64	247.89	245.08	243.38	252.82	252.82	258.14	258.11	-
1988	258.89	254.88	252.19	249.79	247.02	244.04	240.95	238.43	255.19	260.55	260.56	260.02	10 August
1989	259.89	258.91	254.88	252.93	250.82	248.18	245.59	243.47	248.85	260.65	260.53	260.23	29 August
1990	260.07	257.43	256.46	253.52	251.23	248.74	246.19	244.81	258.59	260.59	260.55	260.14	[illegible] August
1991	259.12	257.88	256.76	253.87	251.53	249.17	246.82	245.28	-	260.65	260.56	260.51	15 August
1992	260.46	257.87	256.92	253.89	251.46		247.07	249.22	260.72	260.77	260.54	260.05	28 August
1993	259.21	257.86	256.65	253.54	251.12	248.74	246.21	244.99	256.06	260.62	260.52	259.86	14 August
1994	258.83	257.18	256.23	253.53	250.82	248.19	245.66	245.53	250.83	250.83	250.61	250.56	25 July

Table 5.2 *Month ending reservoir levels (m above sea level) of Guma Dam (Source: Guma Valley Water Company, 1994)*

Year	Monthly rainfall figures (mm)												
	November	December	January	February	March	April	May	June	July	August	September	October	Total
1983	92.75	0	0	0	1.27	30.72	155.64	817.31	2315.06	1842.55	851.33	297.54	6391.17
1984	37.29	19.55	0	0	1.78	64.74	171.38	497.13	1263.66	744.68	616.72	171.38	3588.36
1985	203.62	10.91	0	0	1.02	6.01	59.16	627.64	1179.11	1278.89	817.32	201.85	4404.42
1986	120.61	4.06	0	0	2.54	22.65	260.52	306.84	1673.71	1540.15	1042.51	368.66	5432.44
1987	41.89	10.66	7.11	0	0.76	53.32	154.91	549.69	750.27	1287.78	810.72	325.49	3994.61
1988	80.23	22.61	0	1.27	0	41.89	8.25	370.95	2383.61	2425.52	1346.17	231.56	6985.04
1989	157.16	0	0	4.32	21.07	25.14	69.31	272.69	1128.83	2060.14	778.71	335.15	4852.53
1990	142.18	2.54	0	11.68	0	19.04	129.49	508.56	2111.43	1479.72	693.41	269.92	5367.95
1991	82.26	43.16	0	0	1.27	8.12	141.93	429.34	-	-	739.61	578.38	-
1992	51.29	12.19	0	0	0	42.15	422.99	1004.17	2123.87	2529.09	477.25	194.47	6862.51
1993	151.57	0	0	14.73	13.96	46.97	142.44	585.74	1849.09	1655.17	597.17	222.42	5275.28
1994	8.01	0	0	1.52	16.02	11.93	271.93	771.49	2910.96	1362.42	1290.57	646.42	7451.46

Table 5.3: Monthly rainfall figures in the catchment of Guma Dam (mm) (Source: Guma Valley Water Company, 1994).

Year	Drop in d..m level (m)	Percentage drop in level
1980/81	16.87	6.4
1981/82	17.77	6.8
1982/83	13.70	5.2
1983/84	13.66	5.3
1984/85	18.90	7.2
1985/86	18.87	7.2
1986/87	14.76	5.7
1987/88	22.16	8.5
1988/89	17.18	6.5
1989/90	15.78	6.0
1990/91	15.37	5.8
1991/92	13.70	5.2
1992/93	15.63	5.9
1993/94	13.30	5.1

Table 5.4: Annual changes in reservoir levels for Guma Dam (Guma Valley Water Company, 1994)

5.2 Sawnwood production

5.2.1 Status of sawnwood production

Since the closure of Kenema Sawmills in about 1990, only Forest Industries Corporation (FIC) and Panguma Sawmills officially operated in the East. Panguma Sawmills had been hit three times since 1993 but had resumed operations, albeit on a small scale, in November 1995. Njama Sawmills in the South produced between 80m^3 and 100m^3 of sawnwood annually under licence even before the rebels struck in April 1995. According to management, this figure could be increased slightly when operating in plantations. It is a small mill equipped with one circular, one band and a horizontal saw added recently. The

mill also produces wooden shoe and sandal bottoms from *Gmelina arborea* slabs for a Freetown market. It is yet to resume normal operations

Even prior to the onset of the civil conflict, all the mills generally suffered from the lack of essential parts resulting in interrupted operations and therefore high production costs. There is generally no effective preventive maintenance to ensure sustained production (Kamau, 1988) Thus overhead and other c nd to increase while revenue generation for supporting these costs tend to be erratic Due to their remote locations or frequent power failures, in the case of FIC, the mills generate their own electricity. This is an added cost in terms of fuel and oil consumption, investment capital and repairs

5.2.2 Sawnwood production by Forest Industries Corporation

Sawnwood production by this mill as shown in Figure 5 1 and Table 5.5 indicates a decreasing trend mostly attributable to the on-going civil conflict. This negative trend is therefore likely to be reversed following cessation of the conflict. For this reason, the data was not used in trend projection The reduction in sawnwood output in 1990 could also be attributed to the lack of necessary spares for machinery rehabilitation and managerial problems Although the company claimed a 59% log recovery, calculations of its log recovery on the basis of the ratio between roundwood intake and sawnwood output figures yielded 40% This log recovery figure is however, quite realistic for these ageing sawmills

The company exported 825m^3, 305m^3, 185m^3 and 100m^3 of sawnwood in 1984, 1985, 1986, and 1987 respectively. Schmincke (1988) claims that FIC used 18 9% of total production on furniture and moulding and that the company's log recovery ranged from 53.3% in 1984 to 43 1% in 1986 with a mean of 48%.

5.2.3 Sawnwood production by Panguma Sawmills

Sawnwood production by the Panguma Sawmills indicated a positive trend from 1985 to 1989 but thereafter a negative trend was observed until 1993. This was due to the civil conflict which resulted in the suspension of sawnwood production operations in 1991 and 1994 (refer to Figure 5.2 and Table 5.6). Because of this misleading negative trend, the data was not used in future trend projection. Log recovery over the period ranged from 41% in 1993 to 58% in 1988 with an average of 50% over the seven years. Generally, log

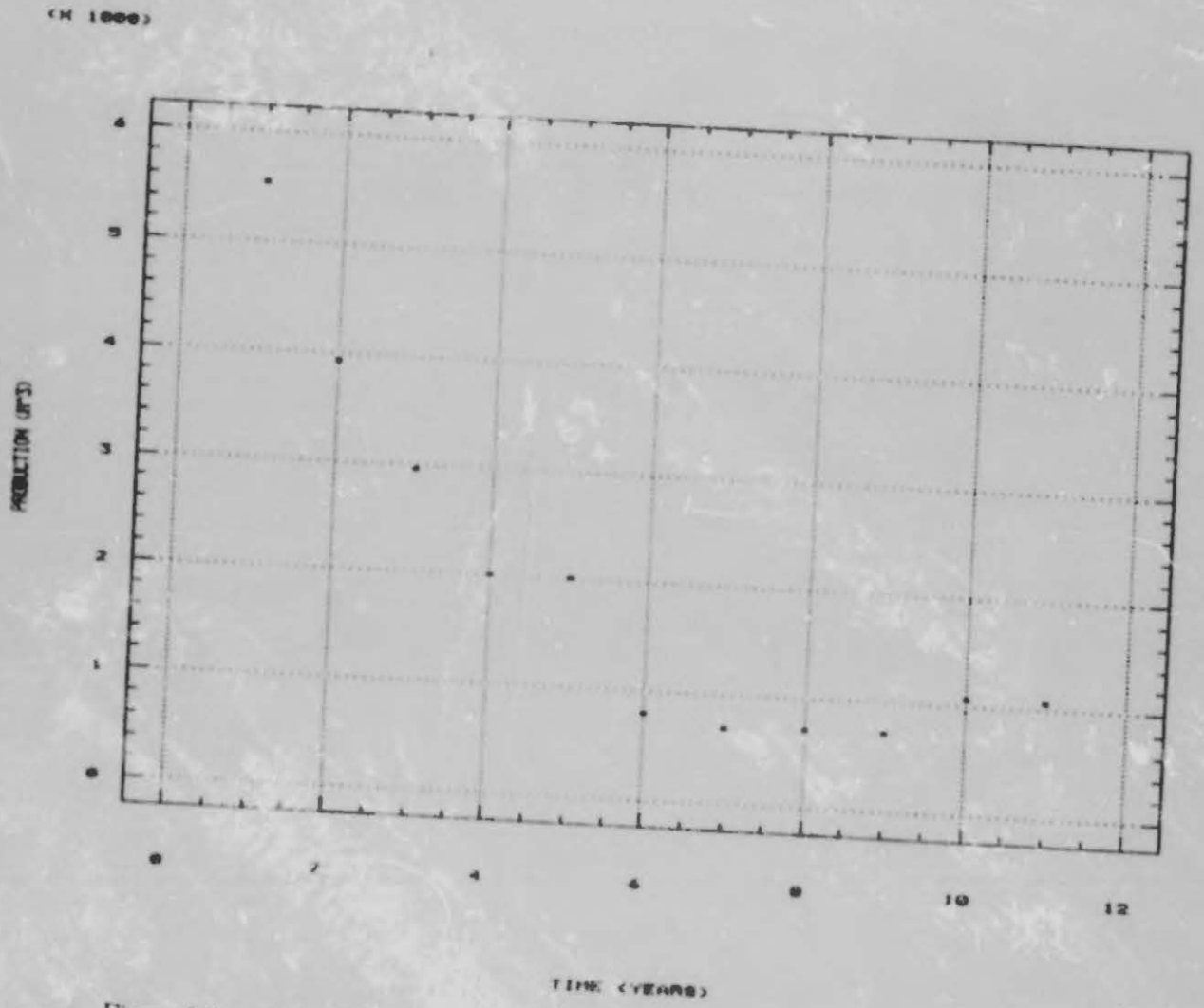

Figure 5.1: Scatterplot of sawwood production by Forest Industries Corporation

Year	Staff strength	Labour strength	Sawnwood output (m^3)	Volume sold in Freetown (m^3)	Volume exported (m^3)
1985	105	602	5,542.7	308.1	305
1986	103	584	3,941.1	314.8	185
1987	110	457	2,956.3	297.2	100
1988	109	482	2,022.5	159.1	-
1989	101	403	2,022.7	314.5	-
1990	103	141	793.5	277.2	-
1991	100	366	693.7	38.6	-
1992	62	162	708.8	38.6	-
1993	64	186	723.9	141.4	-
1994	70	138	1,069.5	191.6	-
1995	70	138	896.7	-	-

Table 5.5: Operational statistics of Forest Industries Corporation.

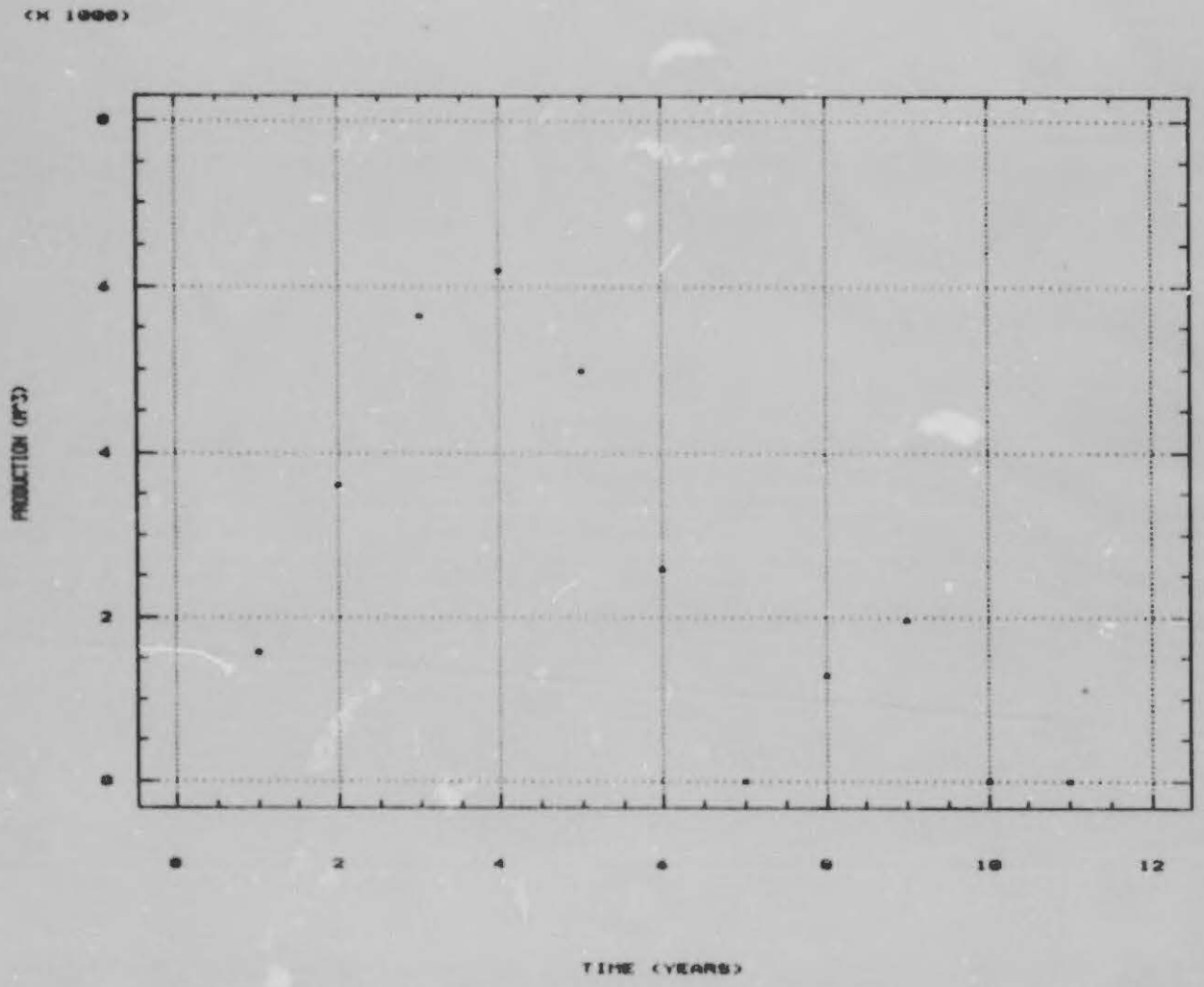

Figure 5.2: Scatterplot of sawnwood production by Panguma Sawmills.

Year	Annual log intake	Annual sawnwood production	% Used in carpentry	Volume exported	Export as % of total	% Yield	Volume sold in Freetown	Manpower strength
	(m^3)	(m^3)		(m^3)				
1985	3,574.7	1,572.9	-	-	-	43.9	-	277
1986	8,651.7	3,608.2	-	-	-	41.7	-	277
1987	12,618.1	5,642.5	13.5	736.4	13.1	44.7	3,949.4	277
1988	10,589.5	6,199.3	24.6	192.1	3.1	58.5	4,339.6	277
1989	8,715.7	4,974.9	30.8	148.3	3.1	57.1	3,482.4	277
1990	5,500.9	2,570.1	18.8	32.1	1.2	46.7	1,799.1	315
1991	-	-	-	-	-	-	-	-
1992	2,232.9	1,282.4	12.1	199.5	15.6	57.7	897.4	-
1993	4,760.7	1,968.9	10.3	231.9	11.8	41.4	1,378.2	-
1994	-	-	-	-	-	-	-	-
Total or Mean	56,644.2	27,819.6	18.3	1,540.2	7.9	50.6	15,846.0	283

There was no operation in 1991 and 1994

Table 5.6: Operational statistics of Panguma Sawmills

recovery increased with log size up to a maximum of 68%, according to mill management. The major species felled over the four-year period is shown in Table 5.7)

The proportion of sawnwood exported over the same period ranged from 1.2% in 1990 to 15.6% in 1992. However, Schmincke (1988) estimated that about 20% of total production on the average was exported up to 1988. About 18% of total production was used in the construction of pre-fabricated buildings and general carpentry and joinery. Of the total annual sawnwood production, about 70% was sold in Freetown but a small proportion was again resold in the provinces. The actual volumes used in carpentry jobs were 24% of the total production in 1989, 30% in 1990, 18% in 1991, 12% in 1993 and 9% in 1994. There was no production in 1991 and 1994.

5.2.4 Sawnwood production by pitsawyers and chainsaw operators

Pitsawyers rip logs on platforms raised with wooden supports in the forest. The saws have provision for one operator on top and one underneath the log, standing on the ground. Both operators push and pull the saw in turn.

Chainsaw operators rip logs while lying on the ground. A special frame attached to the sawing equipment is used to gauge the desired dimension of boards. The sawnwood is then transported to town. In both cases, only light vehicles are used in transportation. The elimination of the need for logging trucks is a major advantage they have over sawmills.

The number of sawyer groups and their annual production output is unknown but Atlanta (1978) estimated 7,600m^3 while Kamau (1988) estimated 6,000m^3 for pitsawyers and portable mills. Since they can operate on very difficult terrain, coupled with the disruption of the operations of the major mills, this group's output is expected to have increased tremendously.

The chainsaw operators probably produce 3,000m^3 per year. Kamau (1988)

Species	1987			1988			1989			1990		
	No. of trees felled	Volume (m^3)	% Of total	No. of trees felled	Volume (m^3)	% Of total	No. of trees felled	Volume (m^3)	% Of total	No. of trees felled	Volume (m^3)	% Of total
Nisgon	765	2,134.0	50.0	705	1,625.8	85.0	158	276.1	13.0	221	509.2	35
Tiama	172	656.3	16.0	53	162.6	8.0	45	143.2	7.0	116	467.1	32
Sipo	44	390.8	9.0	11	71.6	4.0	94	225.4	11.0	31	194.9	13
Naga	108	705.7	17.0	-	-		353	1,311.0	61.0	44	255.3	17
Kosipo	15	114.5	3.0	-	-		2	5.0	0.2	2	13.2	0.9
Dousale	5	29.3	0.6	5	11.4	1.0	21	88.0	4.0	5	19.6	1.0
Sapele	38	168.6	4.0	9	34.9	1.8	13	67.2	3.0	1	1.8	0.1
Bosse	4	20.0	0.4	2	16.4	1.0	10	2.1	1.0	6	17.3	1.0
Total	1,151	4,219	100.0	785	1,922.7	100.0	337	2,143.3	100.0	426	1,478.4	100.0

Table 5.7: Timber species felled by Pan guma Sawmills between 1987 and 1990.

estimated an annual sawnwood production of 6,000m^3 for the two categories but since the chainsaw operators are more efficient, they could produce nearly half of that estimate despite the fairly low number of operators nation-wide. In any case such noisy operations would have been limited to areas not affected by the civil conflict. If the civil conflict seriously deterred the effective surveillance of the government-controlled forest estates, then both categories could have produced even higher. As at now, there is no effective control of chainsaw operations outside reserves. Their numbers are yet to be determined as a preliminary step to the institution of some control measure.

5.2.5 Sawnwood production by the now defunct companies

According to Schmincke (1988), the following defunct sawmills were producing sawnwood at the rates indicated below prior to closure:

(a) Kenema Sawmills: 500m^3 to 750m^3 / year;

(b) Sierra Wood Ltd: 500m^3 to 750m^3 / year and

(c) Kasewe Sawmills: 300m^3 / year.

While sawmills (a) and (b) closed in 1990 and 1988 respectively, operations of the Government-owned Kasewe Sawmills were suspended when rebels struck the mill in March 1995. It was not possible to obtain sawnwood sales figures from any of these mills.

5.3 Sales of timber products

5.3.1 Sawnwood sales by sawnwood merchants

Most of the sawnwood merchants visited, sell sawnwood unstacked, in poorly ventilated stores either as extensions to existing buildings or as seperate structures. For stores without proper identification, in the form of sign plates or wall markings, a few boards are normally displayed outside the structure to attract customers. A group of four merchants actually displayed large quantities of sawnwood on an empty lot for want of a store (as explained in Paragraph 5.1.1).

The building materials stores generally do not stock large quantities of sawnwood (except for cover strips), but could acquire and deliver as part of bulk orders of general building material on short notice.

The sales of sawnwood by the 30 sawnwood stores surveyed exhibited a positive trend throughout the period (refer to Table 5.8 and Figure 5.3).

The following regression coeffcients were obtained using the compound growth model, in analysing the data, as indicated below:

$$Y = a(1+b)^x$$

Coefficient of determination $(R^2) = 87.24\%$

Coefficients: $(a) = 2,932.1$

$(b) = 0.119$

These results show an increase of 12% *per annum* in sawnwood sales for the period 1985 to 1995.

Although the number of stores increased substantially between 1989 and 1995, the effective increases in annual sales per store decreased slightly over this period, especially for the small-scale merchants. The following dimensions of sawnwood were the most common on the market:

1" × 12" × 12ft.
2" × 12" × 12ft.
2" × 6" × 12ft. and
$1\frac{1}{2}$" × 12" × 12ft.
$\frac{1}{2}$" × 3" × 12ft. (cover strips)

Most of the redwood furniture timber were 14 feet long instead of the standard 12 feet. This dimension is ideal especially for furniture manufacture where the plank can provide two pieces of 6 ft 6" for the two sides of a bed. The 2"x 12"x 12ft. is often resawn in special stores, at cost, for use as table and chair legs and for roofing and

User group	Annual sawnwood production, sales and consumption (m^3)										
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Carpentry companies	1,872	2,525	2,610	2,713	2,862	3,001	3,006	3,028	3,185	3,821	3,853
Carpentry workshops	1,690	2,217	2,516	2,793	2,926	3,220	3,335	3,322	3,724	3,900	3,952
Technical institutions	17	20	19	22	51	41	52	50	67	57	127
Construction companies	1,231	1,006	915	1,110	1,623	2,055	2,395	2,514	2,355	2,448	2,911
Casket production	118	151	134	131	130	129	150	153	158	180	226
Total sawnwood consumption	4,928	5,919	6,194	6,769	7,592	8,446	8,938	9,067	9,489	10,406	11,069
Total sawnwood sales	3,935	4,432	4,939	4,472	4,632	5,291	6,105	6,972	6,723	8,681	11,681
Consumption less sales	993	1,487	1,255	2,297	2,959	3,155	2,833	2,095	2,766	1,725	-612
Percentage difference	20	25	20	34	39	37	36	23	29	17	-6
Volume of sawnwood provided by sawmills (m^3)	308	315	4,247	4,499	3,797	2,076	39	936	1,520	192	324
Volume as % of total on the market	8	7	86	100	82	39	1	13	23	22	3

Table 5.8: Sawnwood production, sales and consumption by all user groups (Source: Table 4.11, 4.13, 4.14, 4.15, 4.16, 4.17, 5.5 and 5.6).

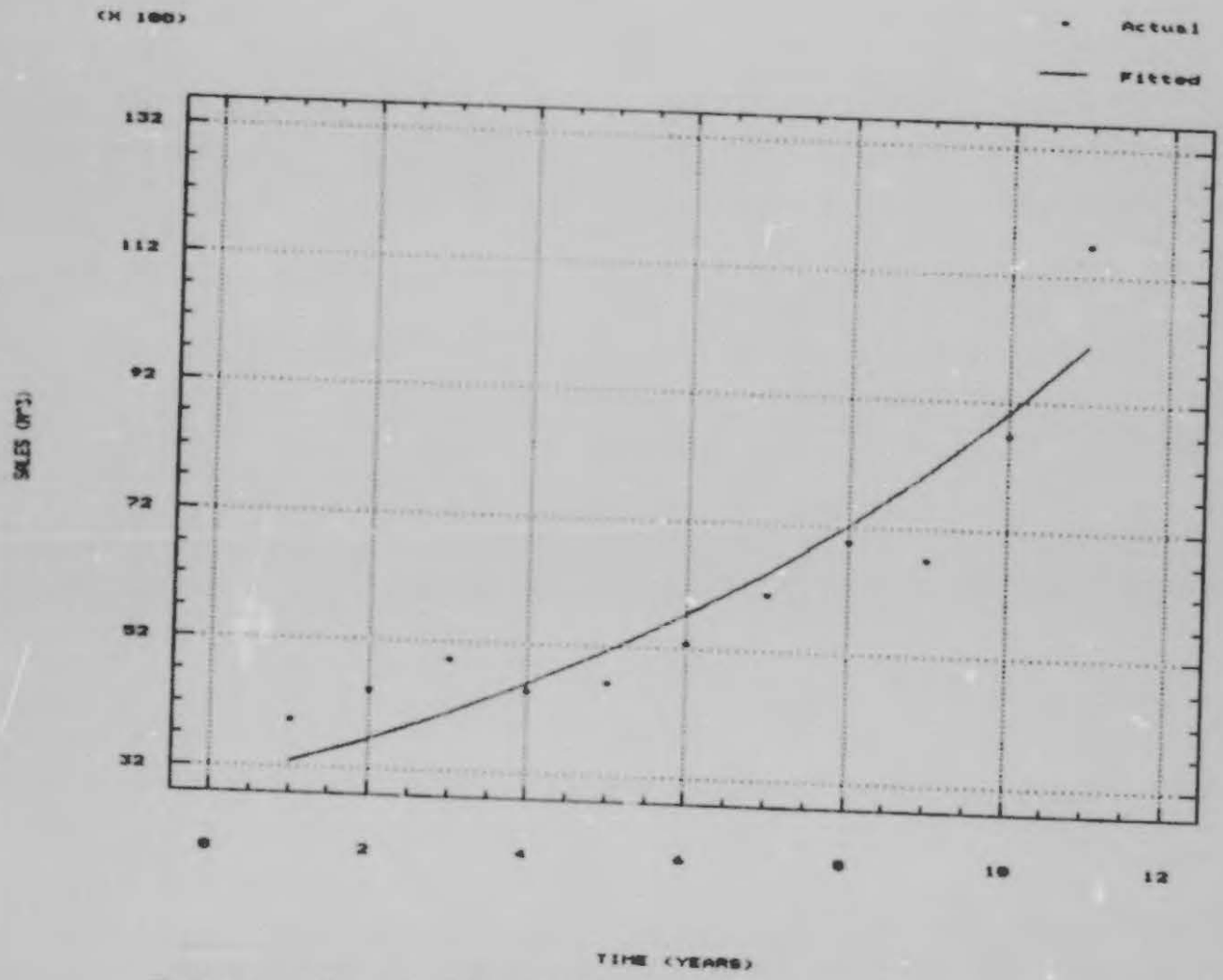

Figure 5.3: *Observed values and secular trend of sawnwood sales by merchants.*

other purposes.

There is a tremendous variation in the types of costs incurred by sawnwood merchants. While some natives of an area pay pittance for logs, strangers may pay higher prices under tougher conditions. While pitsawn timber is cheap and of low quality, the established mills pay full stumpage and production costs to produce high value and expensive boards. In all cases, transportation cost generally accounts for 10% to 20% of total costs. Generally, good quality sawnwood from the east (320 km from Freetown) could yield 50% to 60% profit if the full costs are borne. Average grade A sawnwood from the east was going for about Le 353,650 per m^3 while a grade B was about Le 247,000 per m^3 by December, 1995. Grade A is redwood while Grade B refers to whitewood.

Of all the 30 sawnwood stores sampled, 90% were constrained by high transport cost and unreliability, 87% by low capital, 22% by irregularity of supply due to the security situation, 14% by the unreliability of pitsawyers, 9% by poor storage conditions, and 5% by the scarcity of desired species in the forests.

5.3.2 Sales of construction poles

Unlike sawnwood which is more readily subject to degradation due to weather, all poles are displayed and sold outdoor, normally stacked or standing. During the dry season however, small poles in particular dry out quickly resulting in price reductions. The relative ease of establishment and transfer of this type of business creates a problem of identification and location as there are a number of *ad hoc* entrepreneurs.

Poles are sold by dozen or unit in three size classes, namely: small, medium and large. The merchants use visual examination methods to sort them by classes, in the absence of a standard yardstick of measurement.

Some of the pole producers use "arm length" measure for the length but visual examination for diameter assessment. The survey revealed average mid-diameter and length ranges as in Table 5.9.

Size	Length(m)	Diameter(cm)
Small	3.61	3.64
Medium	3.78	4.87
Large	3.76	6.04

Table 5.9: Mean dimensions of poles on the market.

Size classes seem to be diameter-dependent rather than length as there is no significant difference in the lengths of the three classes. There seems to be equal quantities of the three size classes of poles on the market although the large sizes are in higher demand by the builders. Transportation of poles is normally charged per dozen irrespective of size, but as the drivers would prefer to load more but carry less weight, they insist on nearly equal quantities of each size class. The merchants on the other hand, would prefer to transport more of the more valuable large sizes for profit maximization but are forced to abide by the former's conditions as there are few vehicles available for such jobs.

The sales of construction poles for the 20 out of 36 sales depots sampled indicated a positive trend over the 11-year period with an almost 13-fold increase in sales in 1995 over 1985 (Table 5.10 and Figure 5.4).

The following regression coefficients were obtained using the compound growth model, in analysing the data, as indicated below:

Coefficient of determination $(R^2) = 98.4\%$

Coefficients: $(a) = 6{,}317.9$

$(b) = 0.374$

These results indicate an increase of 37% *per annum* in pole sales over the period 1985 to 1995.

Profitability of the pole-selling business is clearly affected by transportation cost which in turn is influenced by distance, road conditions, running costs, and security of the vehicle and the passengers. During the height of the civil conflict, poles transported by

User group	Annual pole consumption and sales by user groups and merchants (units)										
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Funerals	74,976	79,305	78,360	73,521	65,961	66,576	73,809	81,600	77,040	74,904	77,088
Camps and market stalls							54,520	70,020	70,520	54,520	107,072
"Jobbing" contractors	50,905	55,292	54,162	57,617	52,482	54,072	54,755	60,642	62,689	65,661	66,225
Kitchens and latrines	42,995	44,811	42,400	45,925	38,078	39,186	39,186	46,224	47,663	51,068	53,656
Poles for pegles	13,249	13,549	14,051	14,448	14,877	21,418	21,965	22,629	23,323	23,996	30,803
Construction companies	15,225	15,926	16,637	17,468	20,356	27,859	33,192	33,081	32,457	34,100	37,253
Total pole consumption	197,350	208,883	205,610	208,979	191,745	208,911	277,427	314,196	313,672	304,269	374,099
Total pole sales	15,262	14,920	16,622	15,800	16,488	54,758	55,168	93,695	104,280	147,888	211,730
Consumption less sales	182,088	193,763	188,988	193,179	175,256	154,153	222,259	220,501	209,392	156,381	209,367
Percentage difference	92	93	92	92	91	74	79	70	67	51	43

Table 5.10: Pole consumption and sales by all user groups and merchants (Source: Tables 4.3, 4.4, 4.5, 4.8, 4.12, 4.18 and Paragraph 4.1.2a).

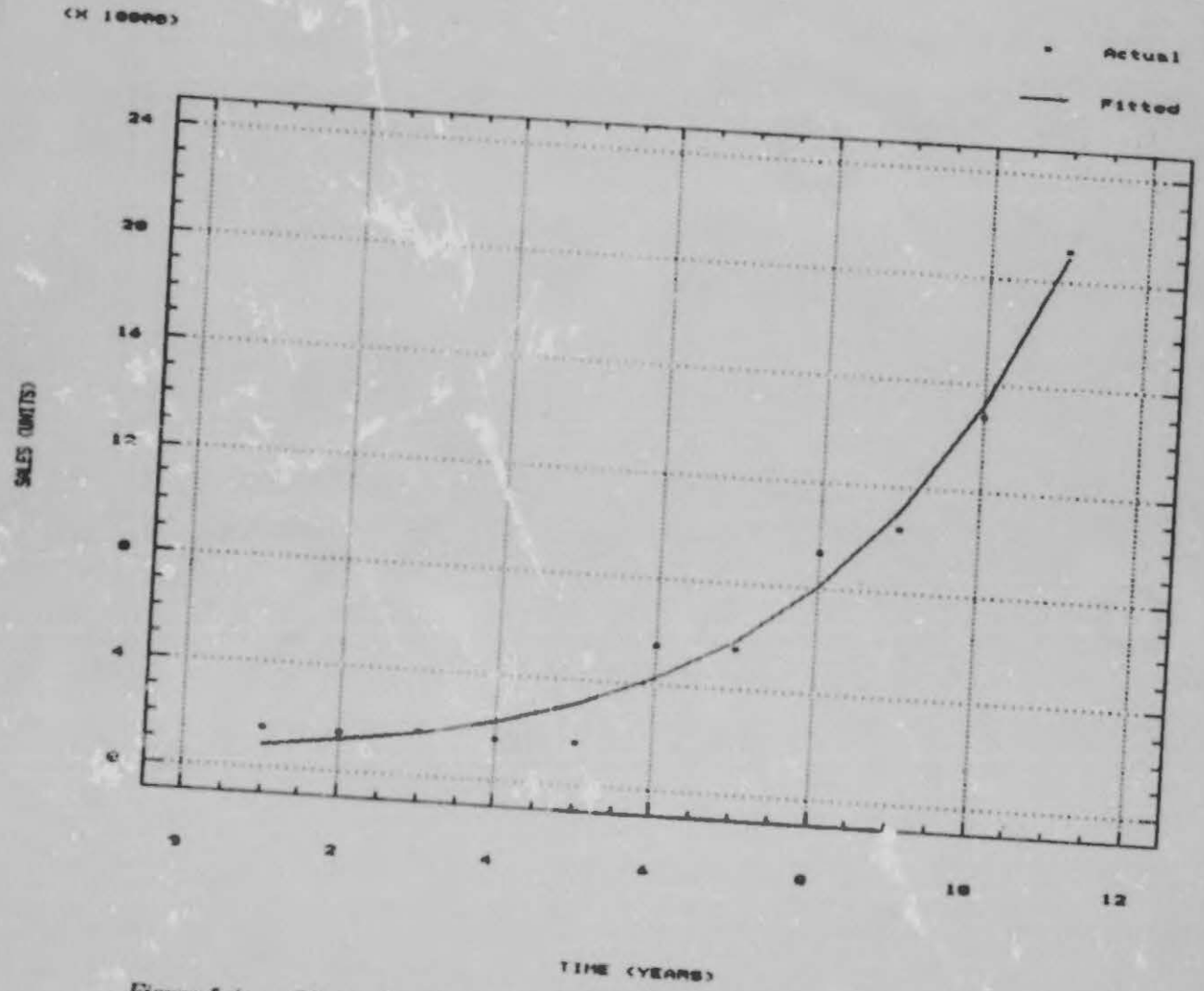

Figure 5.4: Observed values and secular trend of pole sales by merchants.

boat yielded the highest profit of 105% per dozen poles and were generally above 60%. However, profit margins generally ranged from 16% to 105% with a mean of 49% (refer to Table 5.11).

Of all the pole merchants sampled, 53% complained about the security situation, 37% about transport availability and high cost, 32% about limited working capital, and 11% about the poor form and the drying-out of poles in the dry season. While 68.4% of merchants disclosed purchase prices at source, 31.6% withheld this information.

5.3.3 Sales of *Funtumia africana* logs

The sales of *Funtumia africana* logs to the monopolistic match industry exhibited a positive trend between 1985 and 1986 followed by a negative trend thereafter (refer to Table 5.12). The negative trend between 1991 and 1995 was mostly due to the interruption of raw material supply as a result of the on-going civil conflict. This misleading negative trend for most of the period was therefore not used in trend projection as the situation is likely to be reversed at the end of the conflict. The drastic drop in production was generally blamed on:

(a) Low sales due to competition with smuggled products which evade taxation;

(b) Foreign exchange restrictions which affect importation of chemicals and other inputs;

(c) Long haulage distances and high fuel prices resulting in high cost of logs and

(d) Disruption of log supplies by the civil conflict.

Management strongly believes that in the absence of some or all of these problems, especially (d) above, the 1986 production levels would be maintained. There is, however, a possibility of losing the trained staff if the suspension of operations which started in the first week of November 1995 continues indefinately. The present machinery layout in the factory comprises of:

(a) Plyer conveyor;

Dealer number	Cost/dozen at source (Le)	Transport cost (Le)	Average price in Freetown Le/dozen	Profit/ dozen (Le)	Percent profit
1	1033.00	1,500	3500.00	967.00	38
2	800.00	900	3500.00	1800.00	105
3	1000.00	1,500	3500.00	1000.00	40
4	2000.00	2,187	5000.00	813.00	19
5	500.00	1,000	2500.00	1000.00	67
6	2000.00	1,000	4000.00	1000.00	33
7	2000.00	1,000	5000.00	2000.00	67
8	1000.00	1,000	3500.00	1500.00	75
9	1000.00	2,000	3500.00	500.00	16
10	1200.00	1,500	3500.00	800.00	30
11	1000.00	1,500	3500.00	1000.00	40
12	800.00	1,290	3500.00	1410.00	67
13	2500.00	2,000	6500.00	2000.00	44
Mean	1,129.40	1,413.60	3,923.10	1,214.60	49.30

Table 5.11: Profitability of the pole industry.

Year	Quantity of logs purchased	Mean log volume (m^3)	Total volume of logs (m^3)	Number of trees utilised	Price per log (Le)	Total value of logs (Le)	Cartons of matches produced	Manpower strength
1985	150,297	0.071	10,671.09	18,787	2	300,594	19,188	150
1986	401,483	0.071	25,505.29	50,185	3	1,204,449	51,256	150
1987	331,763	0.071	23,555.17	41,470	4	1,327,052	25,247	150
1988	219,886	0.071	15,611.91	27,486	4.5	1,209,360	18,650	150
1989	186,055	0.071	1,089.35	1,918	6.5	1,209,357	28,904	150
1990	10,229	0.071	1,246.12	2,194	100	1,534,397	24,043	150
1991	20,122	0.071	1,428.66	2,515	200	4,024,400	18,755	60
1992	-	-	-	-	-	-	-	-
1993	24,000	0.071	1,704.05	3,000	-	-	-	55
1994	11,000	0.071	781.08	1,375	700	7,770,000	-	55
1995	12,500	0.071	887.50	1,563	700	8,750,000	-	40

Average number of logs per tree = 8

Table 5.12: Funtumia log consumption by SLMCO.

(b) Chopper

(c) Impregnation drum;

(d) Blower;

(e) Drier;

(f) Polishing drum;

(g) Dust extractor;

(h) Reservoir bunker;

(i) Steam chamber and

(j) Painter.

The capacity is claimed by management to be only 45% utilised even at peak production periods. The fully equipped printing section is believed to be only 40% utilised. The installed capacity of the machinery layout is 43,000 boxes (of 50 matches each) per hour. For the normal 8-hour day in a 290-day year, the factory could produce 103,916 cartons of 960 boxes each, *ceteris paribus*.

The company originally hired contractors for log supplies from the Pujehun district and later from Moyamba district. Recently, there was a switchover to the Western Area due to rebel attacks on the first two earlier sources in succession. The other *Funtumia* species, *Funtumia elastica* is used interchangably with *F. africana* as they are very similar and even difficult to differentiate. They are known by the same vernacular names (Savill and Fox, 1967).

5.4 Consumption patterns of forest products

5.4.1 Consumption of sawnwood

The five identified user groups for sawnwood were:

(a) Construction companies;

(b) Carpentry companies;

(c) Carpentry workshops,

(d) Funeral homes and undertakers and

(e) Technical institutions

The total sawnwood consumption by all the user groups covered indicated a positive trend (refer to Table 5.8 and Figure 5.5).

The compound growth model used in the analysis yielded the following coefficients:

Coefficient of determination $(R^2) = 95.2\%$

Coefficients: $(a) = 5{,}173.5$

$(b) = 0.074$

The result indicates an increase of 7% *per annum* by all user groups between 1985 and 1995.

(a) Sawnwood consumption by the carpentry workshops was highest for all the years, but 1985 and indicated a positive trend over the period (refer to Figure 5.6 and Table 5.8).

The following coefficients were obtained for the compound growth model indicated below:

$$Y = a(1+b)^x$$

Coefficient of determination $(R^2) = 92.2\%$

Coefficients: $(a) = 2{,}009.1$

$(b) = 0.068$

The model indicates an increase of 7% *per annum* in sawnwood consumption by carpentry workshops for the period 1985 to 1995.

(b) The next highest volume was consumed by the carpentry companies. The trend in consumption for this group as indicated in Figure 5.7 and Table 5.8 was positive throughout the period 1985 to 1995. The following coefficients were obtained for the compound growth

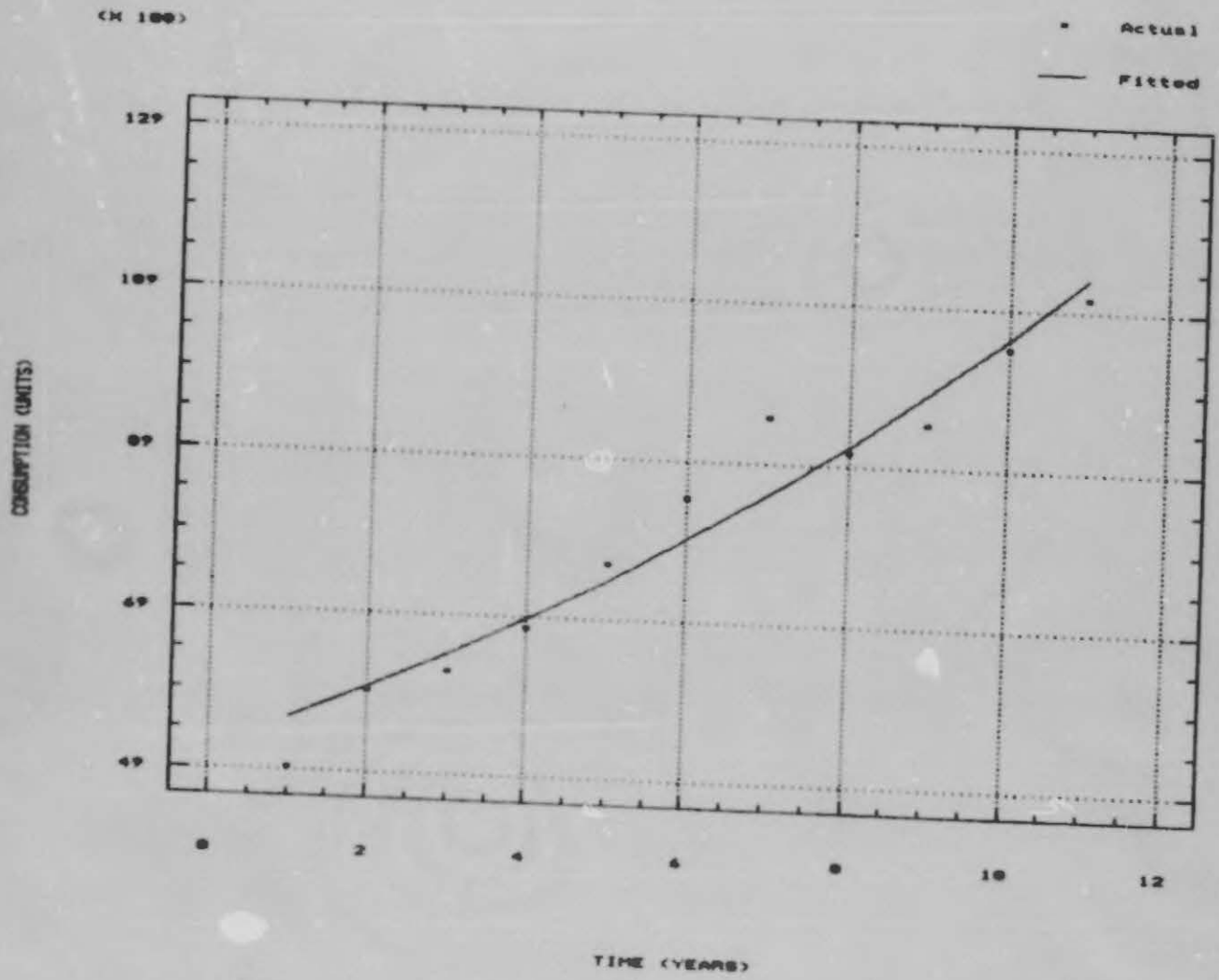

Figure 5.5: Observed values and secular trend of total sawnwood consumption by all user groups.

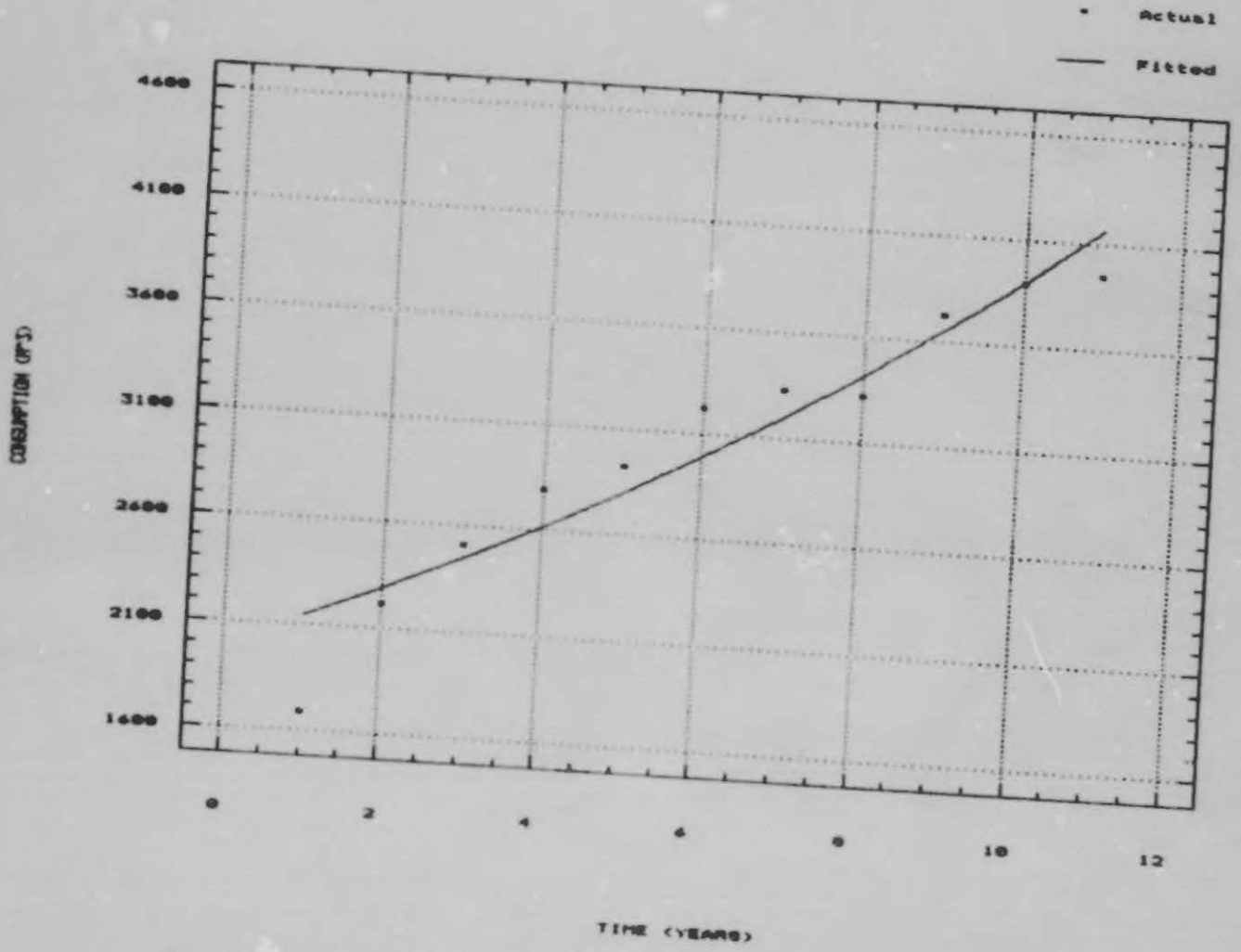

Figure 5.3: Observed values and secular trend of sawnwood consumption by carpentry workshops.

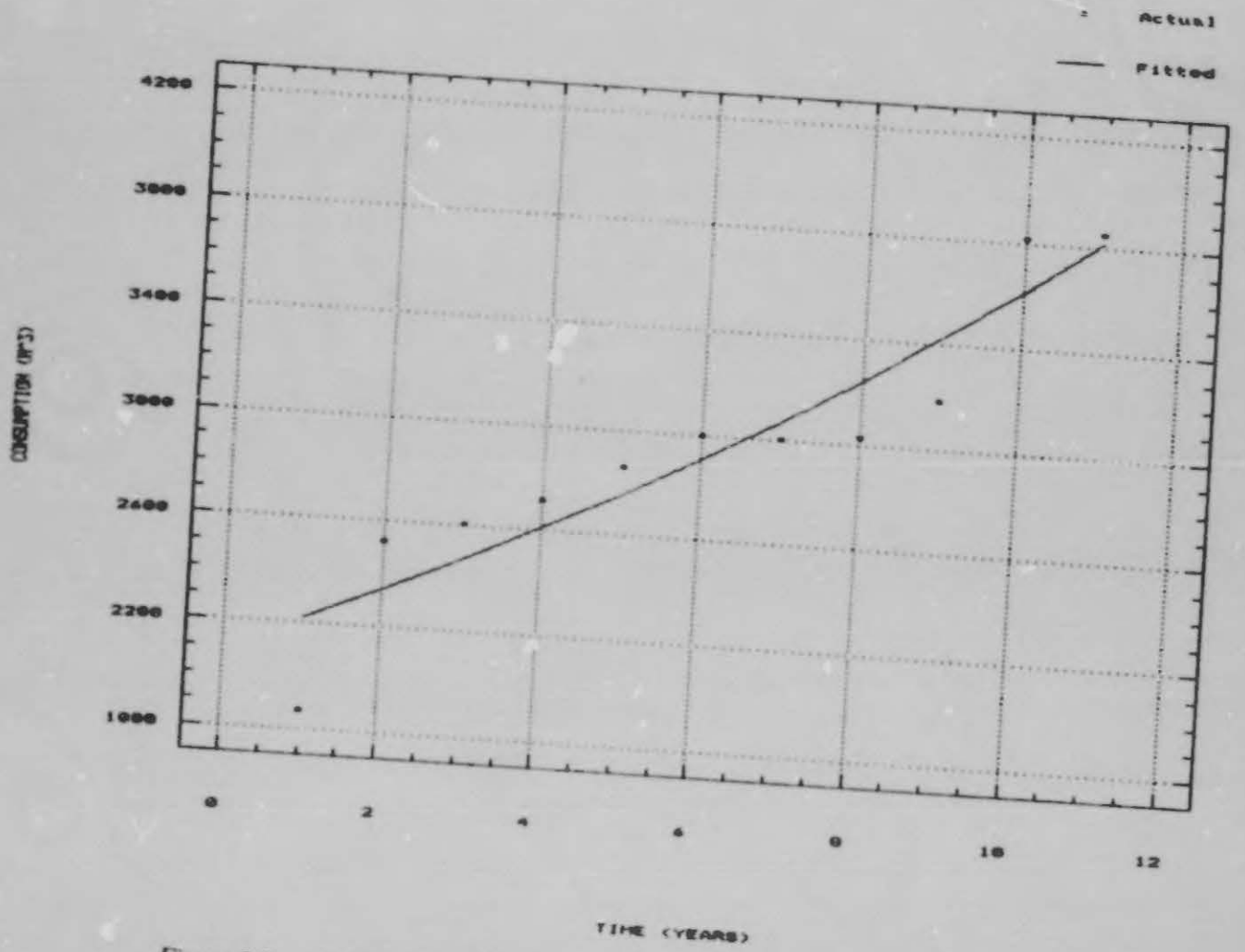

Figure 5.7: *Observed values and secular trend of sawnwood consumption by carpentry companies.*

regression model used

$$Y = a(1+b)^x$$

Coefficient of determination (R^2) = 88.8%

Coefficients (a) = 2,1025

(b) = 0.055

The model indicates an increase of 6% *per annum* in sawnwood consumption by carpentry companies for the period 1985 to 1995

(c) Sawnwood consumption by the third biggest consumers, the construction companies indicated a positive trend as indicated in Figure 5.8 and Table 5.8.

The following regression coefficients were obtained for the compound growth model used in the analysis

$$Y = a(1+b)^x$$

Coefficient of determination (R^2) = 74.7%

Coefficients (a) = 9958

(b) = 0106

The equation indicates an increase of 11% *per annum* in sawnwood consumption by construction companies for the period 1985 to 1995

(d) The consumption of sawnwood for the construction of caskets indicated a rather erratic trend with only slight increases and decreases. The survey covered three funeral companies and two government departments involved in casket manufacture. Total sawnwood consumption ranged from 117m^3 in 1985 to 226m^3 in 1995 (refer to Figure 5.9 and Table 5.8)

The following coefficients were obtained for the compound growth model

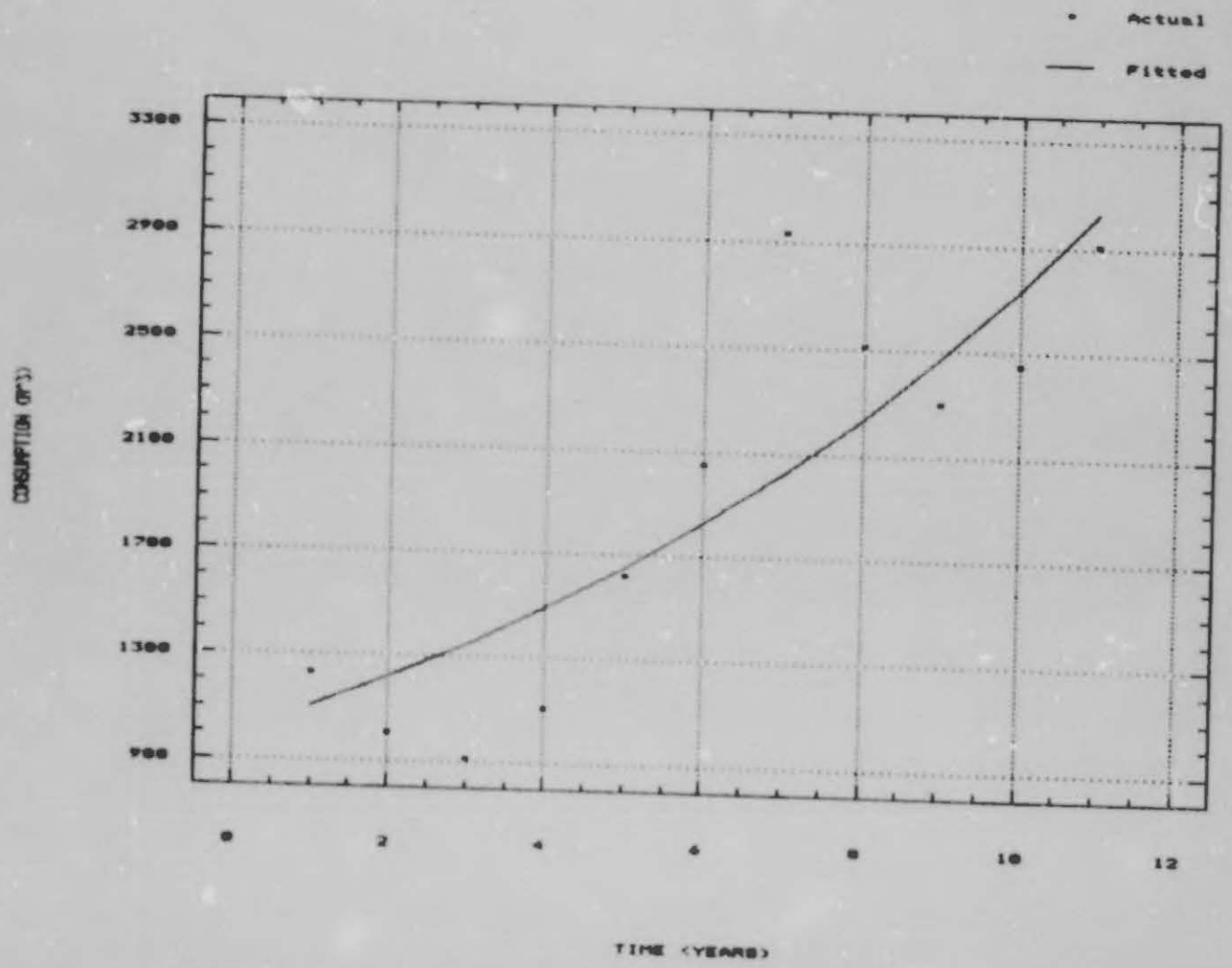

Figure 5.8: *Observed values and secular trend of sawnwood consumption by construction companies.*

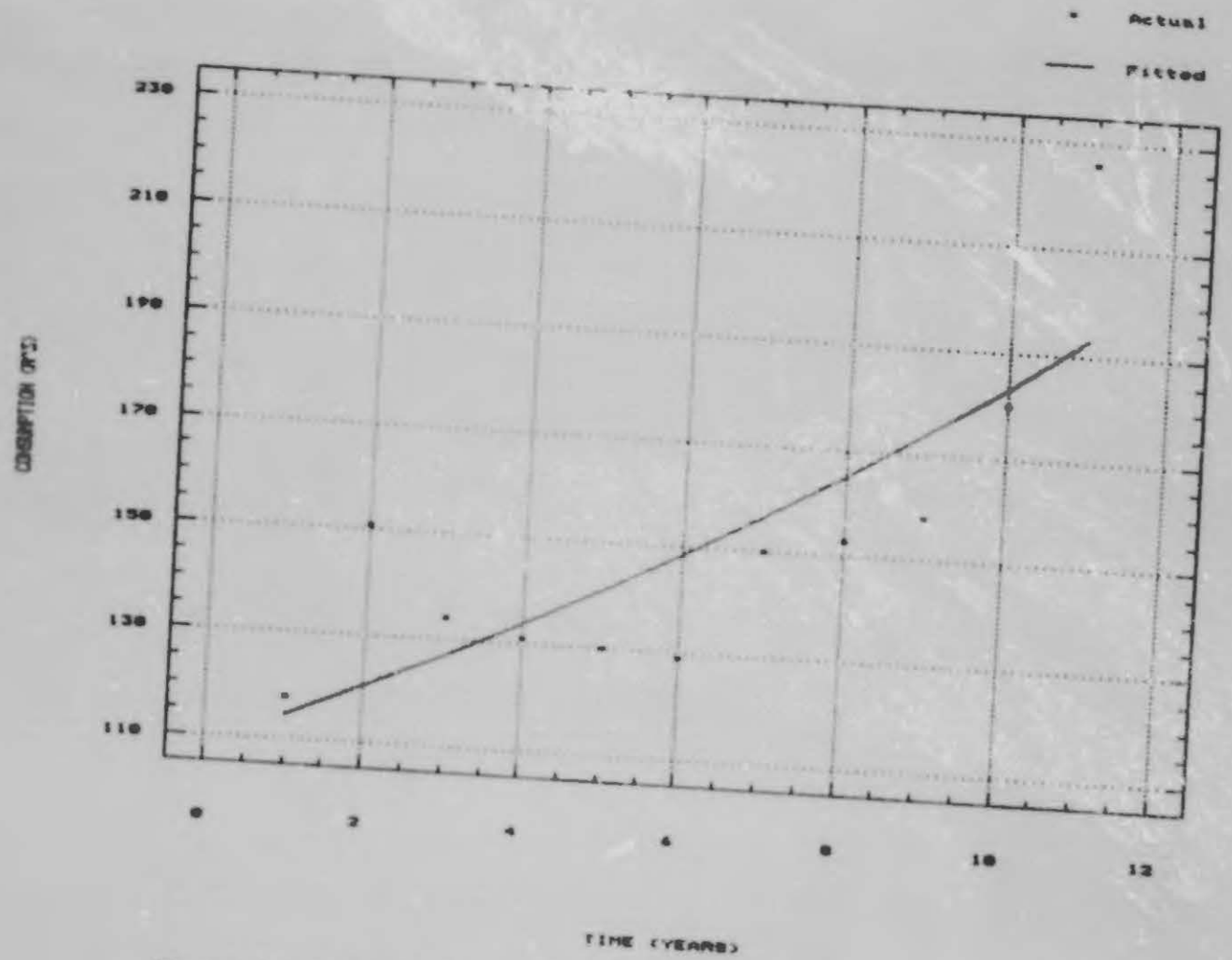

Figure 5.9: *Observed values and secular trend of sawnwood consumption in casket production.*

$(Y = a(1+b)^x)$ used in the analysis

Coefficient of determination $(R^2) = 67.1\%$

Coefficients $(a) = 108.8$

$(b) = 0.053$

The equation indicates an increase of 5.0% *per annum* in sawnwood consumption for caskets for the period 1985 to 1995

The use of sawnwood by the army for the burial of senior officers who died at the war-front was only estimated as this information was considered too sensitive and confidential to be released. The military normally deposit bodies at one of the funeral homes in Freetown and provides caskets as well.

(e) The technical institutions consumed the least with a range of $17m^3$ in 1985 to $126m^3$ in 1995 (refer to Table 5.8 and Figure 5.10) The coefficients obtained for the compound growth model $(Y = a(1+b)^x)$ used were as follows

Coefficient of determination $(R^2) = 81.7\%$

Coefficients $(a) = 12.0$

$(b) = 0.217$

The model indicates an increase of 22% *per annum* in sawnwood consumption over the period 1985 to 1995

However, less than 20% of these annual consumption totals, especially in 1995, could be attributed to practical exercises by students offering carpentry or joinery subjects. About 80% of the sawnwood is used in the repairs or manufacture of school furniture and contracts from other schools, private individuals or for staff members of the respective or other schools. One of the institutions actually constructs its own buildings using the services of the staff of the Construction Department. In two of the institutions, students are instructed to provide sawnwood for woodwork practicals.

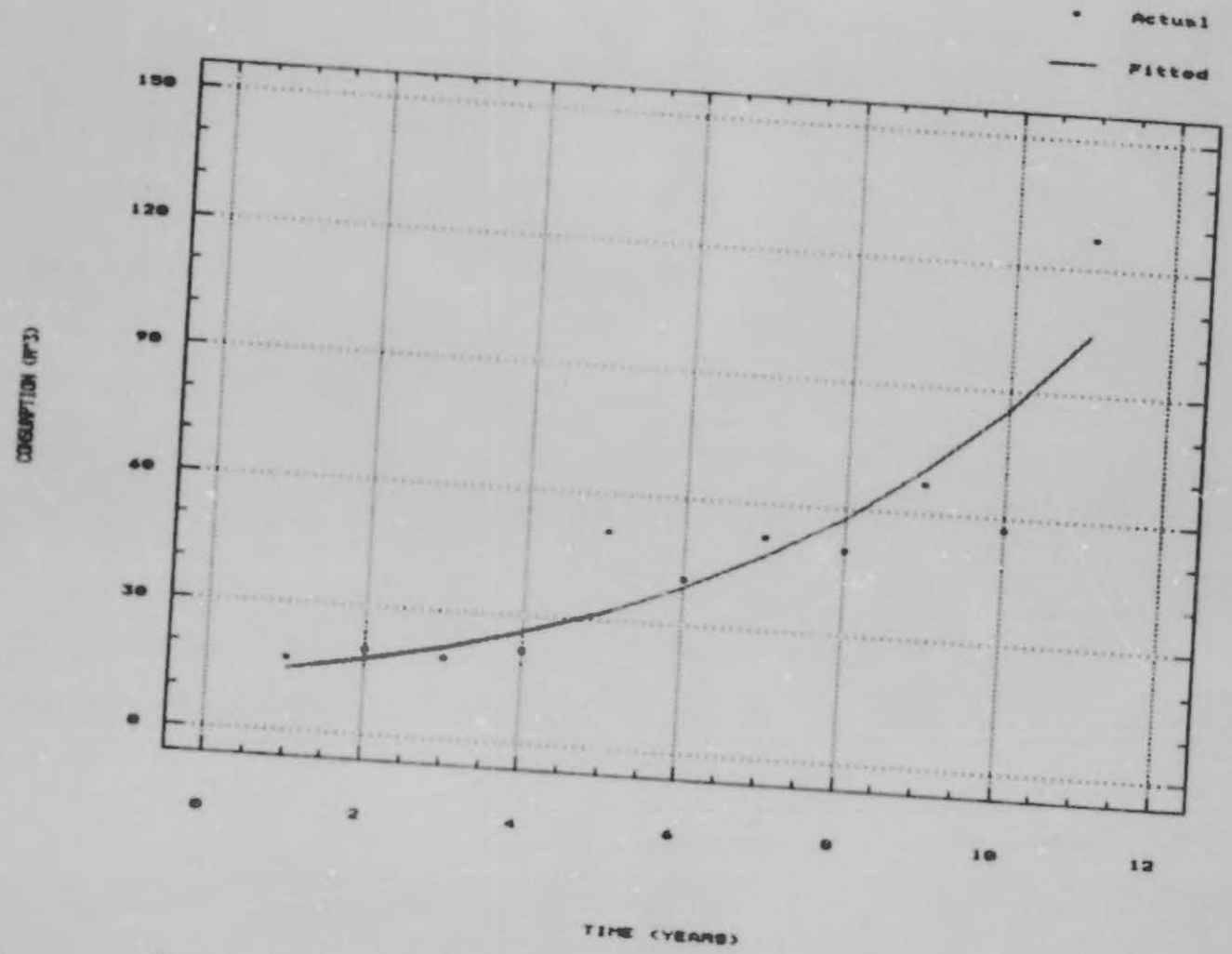

Figure 5.10: Observed values and secular trend of sawnwood consumption by technical institutions.

The quality of sawnwood provided in these cases is mostly sub-standard, comprising of packaging materials, damaged planks and even broken furniture. These were excluded from the survey for fear of double counting and irregularity.

5.4.2 Consumption of construction poles

The following main end uses were identified for construction poles:

(a) Camps and market stalls;

(b) Funeral ceremonies (burials and vigils);

(c) Buildings: (i) by jobbing contractors;

(ii) by construction companies;

(d) Kitchens and latrines and

(e) Pestles.

The consumption of construction poles by all user groups indicated a positive trend over the 11 years period as contained in Table 5.10 and Figure 5.11. The near 2-fold increase in pole consumption in 1995 over 1985 could be attributed to the construction of more refugee camps in 1995.

The following coefficients were obtained for the compound growth model used in the data analysis:

$$Y = a(1+b)^x$$

Coefficient of determination $(R^2) = 85.05\%$

Coefficients: $(a) = 161{,}286$

$(b) = 0.074$

The model employed indicates an increase of 7% *per annum* in total pole consumption for the period 1985 to 1995.

(a) Although the market stalls and displaced camps consumed the largest quantity

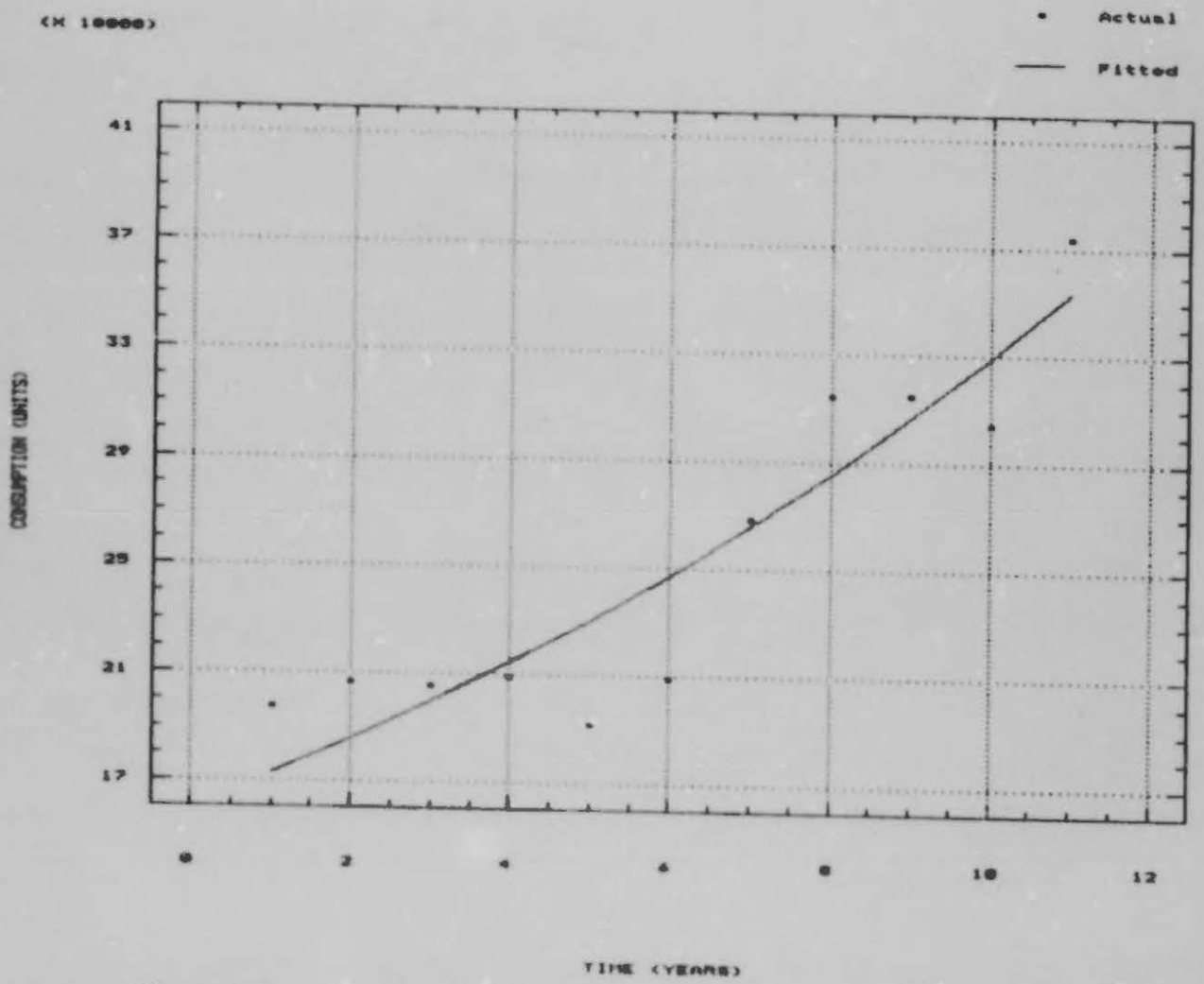

Figure 5.11: *Observed values and secular trend of construction pole consumption by all user groups.*

of poles between 1991 and 1995 (refer to Table 5.10 and Figure 5.12), the limited data and the likelihood of the elimination of displaced camps following cessation of the civil conflict makes the trend misleading. Hence, the data was not used in trend projection

(b) The next highest consumption was for funeral ceremonies with a range of 74,976 in 1985 to 77,088 in 1995 but with a peak consumption of 81,600 in 1992. However, since the data did not exhibit any constant and remarkable trend (refer to Table 5.10 and Figure 5.13), it was not used in future trend projection for the user group

(c) The quantity of poles used in buildings by "jobbing" contractors was next with a range of 50,905 in 1985 to 68,225 in 1995. For this category, the trend was influenced by the number of registered buildings (refer to Table 5.10 and Figure 5.14)

In this case the compound growth model ($Y = a(1+b)^x$) used yielded the following coefficients

Coefficient of determination (R^2) = 76.4%

Coefficients (a) = 49,250.7

(b) = 0.026

The equation indicates an increase of 3.0% *per annum* in pole consumption for buildings by "jobbing" contractors for the period 1985 to 1995

(d) Pole utilization in the construction of kitchens and latrines exhibited a changing trend for the 11 years period (refer to Table 4.4 and Figure 5.15). Thus the data was not used for trend projection for this user group as it seems misleading.

(e) The estimated quantity of poles used as pestles on the basis of population increases indicated a distinct positive trend for the 11 years period (refer to

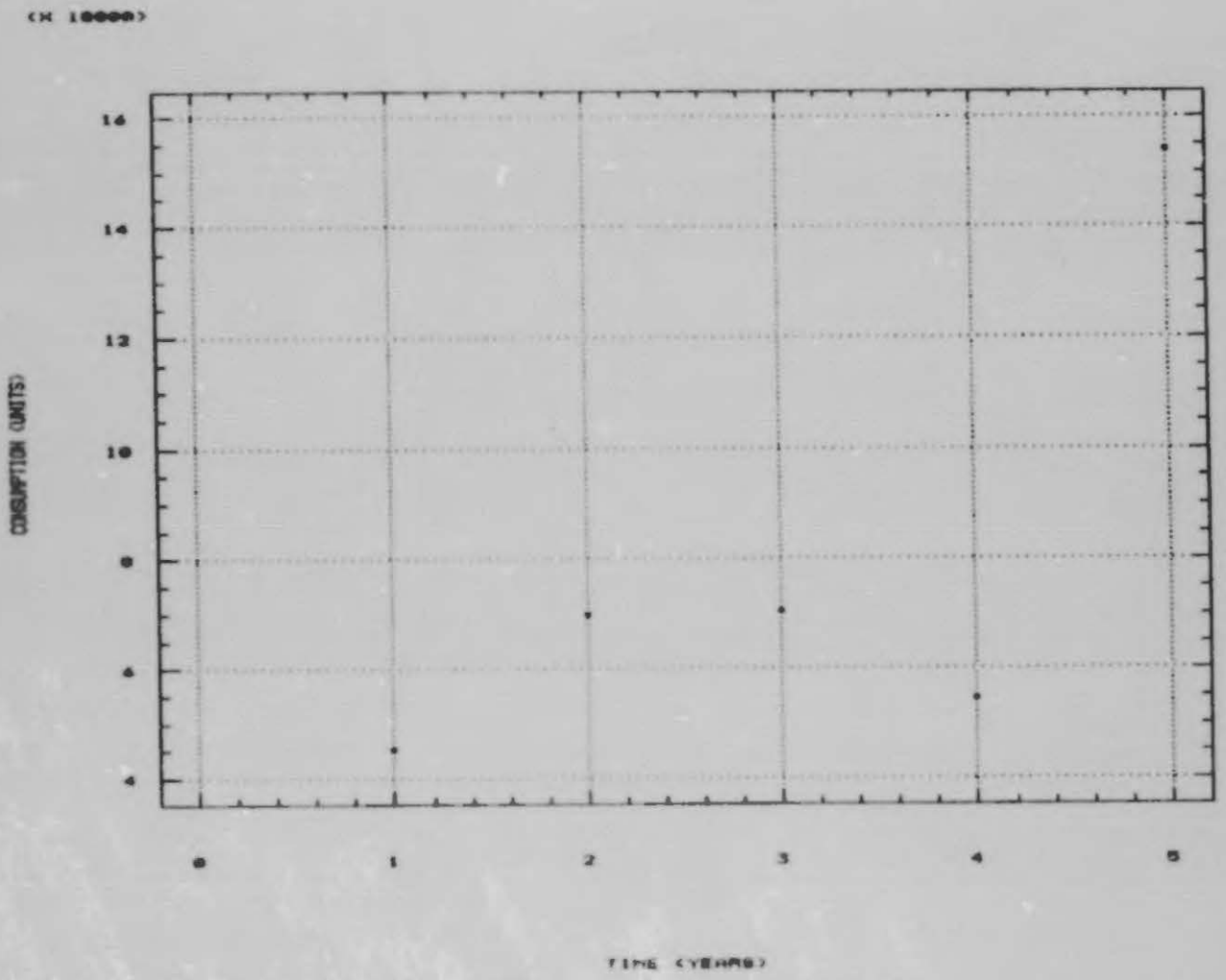

Figure 5.12: Scatterplot of construction pole consumption in the construction of market stalls and refugee camps.

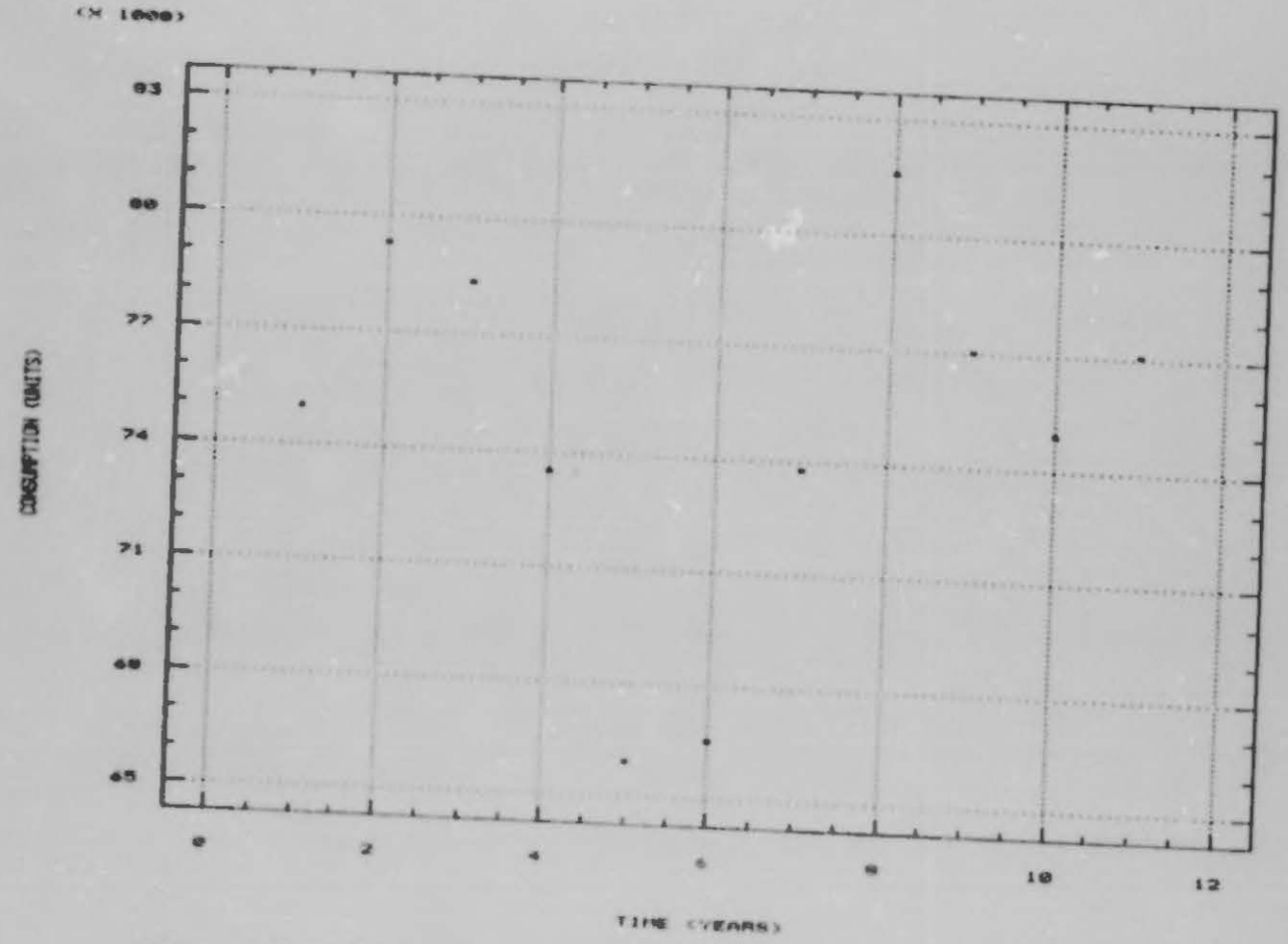

Figure 5.13: Scatterplot of construction pole consumption in funeral ceremonies.

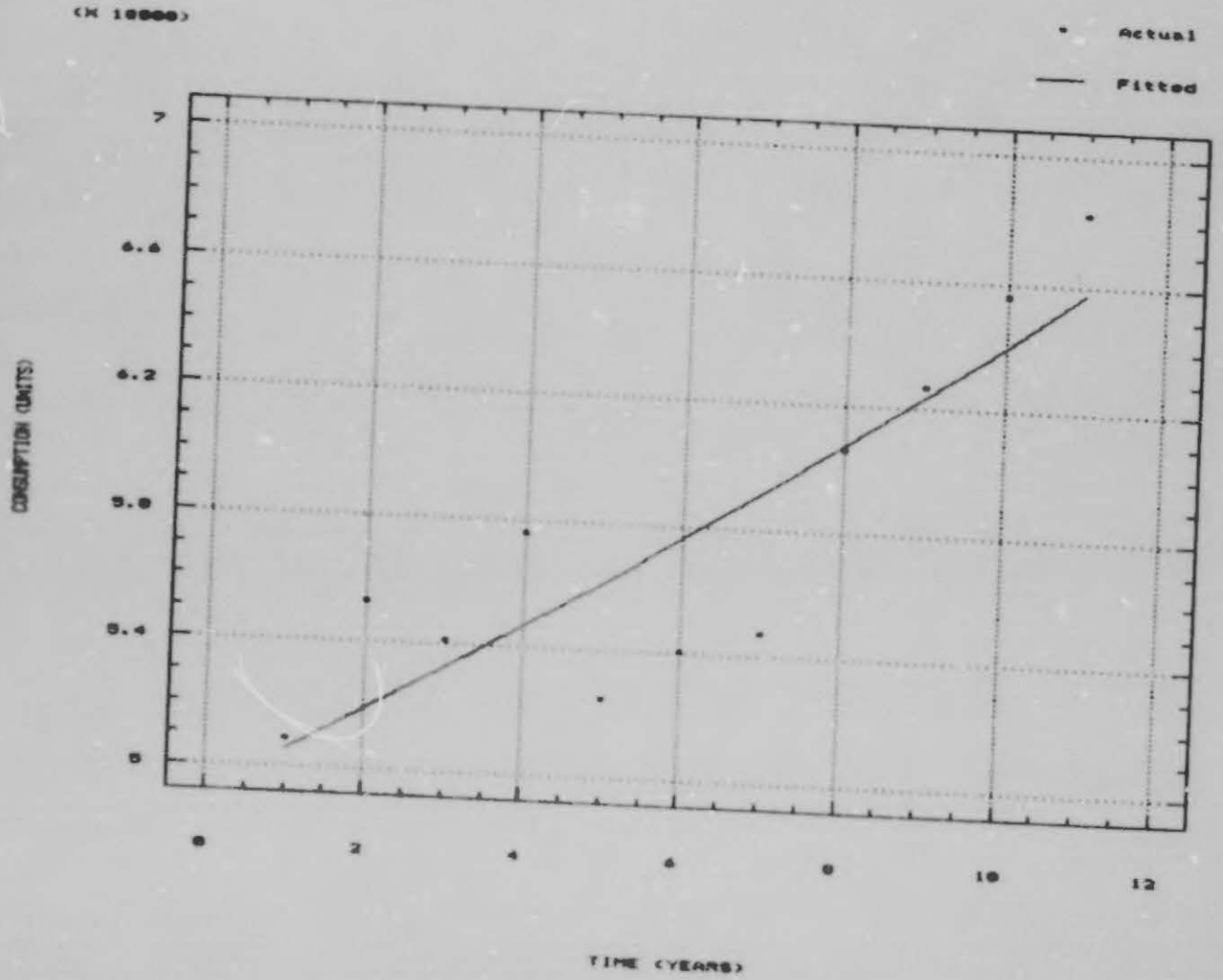

Figure 5.14: Observed values and secular trend of construction pole consumption by "jobbing" contractors.

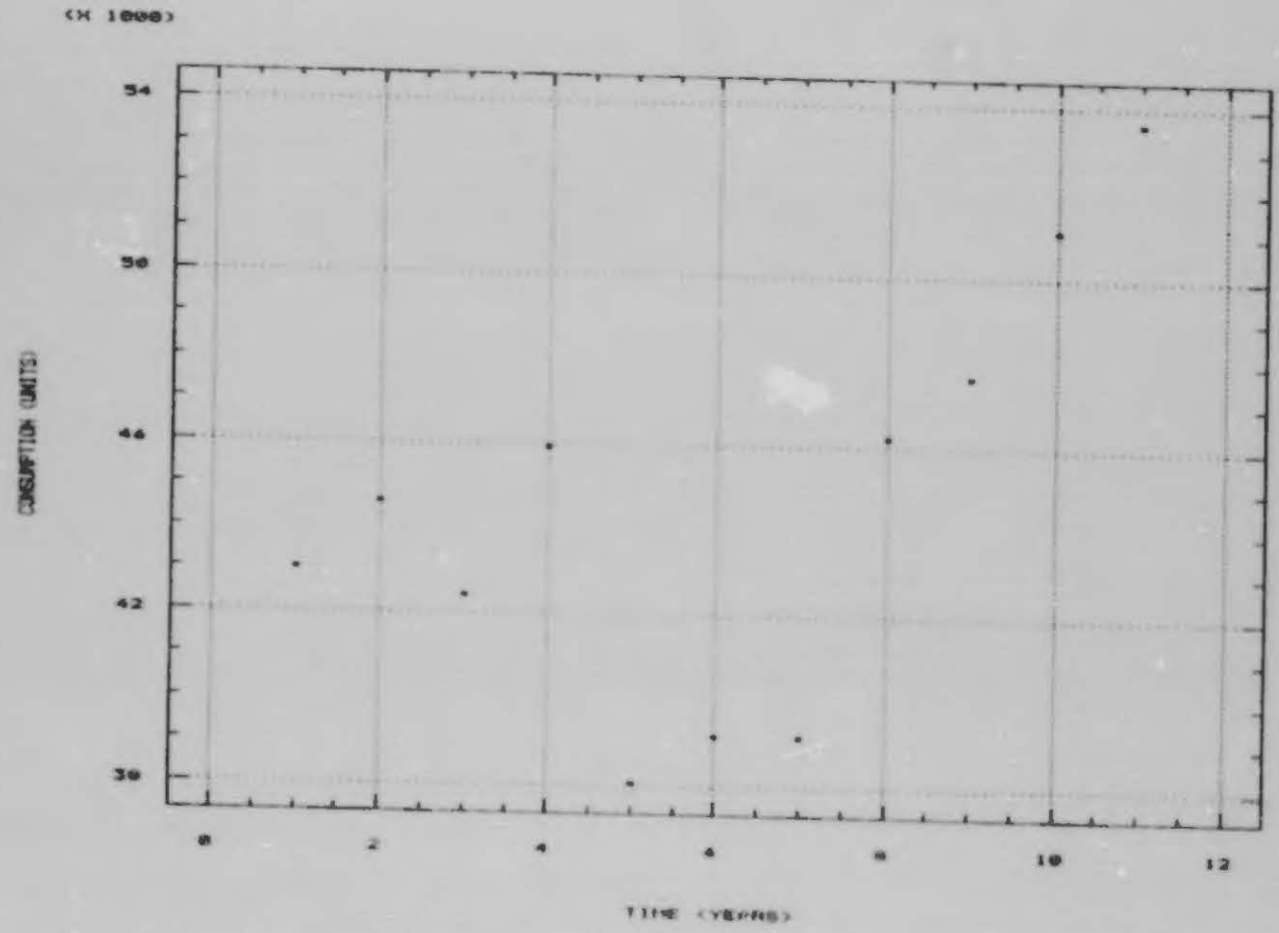

Figure 5.15: Scatterplot of construction pole consumption in the construction of kitchens and litrines.

Table 5 10 and Figure 5 16)

The compound growth model employed ($Y = a(1+b)^t$) gave the following coefficients

Coefficient of determination (R^2) = 90 3%

Coefficients (a) = 11,188

(b) = 0 090

The equation indicates an increase of 9% *per annum* in pole consumption as pestles for the period 1985 to 1995

These estimated values tend to increase with the population and household projections

(f) Pole consumption by construction companies in building construction indicated a positive trend throughout the 11 years period (refer to Figure 5 17 and Table 5 10)

The compound growth model ($Y = a(1+b)^t$) employed yielded the following regression coefficients

Coefficient of determination (R^2) = 88 8%

Coefficients (a) = 14,099

(b) = 0 098

The equation indicates an increase of 10% *per annum* in pole consumption for the period 1985 to 1995

5 4 3 Consumption of *Funtumia africana* logs

As already explained in Paragraph 5.3 3, the consumption of *Funtumia* logs by SLMICO followed a negative trend mostly due to the interruption of raw material supply during the civil conflict. The data was therefore not used in trend projection (refer to Table 5.12 and Figure 5 18).

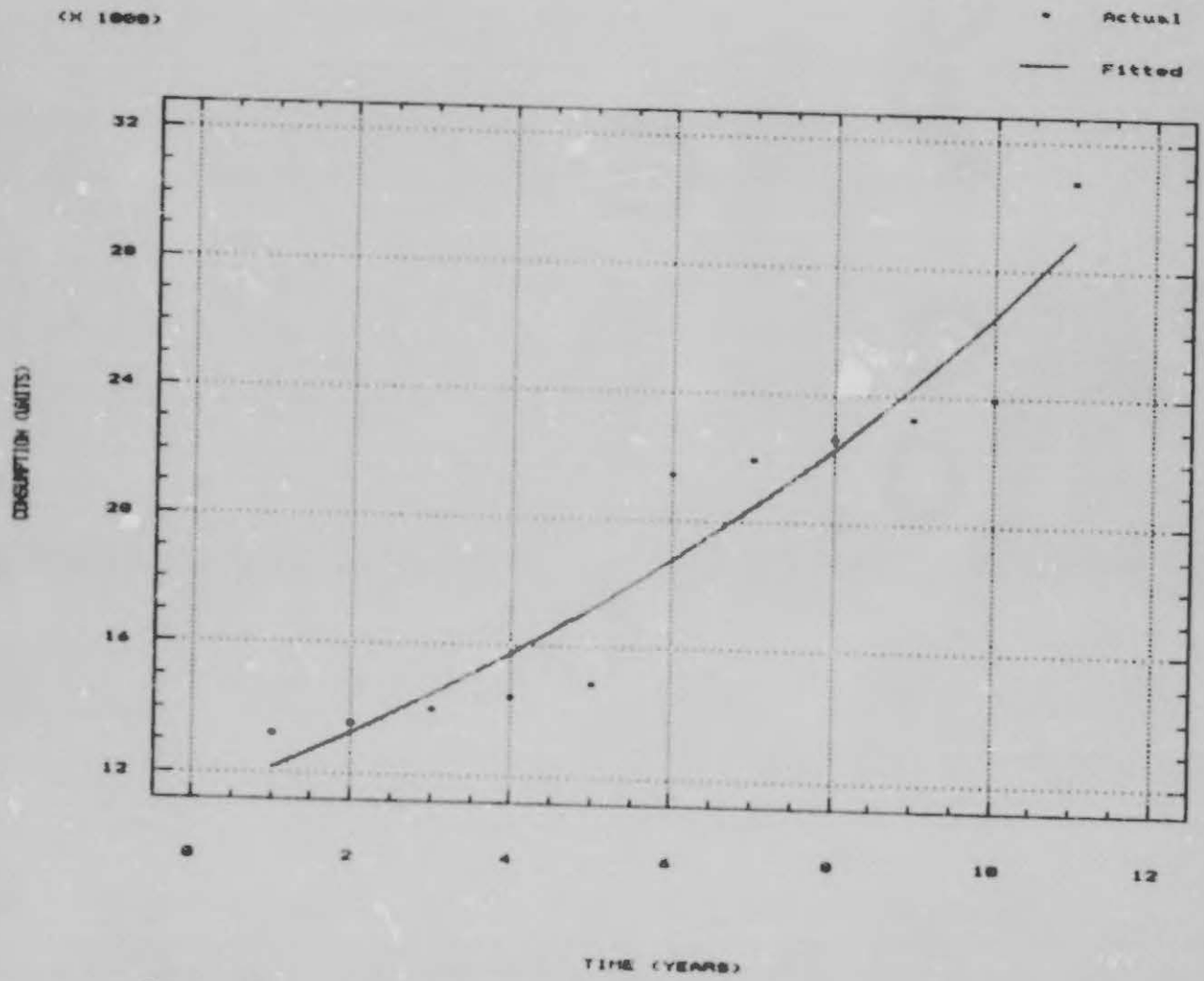

Figure 5.16: Secular trend of estimated construction pole requirements for pestles.

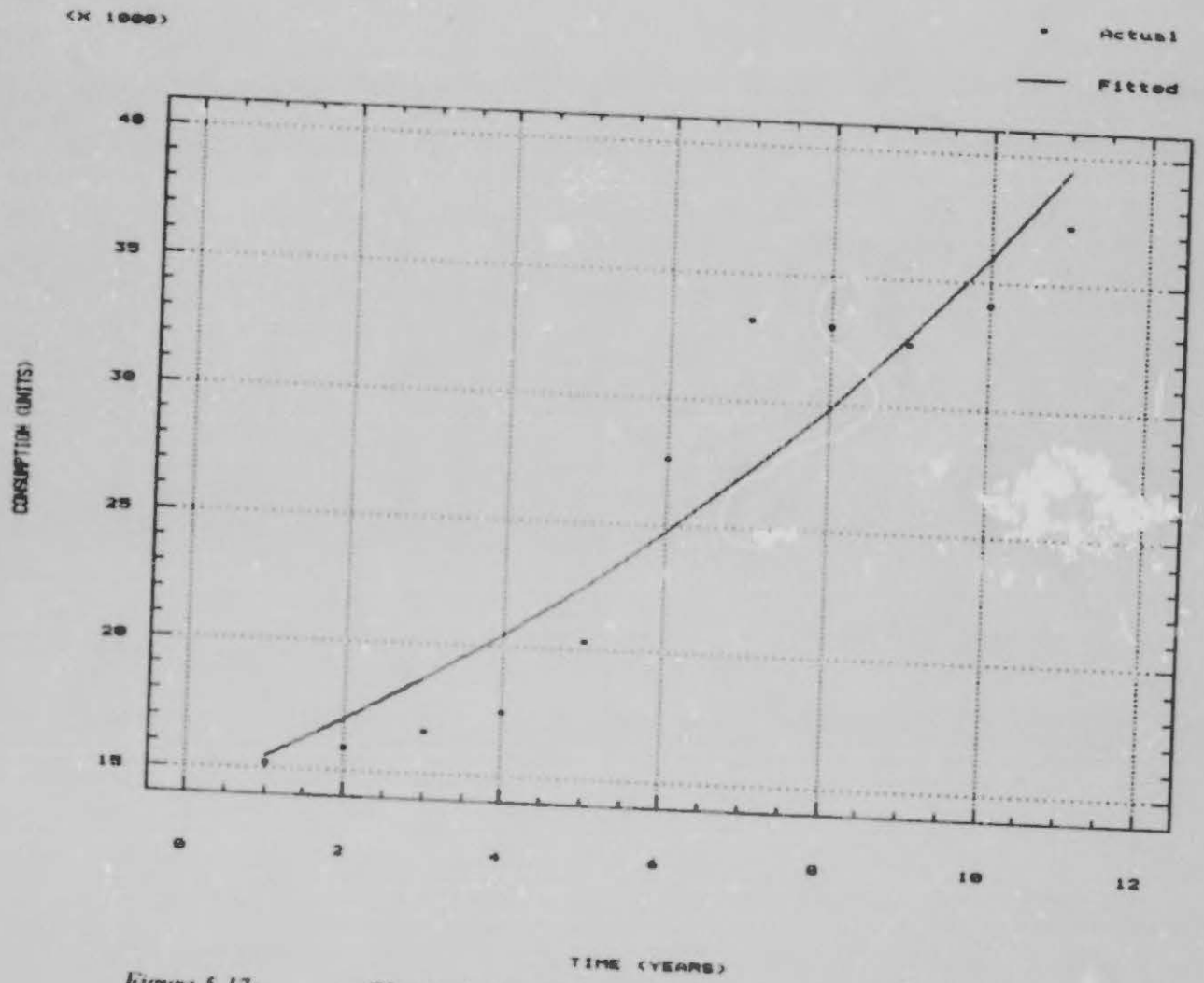

Figure 5.17: *Observed values and secular trend of construction pole consumption in building construction by construction companies.*

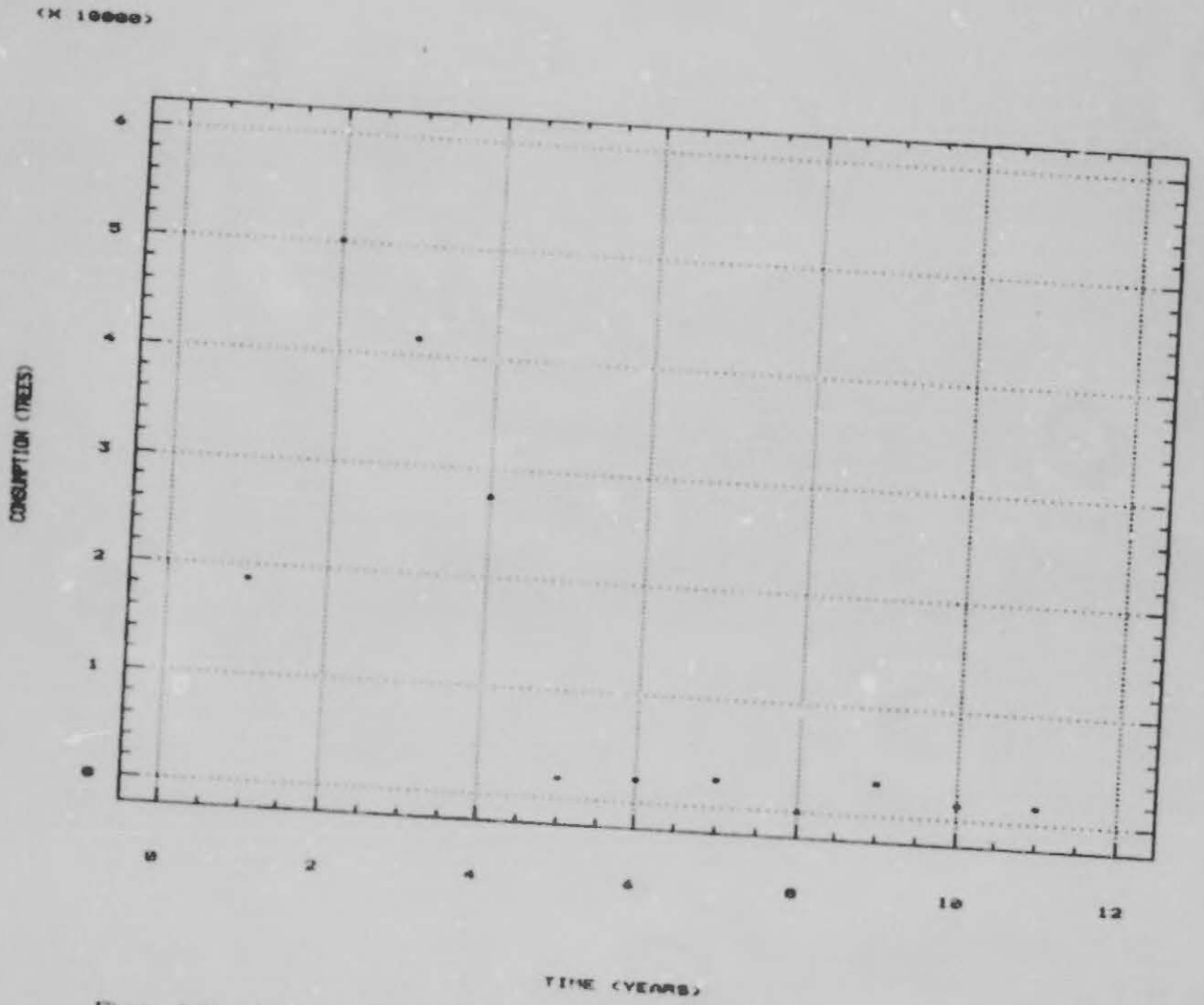

Figure 5.18. Scatterplot of Funtumia log consumption by SIMICO.

In some of the regression analyses, it was possible that a high order polynomial equation, for instance, could have given a high coefficient of determination but such a model wouldn't be utilisable for forecasting due to changing trends

5.5 External trade in forest products

Sierra Leone has spent between 1 6 million and 2 8 million US dollars on the importation of forest products and substitutes annually between 1985 and 1995 (refer to Table 5 13) These comprised mostly of paper products (35%), paperboard/hardboard (31%), registers, exercise books and similar items (17%), plastic chairs (10%), plywood (4%) and rattan and wooden chairs and stools comprising 1% of the total forest products import costs (refer to Table 5 14)

The remarkable devaluation of the "Leone" by 84% in 1989, 153% in 1990 and 95% in 1991, apart from reducing the customer's purchasing power, also reduces the actual amount of US dollars spent on these imports annually This is because the divisor in the conversion formula increases tremendously with devaluations Between 1985 and 1986, for instance, about US$ 55,000 was spent on the importation of these products (Lenau, 1988) In 1987 and 1990, about US$ 740,000 and US$ 3,200 were spent respectively on the importation of hoopwood and split poles

Hoopwood is a circular band or ring of wood used for binding together the staves of casks or tubs Split poles are poles split lengthwise and are mostly used for fencing.

Items imported mostly as furniture under personal effects were too small in value and quantity to be included in the survey Their importation does not normally entail the use of the nation's foreign reserves, as the incomes are mostly earned abroad in the form of allowances and salaries Also excluded from the survey were furniture items which were partly made of wood or those for which the type of material was not specified (refer to Table 5 15) Smuggled items were naturally excluded but this study asumes that these account for less than 10% of the total imports per year

Year	Value of imports of forest products (US$)	Value of imports of all products (US$)	Forest products imports as % of all imports
1987	2,052,262	120,162,000	2.4
1988	2,261,848	147,222,000	1.5
1989	1,650,852	174,213,000	0.9
1990	2,839,082	172,337,000	1.6
1992*	2,839,082	146,515,000	1.9
1993	2,971,950	153,571,000	1.9
1994	2,705,000	141,201,000	1.9

*There was no data for 1991

Table 5.13 Import value of forest products as percentage of total imports

Item	Total import cost (m Le)	Total products imports as % of of total imports
Sawnwood (NC)	8.2	1.0
Waste paper	31.5	4.1
Plywood	32.4	4.2
Wooden doors	2.4	0.3
Newsprint	5.8	0.7
Printing paper	25.6	3.4
Kraft paper	13.7	1.8
Cigarette paper	78.1	10.1
Packaging paper	34.2	4 5
Paperboard	116.1	15 2
Paperboard boxes	124 2	16.2
Writing blocks	22.6	3 0
Registers and books	110.5	14 5
Copy paper	9.1	1.2
Sanitary paper	49.3	6.5
Rattan chairs	10.7	1.4
Plastic chairs	79.8	10.4
Metal chairs	2.8	0.3
Wooden chairs	7.4	1 0

NC = non conferous

Table 5.14: *Importation of forest products and substitutes from 1987 tot 1994 (Source: Central Statistics Office, 1995)*

Year	Items imported	Quantity	Value of imported item	
			Leones	US dollars
1987	Unspecified plastic items	532	10,914,231	321,006.79
1988	Plastic items	496	7,391 183	230,974.46
	Metal filing cabinets	8,014	1,655,251	51,726.59
	Cabinets	8,014	1,655,251	51,726.59
	Matches	*120	45,000	1,406.25
1989	Unspecified articles of wood	13,632	1,847,847	20,769.43
	Match splints	*25	390,582	6,509.17
	Other furniture	307	3,660,827	61,013.78
	Wooden furniture	278	8,899,098	164,984.96
	Other furniture	638	8,986,762	149,779.36
1992	Metal chairs	236	4,171,000	30,463.16
	Other chairs	506	19,718,000	66,840.67
	Wooden furniture	999	5,325,000	18,050.84
	Unspecified articles of wood	250	6,179,000	20,945.76
	Metal furniture	18	36,000	122.03
1993	Match splints	*18	38,000	76.15
	Unspecified articles of wood	511	52,512,000	105,234.46
	Metal chairs	882	420,000,000	740,740.07
	Unspecified wooden furniture	184	696,337,000	1,228,100.75
	Furniture, material unspecified	492	500,000,000	881,834.21
1994	Metal chairs	544	23,066,000	39,361.77
	Other chairs	6,185	56,495,000	96,407 84

* = Boxes of match splints

Table 5.15. Importation of match splints and furniture (metal and unspecified materials) from 1987 to 1994

Although external trade in forest products comprised only 1% to 2% of the total annual imports (refer to Table 5.13), it is significant for a country with a high balance of trade deficits and limited foreign reserves.

6. CONCLUSIONS

6.1 Past demand for forest products

The least squares technique of regression analysis was employed to establish the past demand trends in Chapter 5 The compound growth model was used for all of the data as it described the trends better than the other six models Regression analysis for trend projection methods have been used by Buongiorno and Gilles (1987); Fildes and Howell (1979), LHA Management Consultants (1985, 1987 and 1992); FAO (1986) and Meier (1986)

6 1 1 Sawnwood

The overall annual demand for sawnwood for all five end users grew by 7% *per annum* over the 11-year period from 1985 to 1995 The annual growth in demand for sawnwood with respect to end users was as follows Construction companies (11%), carpentry companies (6%), carpentry workshops (7%), technical institutions (22%) and casket producers (5%) (refer to Paragraph 5 4 1 (a - e))

The large differences between total annual sawnwood sales and total consumption indicated in Table 5 8 was because 20% to 39% of the sawnwood consumed from 1985 to 1995 evaded the normal market system This was due to direct transportation of products from sources to individual stores Hence sales was not fully representative of consumption in this case

Sawnwood production by the two operational sawmills indicated a negative trend over the 11 years period (refer to Tables 5 5 and 5 6) while the pitsawyers and mobile sawmills supplemented the additional volume demanded The latter category produced an average of 57% of the sawnwood consumed in the Western Area from 1985 to 1995 (refer to Table 5 8). The trend in sawnwood production is expected to reverse following the end of the on-going civil conflict

This study revealed a *per capita* sawnwood consumption of 0 016m^3 for the Western Area which is higher than the estimate of Atlanta Industries (1979) and Kamau (1988) of 0 007m^3 and 0 005m^3 *per capita* respectively, nationwide

6.1 2 Construction poles

The annual growth in demand for construction poles for the six end users combined was 7.0%. Compared to sawnwood, the individual end users generally exhibited a relatively high annual growth in demand as follows "jobbing" contractors (3%), construction companies (10%), and pestle users (9%) Despite the high demand about 43% to 93% of poles consumed during the period evaded the normal market system (refer to Table 5 10) Production and direct consumption of the commodity, unlike for sawnwood, was common because its use does not entail any sophisticated processing after harvest

Kingston (1986) estimated a *per capita* pole consumption of 2 1 poles nation-wide but this study revealed 0 74 poles *per capita* for the Western Area Understandably, the rural communities which consume less sawnwood use more poles mostly for general construction, pestles, tool handles and furniture Hence the low consumption in the Western Area in general and particularly in Freetown

6 1 3 *Funtumia* logs

The annual intake of *Funtumia* logs by SLMICO indicated a negative trend over the 11 years period mainly due to the interruption of raw material supplies caused by the civil conflict (refer to Table 5 12) The other reasons are due to unfair competition, shortage of foreign currency for the necessary importations, and high cost of logs due to high fuel prices The disruption of supplies over the past three years was, however, the major determinant factor in log intake rather than the SLMICO's capacity The negative trend in demand for *Funtumia* logs is expected to be reversed following the end of the civil conflict

6.2 Factors affecting future demand

Future consumption of all three products will be affected by demand shifters, some of which have affected past demand These demand shifters have been found to vary both with product and end use as indicated below

6 2 1 Sawnwood

The demand for sawnwood will be affected by the following main factors

(a) The high price of the commodity affects its effective demand It is about eight times more expensive than equal volumes of construction poles or *Funtumia* logs (Kamau, 1988 and Hunter, 1989),

(b) The low level of employment could affect the procurement of sawnwood Less than 10% of the eligible population are employed (refer to Table 6 1 and Bank of Sierra Leone, 1995) The retrenchment of 30,000 government workers and further retrenchment plans will exacerbate the situation Salaries are generally low in comparison with other developing countries in the region (refer to Tables 6 2 and 6 3) This means that the worker's disposable income is too low to significantly influence sawnwood sales,

(c) Durability of wooden furniture and the use of wood preservatives entails slow replacement rates However, the following proposed activities could increase the demand for sawnwood

   (i) The increasing cost of upholstery materials may result in designs without upholstery but using high-value cabinet wood instead This may offset the need for upholsery decorations without significantly reducing the demand for sawnwood,

   (ii) The interior decoration and hard-furnishing of the proposed DLHE buildings and the replacement of 1,080 dwellings in the Western Area will be undertaken by construction and carpentry companies

   (iii) The need to repair or replace the current stock of furniture in dwellings and offices could increase the demand for sawnwood The absence of

Industry	Total number of persons employed in year									
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
All industries	74,406	81,212	76,587	78,197	88,153	83,240	59,381	56,800	53,247	31,538
Agriculture	5,951	7,051	7,090	7,262	9,529	9,694	7,030	4,835	2,755	408
Mining	6,348	6,357	6,896	5,845	6,850	6,244	4,837	3,321	3,378	-
Manufacturing	8,142	8,314	7,474	8,616	9,391	9,450	5,057	4,102	1,761	1,761
Construction	9,117	9,181	7,279	7,259	12,584	10,491	3,658	3,488	2,109	2,109
Power	2,116	2,182	2,188	2,713	2,208	2,259	2,154	2,272	2,305	2,310
Commerce	6,281	6,922	4,965	5,058	4,234	4,082	4,354	3,824	4,487	3,069
Transportation	7,474	8,019	7,545	7,718	7,774	8,221	4,499	3,413	1,646	1,883
Services	23,931	25,686	25,650	25,714	31,012	32,665	27,504	31,142	34,294	19,486
Others	7,046	7,500	7,500	8,012	4,571	134	288	403	512	512

Table 6.1: Employment profiles for daily-rated employees (1985 to 1994)

Salary scale	Highest salary		Salary scale	Highest salary	
	Leones	US$		Leones	US$
AA lower	781,297	822.0	C(E)TG	204,388	215.1
AA upper	871,048	16.9	C(E) 7	646,792	680.0
Group GA	1,125,360	,184.6	ESS	1,051,182	1106.5
Group HA	806,299	848.7	C(T)TG	211,716	222.8
Group A	1,632,464	17,185.0	CT7	646,792	680.8
Group B	1,501,701	1,580.7	F3	265,749	279.7
Group C	1,405,879	1,479.9	G3	270,681	284.9
Group D	1,316,934	1,386.2	H2	197,776	208.2
Group E	1,235,896	1,300.9	M	938,367	987.8
Group F	1,161,151	1,222.2	N8	646,792	680.0
Group G	1,081,944	1,138.8	P8	371,728	391.3
Group H	740,067	779.0	S5	172,422	181.5
Scale A Lower	562,008	591.6			
Scale A Upper	646,792	680.8			
Scale B4	646,792	690.8			

Table 6.2: Highest gross annual salaries per scale or group in the Sierra Leone Civil Service, effective January, 1996 (Source: Sierra Leone Government, 1996).

Country	Average# income	Average* purchase price	Ratio@ price/ income
Algeria	1,800DA	2,500DA	1:1.4
Benin	15,000CFA	55,000CFA	1:3.7
Burkina Faso	25,000CFA	100,000CFA	1:4.0
Cameroon	30,000CFA	80,000CFA	1:2.7
Centr. Afr. Rep.	10,000CFA	90,000CFA	1:9.0
R.P.Congo	33,000CFA	120,000CFA	1:3.6
Liberia	100$	450$	1:4.5
Malawi	60Ka	300Ka	1:5.0
Sierra Leone	500Le	15,000Le	1:30.0
Sudan	80SL	2,000SL	1:25.0

Exchange rates as at August 1988:

Algeria: 1US$ = 6 Dinar; Benin/Burkina Faso/ Cameroon Central African Rep./ Congo: 1US$ = 310 Fr CFA; Liberia: 1US$ = 1Lib$; Malawi: 1US$ = 3 Kwacha; Sierra Leone: 1US$ = 33Le Sudan: 1US$ = 2.2SL

#Average monthly income for skilled worker.
*Average sales price for species and quantity mix per m ^ 3.
@Average ratio gives the total amount of salaries for one m ^ 3 of sawnwood.

Table 6.3: Comparison of income to purchasing price of sawnwood in ten African countries (Source: Schmincke, 1988).

old furniture shops puts pressure on repair and replacement work which will increase the demand for sawnwood.

(d) Non-wood furniture items such as rattan, cane (raffia and bamboo), metal and plastic may reduce the demand for sawnwood but the overall demand for grade A sawnwood will be affected by the following factors:

(i) Rattan furniture substitutes wooden furniture but it is relatively more expensive as it is mostly preferred by tourists who can afford the high cost. Locally-made raffia cane furniture are very cheap but not readily available in large quantities in urban areas. Hence, these can not effectively substitute wooden or rattan furniture in these areas;

(ii) There could be a tendency for the heads of technical institutions to control the number of private carpentry jobs in future. The staff concerned are also involved in teaching and can only use free periods for private jobs. Due to relatively low overheads incurred by these producers however, the furniture will be slightly cheaper and would therefore be preferred by the few priviledged customers;

(iii) The need to furnish new schools including those affected by the civil conflict and to replace old furniture will tend to maintain the demand at forecast levels;

(iv) The frequent replacement of wooden furniture with metal types especially in schools and public houses will tend to slightly decrease the demand for sawnwood by this group. The need for frequent painting of metal chairs to prevent rust and improve their appearance may, however, weigh against metal furniture due to the added cost incurred and

(v) Companies producing sawnwood for their own operations may not be limited by the high cost of sawnwood in future, especially if cheap transport could be available.

(e) Increasing use of packaging wood mainly by the low income group (Kamau, 1988) could reduce the demand for sawnwood, as indicated below:

(i) The use of packaging material is more common with the carpentry workshops whose customers prefer rough and affordable furniture. There is however a tendency to replace these rough furniture as the family income level increases;

(ii) About 90% of the wooden crates have now been replaced by plastic crates in the two soft drink bottling companies. The replacement process will be completed by 1997. Some packaging wood is also used in the production of wooden crates. The design of the wooden crate allows for frequent breakages of bottles in transit especially on bad roads. This necessitated the change and

(iii) Pallet construction for the stacking of crates will continue to demand sawnwood at the rate of 80m^3 to 100m^3 *per annum* for the two bottling companies. Pallets used as refrigerator stands are often made of packaging wood. This does not therefore increase the demand for locally-sawn timber to any extent.

(f) Hiring of furniture for special gatherings could affect the demand for sawnwood. This new business of renting mostly plastic and metal furniture for weddings, funerals and other gatherings, is a significant step in reducing the demand for sawnwood. Current conditions of rent seem to be acceptable. This factor however, affects all furniture producers;

(g) The increasing use of metal doors for front and back entrances of dwellings and commercial buildings could reduce the demand for sawnwood. However, the volume of sawnwood normally consumed in the construction of doors is too small to cause any significant shift in demand;

(h) The need to rehabilitate towns affected by the civil conflict will increase the demand for sawnwood. According to King (1995), about 1,080 dwellings were destroyed in the Western Area and the immediate environs during the civil

conflict. Based on the low-cost housing estimate of $4m^3$ of sawnwood for a 3-bedroom concrete house with timber-structured roof, $4,320m^3$ of sawnwood will be required. The replacement exercise is expected to span a period of over 5 years due to funding and other limitations. The rehabilitation exercise could entail the injection of capital by funding agencies and countries (Sovula, 1995). The possible influx of personnel for the exercise, could increase housing needs in Freetown where they will initially be based;

(i) The installation of a civilian regime and the on-going peace process could restore confidence in the business sector. This could result in new infrastructural development thereby shifting the demand for sawnwood upwards. In addition, existing businesses may also expand over the next 5 years. This could result in increased housing needs and therefore the consumption of more sawnwood.

(j) The increase in normal death rates in line with population increases could increase the demand for sawnwood especially for Christians and the Fourah Bay community burials. The tradition of all Christians using caskets for burials will probably be amended with time and the respective circumstances. There is now a strong tendency to stain whitewood to make it look like redwood for some of these caskets as a cost saving measure. In a few instances, caskets are procurred abroad where the deaths occur prior to conveying the bodies to the country. This may decrease the demand for casket timber locally, depending on the frequency of such indirect casket importations;

(k) The use of hardboards in concrete casting of multi-storey buildings, is not very likely to affect demand significantly as only 10% to 15% of future buildings in Freetown will be affected. Apart from the fact that sawnwood used in concrete casting is re-usable, the total number of people currently renting casting boards is small and the expansion of the business will depend on the future cost of hardboards in relation to rough-sawn timber;

(l) Population increases which put additional demand on housing could shift the demand for sawnwood upwards. The proposed housing project of the Department of Lands, Housing and the Environment (DLHE) covering the next

10 years will utilise 1,981m^3 of sawnwood or 71,323 poles *per annum* in the Western Area over the period (Department of Lands, Housing and the Environment, 1994) and

(m) Increase in demand of especially rural dwellings due to population increases and shifts in the age structure from youth to adult will affect the demand for furniture and housing and therefore of sawnwood.

6.2.2 Construction poles

Future consumption of construction poles will be affected by the following factors:

(a) Durability of the commodity when used indoors results in slow replacement rates. When used as rafters in the roofs of buildings, for instance, *Anisophyllea laurina* poles could last for 20 years or more;

(b) The increasing use of metal scaffolds and props by the large building companies could reduce the demand for poles but the total number of new buildings erected per year will increase the demand for poles. These are expected to grow at the rate of 700 to 900 buildings *per annum*. These would require at least 38,000 to 43,000 poles *per annum*;

(c) The less frequent use of military tents due to a low military presence during civilian rule could increase the demand for poles for shed construction for gatherings;

(d) The increasing use of concrete fences which are more effective and durable could reduce the demand for construction poles which deteriorate rapidly with adverse weather;

(e) The use of sawnwood in place of poles in burials by the Fourah Bay Community could increase the demand for sawnwood at the expense of poles. However this group comprises only 5% to 10% of the Freetown population;

(f) The lull in rebel activities on the highways could reduce the transport cost of forest products and therefore the unit cost of poles. This may influence consumption positively;

(g) Demand for poles for the replacement of market stalls will increase. The structure of market stalls allows for the fast deterioration of poles since old corrugated aluminium sheets are often used with a high tendency to leak. During the rainy season these, mostly weak, roofs are sometimes either blown off or partly damaged thereby exposing the poles to rain. Once the poles are exposed to rain they deteriorate rapidly. It was found during this study that 20% to 30% of the stalls are replaced seasonally as the dealers try to occupy front positions in the dry season. Some of the stalls are less frequently used at this time and could even be demolished. Pole demand for the construction of refugee camps will be finally reduced to nil, following the end of the civil conflict;

(h) The utilization of packaging wood for the construction of market stalls could affect the demand for poles for that purpose. Unlike poles, packaging wood provides a flat and ideal surface when used as table tops for the display of wares;

(i) The increase in normal death rates in line with population increases will increase the demand for poles for funeral purposes. However, improvements in health-care services could dampen such increases. In the absence of proper records, as in the case of sawnwood for casket production, only estimates of pole consumption in funerals was made. At any rate the pattern in both cases indicated a slow growth over the 11-year period;

(j) The demand for pestles and mortars will tend to increase with population. According to a replacement rate of 5 years, pestles acquired in 1995 will be replaced in the year 2000. These replacements and the new supplies should be replaced by the year 2005. The 105,404m^3 of timber utilised for mortar construction will increase with normal population increases at a very slow replacement rate of 20 to 30 years (refer to Table 4.7);

(k) The proposed new dwellings in the Western Area will need poles for the construction of outdoor kitchens and latrines. At the normal rate of construction of 700 to 950 houses *per annum* in the Western Area, it would require these units for 70% to 80% of the new buildings and

(l) The proposed housing project mentioned in Paragraph 6.2.1(h) will require 105,000 poles for the mud-and-wattle houses with pole-structured roof.

6.2.3 *Funtumia* logs

The future demand for *Funtumia* logs will be affected by the following demand shifters:

(a) The likely employment of some match factory personnel in other establishments, if the resumption of operations are delayed for a very long time. This could affect log intake depending on how crucial the worker's operations are;

(b) The possible diversion of funds by management to other businesses on a temporary basis could influence the liquidity of SLMICO at the initial stages of resumption of operations;

(c) Possible damage of the company's machinery due to lack of use could increase down-time on resumption of operations. Delays will be inevitable when such maintenance operations involve the acquisition of parts from abroad;

(d) Foreign currency restrictions could affect the importation of production requirements and a possible decrease in demand for *Funtumia* logs;

(e) Demand for *Funtumia* logs for carvings will increase in line with population increases and with the status of development of the tourist industry. Tourists are the major purchasers of carvings and other handicrafts from curio shops;

(f) With the lull in the civil conflict and an end to hostilities in sight, normal match production operations could resume immediately;

(g) The need to make up for lost production could entail extra working time and therefore a high initial log intake;

(h) Log supply from the Moyamba District which is about 100km from Freetown could maximise profit by cutting down transport costs and

(i) The intensive use of matches for lighting homes and cooking by the poor communities will tend to increase the demand for this commodity in line with population growth. The low cost of the commodity and the ineffectiveness of anti-smoking campaigns could result in an increasing trend in future demand for matches for smoking. Exportation of matches to neighbouring countries could yield foreign currency for the importation of production requirements.

6.3 Demand forecasts

The demand shifters, discussed in Paragraph 6.2, are likely to influence the future demand for the respective products by end user as indicated below and in Table 6.4.

6.3.1 Demand for sawnwood

The demand shifters listed in Paragraph 6.2.1 will have the following effect on the different end users:

(a) Construction companies:

The past annual growth in demand by this end user was found to be 11% but due to the demand shifters mentioned earlier the future annual growth is estimated as 12%.

(b) Carpentry companies:

The increasing trend in the consumption of sawnwood by this end user which was found to be 6% *per annum* is likely to increase to 7.5% *per annum* due to the explanation given in Paragraph 6.2.1.

(c) Carpentry workshops:

The demand trend of the carpentry workshops is likely to be reduced from 7% *per*

	Sawnwood consumption forecasts (m^3)											
End user of sawnwood	Trend (%)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Construction companies	12.0	2,911	3,260	3,652	4,090	4,581	5,130	5,746	6,435	7,208	8,072	9,041
Carpentry companies	7.5	3,853	4,142	4,453	4,787	5,146	5,531	5,946	6,392	6,872	7,387	7,941
Carpentry workshops	4.7	3,852	4,138	4,332	4,536	4,876	5,105	5,345	5,596	5,859	6,135	6,423
Technical institutions	15.0	127	146	168	193	222	255	294	338	388	447	514
Casket production	5.0	226	237	249	262	275	288	303	318	334	351	369
Total sawnwood consumption	7.8	11,069	11,910	12,815	13,789	14,837	15,965	17,176	18,484	19,889	21,400	23,027
	Pole and Funtumia consumption forecasts (units)											
End user of poles and Funtumia	Trend (%)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Construction companies	10.5	37,253	41,185	45,487	50,283	55,541	61,372	67,816	74,937	82,806	91,500	101,108
Poultry	10.5	30,803	34,037	37,611	41,560	45,924	50,748	56,075	61,953	68,469	75,656	83,602
"Jobbing" contractors	4.0	68,225	70,954	73,792	76,744	79,744	83,006	86,326	89,779	93,371	97,105	100,990
Total pole consumption	8.6	374,089	406,272	441,211	479,155	520,326	565,113	613,713	664,492	723,811	786,059	853,660
Funtumia consumption by SLMSCO	5.0	50,185	52,694	55,329	58,095	61,000	64,050	67,253	70,615	74,146	78,853	81,746

Table 6.4: ***Forecast of sawnwood, pole and Funtumia demand according to adjusted growth trends***

annum to 4.7% *per annum* in the future

(d) Casket production:

The past growth rate of 5% *per annum*, which could have been higher but for some incidences of unreported deaths, seems reasonable especially towards the end of the civil conflict. This growth rate in demand could be maintained for the forecast period.

(e) Technical institutions:

The past annual demand for sawnwood by this user group was found to be 22% but this should be reduced to about 15% *per annum*.

(f) All end users:

The overall demand trend for sawnwood for all end users is likely to be increased from 7% to 7.6% *per annum*.

6.3.2 Demand for construction poles

The use of construction poles by the following end users will be affected by demand shifters mentioned in Paragraph 6.2.2.

(a) Funeral ceremonies:

Despite the absence of a clearly observed trend from the data, the demand trend for construction poles for funeral ceremonies is likely to increase in line with population increases in future.

(b) Pestles:

A past annual growth in demand of 9% *per annum* was obtained for this user group and this trend is likely to increase to 10.5% *per annum* in future.

(c) Kitchens and latrines:

The demand trend for poles for this end use is likely to increase in line with housing needs as 70% to 80% of new buildings would require these structures (Central Statistics Office, 1985).

(d) Market stalls and refugee camps:

Although there will be no demand for poles for the construction of refugee camps following the cessation of the civil conflict, the demand for poles for the construction of market stalls is likely to increase in line with population increases of the Western Area.

(e) Construction companies:

The annual growth rate in consumption of poles by this category is expected to increase from 10% to 10.5% *per annum*.

(f) "Jobbing" contractors:

The trend in the demand of poles in the structures of buildings by "jobbing" contractors is expected to increase from 3% to 4% *per annum*.

(g) All end users:

The trend for the overall demand for poles by all end users is likely to increase from 7% to 8.6% *per annum*.

6.3.3 Demand for *Funtumia* logs

The future demand trend of *Funtumia* trees will be affected by the demand shifters mentioned in Paragraph 6.2.3. Despite the decreasing demand trend observed from Table 5.12, however, the future demand trend for this commodity is likely to be 5.0% *per annum* in line with population increases for the poor communities in the Western Area and to make provision for the continuous exportation of matches to neighbouring countries (refer to Paragraph 6.2.3(i). The factory's capacity (refer to Paragraph 5.3.3) could cope with the scale of production.

7. FRAMEWORK OF THE STRATEGIC PLAN

7.1 Vision, goal and objectives

7.1.1 Vision

The vision of this strategic forestry development plan is the judicious management of the forest resources of the Western Area and the neighbouring supply regions, in order to ensure the sustainable production of forest products and the related services for the benefit of the community.

7.1.2 Overall goal

The overall goal of this plan is to ensure an adequate supply of sawnwood, construction poles and *Funtumia* logs for the development needs of the Western Area.

7.1.3 Objectives

This overall goal will be achieved through the following specific objectives:

(a) To supply the following commodities to the Western Area:

- (i) At least 11,283m^3 of white sawnwood by the year 2025;
- (ii) 853,660 Construction poles by the year 2005 and
- (iii) At least 81,746 mature *Funtumia africana* trees by the year 2010.

(b) To ensure sustainable landuse practices in comformity with the environmental concerns of the Western Area as enshrined in the Forestry Act (1988) and the enforcing Regulations of 1990 (Forestry Division, 1988 and 1990).

7.2 Sources of interim timber supply

7.2.1 Sawnwood

Kingston (1986) estimated a standing timber volume of 33.4m^3/ha in forest reserves and 21.3m^3/ha outside reserves in the natural forests of Sierra Leone. Schatens (1989) however, suggested 15m^3/ha based on a standing timber volume of similar forests in neighbouring Liberia and only for timber trees with a minimum merchantable diameter

at breast height of 60cm. This low estimate of standing timber volume seems reasonable as only 30 out of the 200 tree species in the closed forests (15%) are being harvested for timber at the moment.

Schatens (1989) also estimated that about 97,000m^3 of *Gmelina arborea* and 81,000m^3 of *Terminalia ivorensis* and a small proportion of other species, could be in the pre-1972 plantations nation-wide. The mean annual increment (MAI) of plantations, closed forests and forest regrowth are estimated by him as 3 to 5m^3/ha/yr, 2 to 4m^3/ha/yr and 2 to 3m^3/ha/yr respectively.

The total volume of standing timber in closed forests in the east of the country, from where the redwood is currently supplied, could therefore be estimated at 1,590,225m^3 on the basis of a standing timber volume of 15m^3/ha (assuming only 15% of the tree species are utilised for timber) and a total area of 106,015ha. However, the above high MAI estimate of 4m^3/ha/yr for closed forests will yield an annual exploitable volume of only 424,060m^3 for a total area of 106,015ha. This annual allowable cut could be harvested from the forests in the east of the country on a sustained yield basis.

Forest estates and salvage areas in the South West, North West, North Central and Western Area regions should supply the required whitewood timber for the Western Area in the interim until the planned plantations come into maturity (refer to Paragraph 7.3.1). The areas of forest estates in the four regions are indicated in Table 7.1.

Region	Forest reserves (ha)	Protected forests (ha)	Total forest area (ha)
Western Area	17,440.3	0.0	17,440.3
South West	3,578.0	299.0	3,877.0
North Central	52,446.4	8,653.2	61,099.6
North West	216.0	2,351.0	2,567.0
Total area of forests (ha)	73,680.7	11,303.2	84,983.9

Table 7.1: Areas of forest estates in the timber supply regions (Source: Forestry Division files, 1995).

Based on a total area of 84,983.9ha and this estimated standing timber volume of 15m³/ha, about 1,274,758.5m³ of timber could be exploitable in the four regions. From the high MAI estimate of 4m³/ha/yr for closed forests indicated earlier however, an annual allowable cut of only 339,935.6m³ can be harvested from a forest area of 84,983.9 on sustainable basis.

Although MAI records for the common plantation species of Sierra Leone were not available, figures quoted by Evans (1993) for other humid tropical regions could apply to the country (refer to Table 7.2).

Species	Country	MAI (m³/ha/yr.)
*Terminalia ivorensis**	Nigeria	10 - 12
*Triplochiton scleroxylon**	Cameroon	8
Tectona grandis	Tanzania	12
Gmelina arborea	Nigeria	15
Eucalyptus camaldulensis	Cameroon	5 - 10
E. grandis/urophylla+*	Brazil	60
Pinus caribaea var. hondurensis	Tanzania	up to 40

(* wide spacing)

(+ clonal hybrids)

Table 7.2: Mean annual increment of plantation species in the humid tropics (Source: Evans and Wood, 1993)

The eucalypts indicated in Table 7.2 are normally planted for fuelwood and poles while the rest of the species are grown for sawnwood in Sierra Leone.

Due to the long rotations and inadequate understanding of the silviculture of the so-called redwood species, supplies from natural forests of the eastern and other areas of the country must continue to satisfy this demand, as no redwood plantations will be established.

Panguma Sawmills and Forest Industries Corporation are likely to continue to export about 227m³ of redwood annually (refer to Tables 5.5 and 5.6). About 1,334m³ of

non-coniferous timber is likely to be imported annually for various projects nation-wide (refer to Table 7.3). It was not possible to determine what proportion of these sawnwood imports was solely utilised in the Western Area but the proportion could be quite substantial due to the economic importance of the region (refer to Paragraph 1.5(b)).

Year	Sawnwood imports (m^3)
1982 - 1986	2,805
1987	221
1988	8,285
1989	1,000
1990	276
1991	*
1992	330
1993	1,840
1994	1,260
Annual average	1,335

(* = no data available)

Table 7.3: Imports of sawnwood between 1982 and 1994 (Source: Central Statistics Office, 1995)

In order to reduce transportation costs, timber supply should be limited to forest estates and communal lands within 100km of Freetown. About 30% of the low-lying estates of the Western Area are planted mostly with fuelwood species (Koroma, 1995). On the basis of the planted area of 219ha and an estimated standing volume of $20m^3$/ha a total fuelwood or standing timber volume of $4,380m^3$ could be available for exploitation. However, calculations based on a high MAI of $5m^3$/ha/yr for timber plantations gives an annual allowable cut of only $1,095m^3$ for a plantation area of 219ha.

PLAN International in collaboration with the Forestry Division, assisted farmers to establish 400ha of *Acacia mangium* and *A. auriculiformis* woodlots in the Western Area between 1992 and 1994. Similarly, the FAO-Forestry Division Project assisted farmers to establish up to 1,000ha of the two species, and a small quantity of others

from 1985 to 1991 (Koroma, 1995). The *A.mangium* and *A.auriculiformis* plantations could provide sawlogs in about 25 years to augment sawnwood supplies The 1,400ha of plantations of the two species on farmers' fields should give a standing volume of 20,000m^3 at the time of clearfelling if managed for sawlog production.

7.2.2 Construction poles

There is no known plant density estimate of pole-stage *Anisophyllea laurina* plant populations on communal lands in the country However, studies by Sannoh (1993) and Lebbie (1988) indicate that the species is widely distributed in the country. Savill and Fox (1967) in an enumeration exercise, found 3 to 5 trees of more than 60cm diameter at breast height (DBH) per km^2 in the Gola Forest Reserve The Gola forests like the forests of the Western Area are the few remnants of the Upper Guinea Forest Block, hence similar species composition could be found in the latter forest. Since the species thrives well in forest regrowths and secondary forests, plant populations in disturbed forests of the Western Area could exceed 500 stems per km^2 as trees of lesser size classes could have indicated higher populations in that enumeration. However, the management objective of the Western Area forests does not entertain the exploitation of these forests for poles Hence the demand forecasts indicated in Chapter 6 will be met from plantations within and outside the region (refer to Paragraph 7 3.2). Natural stands of the species in the lowlands of the Western Area and from other regions could augment supplies from plantations. Poles are also obtained from *Gmelina arborea* stands for Agricultural Shows and other minor construction work at the moment

The volume of timber required for mortar construction (refer to Table 4.7) was not catered for because logging residue is often utilised and various indigenous tree species are presently utilised. If a whole tree is utilised, as many as 10 mortars of 1m height could be obtained as revealed by this study The demand for timber for this commodity is further reduced by its long durability (refer to Paragraph 6.2.2(j)).

7.2.3 *Funtumia* logs

Although there has been no recent studies on the density of *Funtumia africana* trees in parts of the Western Area, Savill and Fox (1967) quoted a density of 18 and 9 trees of

19cm to 39cm DBH and 39cm to 58cm DBH respectively per hectare in the Lalay Forest Reserve in the south of the country. Since this forest is similar in structure and composition to the forests of the Western Area, these estimates of *Funtumia* plant populations could apply to parts of the Western Area. It is likely that DBH classes less than 19cm, which were excluded from Savill and Fox's (1967) enumeration, could indicate higher densities in the Western Area.

It is however important to note that the Western Area Forest Reserves mainly serve a protection function. In addition, the natural *Funtumia* stands especially on low lands are expected to satisfy the traditional carving needs of the population while this study is aimed at producing plantation *Funtumia* logs solely for the match industry. The latter demands more *Funtumia* logs than the former. This is because other tree species are also used for carvings (Glyn-Davies and Richards, 1991) and carvings from other regions are also sold in Freetown. This use of alternative species and the sale of carvings from other regions in Freetown has no influence on the demand for *Funtumia* logs in the Western Area. Thus the total demand forecasts are to be catered for as indicated in Paragraph 7.3.3 below.

7.3 Balancing supply and demand

Timber plantation establishment will be deferred to the year 2000 because of the following reasons:

(i) The results of the plantation species trials proposed in Project S2 (refer to Paragraph 7.4) will eventually indicate the choice of suitable species for planting.

(ii) Funding and logistical constraints could delay the implementation of some of the proposed projects for even up to four years.

However, if funding and logistical constraints could be addressed adequately in a shorter time period, then the time for plantation establishment could be brought forward accordingly. Unlike construction poles and *Funtumia* trees, the choice of timber species to be planted was based on past experience and the results of this study.

There is very little knowledge of the silviculture of the potential pole species and *Funtumia africana* listed in Project S2.

7.3.1 Sawnwood

There are currently 1,274,083.5m^3 of standing timber in the 84,938.9ha of the four supply areas indicated in Table 7.1 and 1,590,225m^3 of standing timber in the 106,051ha of closed forests of the east of the country (refer to Paragraph 7.2.1) assuming a standing timber volume of 15m^3/ha. The annual allowable cuts indicated in Paragraph 7.2.1 will continue to satisfy the demand for sawnwood on the Freetown market until the whitewood timber plantations established in the year 2000 mature in 2025. Most of the timber supply indicated in Paragraph 7.2.1 should however be supplied from existing plantations in the Western Area as prices of current supplies are relatively high partly due to high transport costs. The aim is to make the Western Area self-sufficient in sawnwood supply. Experience gained during the civil conflict indicates the risks associated with product supplies over long distances. The demand forecasts in Table 7.4 indicate a demand of 56,807 timber trees by the year 2005. Of the 56,807 timber trees to be established yearly from the year 2000 to 2004, 51% will comprise of redwood while 49% will comprise of whitewood. Subsequent reviews of the plan in years 2005, 2010, 2015, 2020 and 2025 will ascertain whether the proportions of the two grades of timber are still valid and will take new demand forecasts for the years beyond 2005 into account.

The volume of redwood timber in closed high forests in the east of the country could adequately satisfy the demand for this grade throughout the life of this plan, if judicious management practices are maintained.

The Western Area lowlands could provide up to 730ha in the Fabaina and Waterloo forest reserves for the establishment of plantations. The possibility of using farmers' fields for the establishment of plantations is highly feasible on the basis of previous experience. The use of these communual lands is inevitable as a total land area of at least 2,840ha would be required for the establishment of timber plantations over the 25-year period.

However, the actual areas of these annual plantings should increase in line with the changing demand trend over the 25-year period. The actual areas will therefore be determined from the five-yearly reviews of the plan. Hunter (1989) estimated that *Pinus caribaea* plantations at Braford in the South-west of the country could attain a 40cm DBH in 25 years. The choice of rotation for the fast growing species recommended in project L2 was based on this estimate. Thinnings will be used as firewood for the Western Area market.

Sawnwood forecasts for the year 2005 (m^3)	23,027
Less 51% for redwood from natural forests	11,744
Less annual average sawnwood imports (m^3)	1,335
Plus average sawnwood exports (m^3)	277
Revised sawnwood forecast for the year 2005 (m^3)	10,225
Conversion factor for sawnwood to roundwood	2.5
Required roundwood volume by the year 2005 (m^3)	25,563
Volume of an average plantation tree at rotation age of 25 years (m^3)	0,45
Total number of trees required	56,807
Planting density @ 3.0m x 3.0m (s.p.ha)	1,111
Stand density at clear-felling (s.p.ha)	500
Land requirement in the year 2000 (ha)	114
Land required for sustention (ha)	2,840
Seedling requirements in year 2000 (inclusive of 30% allowance for beating up	164,650

(Values rounded to the nearest whole number, but actual values including decimals were used in the calculations)

Table 7.4: Determination of land and seedling requirements for timber tree plantings in the year 2000 and for sustainable production

7.3.2 Construction poles

Since the minimum rotation of the construction pole plantation species (or natural stands) is five years (Amoo-Gottfried, 1994 and Glyn-Davies and Richards, 1990), current sources of supply should continue until the first harvests of construction poles from plantations in the year 2005. Coppice rotations of *Anisophyllea laurina* will be managed until a reduction in coppice vigour necessitates the replanting of the site. Lebbie (1988) and Sannoh (1993) noted that *A. laurina* coppices well.

Current supplies of construction poles from within 100km of Freetown are expected to satisfy the demand for *A. laurina* poles until the year 2005. The proposed plantations to be established by the year 2000 should supply all 853,660 poles projected as a demand for the year 2005. Plantation establishment is deferred to the year 2000 for reasons explained in Paragraph 7.3. At least 1,109,758 seedlings of various construction pole tree species (inclusive of 30% for beating up) should be planted annually from the year 2000 to 2004 in order to sustain pole supplies (refer to Table 7.5). A total planting area of at least 960ha will be required for the establishment of these plantations. This area will increase annually on the basis of the change in the demand trend for construction poles over the forecast period and subsequent review periods. In addition, natural stands of *Anisophyllea* brought under management as proposed in Project S5 (refer to Paragraph 7.4) could augment plantation supplies of the sp.. ..s accordingly.

Construction pole forecasts for the year 2005 (poles)	853,660
Number of trees required by the year 2005	853,660
Seedling requirement (inclusive of 30% allowance for replacement of failures)	1,109,758
Recommended spacing	1.5m x 1.5m
Planting density (plants per ha)	4,444
Land requirement for planting in the year 2000 (ha)	192
Land required for sustained yield (ha)	960

(Values rounded to the nearest whole number, but actual values including decimals were used in the calculations)

Table 7.5: Determination of land and seedling requirements for new afforestation with pole species in the year 2000 and for sustainable production

Since the profitability of the pole-selling business is significantly influenced by transportation cos s, the supply of this commodity from the Western Area plantations and natural stands in the lowlands should be given priority. The actual volume of construction poles in the Western Area can not be easily estimated but whatever the case, supply from these natural sources especially on the highlands contravenes the management objectives of the forests of the Western Area. Thus pole supplies from plantations by the year 2005 should be encouraged as far as feasible.

7.3.3 *Funtumia* logs

Although there could as well be up to 50 *Funtumia* trees per hectare in some parts of the Western Area, this stock should be reserved for the satisfaction of traditional carving needs. This estimate of 50 trees per hectare is higher than the findings of Savill and Fox (1967) which excluded all *Funtumia* trees less than 19cm DBH as timber supply was the main objective of their enumeration. The Sierra Leone Match Industrial Company (SLMICO) has sometimes used *Funtumia* logs of less than 19cm mid diameter between 1985 and 1995 (refer to table 7.6).

Log mid-diameter* (cm)	Length of log (m)
17.8	0.70
20.3	0.70
22.9	0.70
25.4	0.70
27.9	0.70
30.5	0.70
33.0	0.70
35.6	0.70
38.1	0.70
40.6	0.70
Mean log diameter	29.2cms

* diameters recorded overbark

Table 7.6: Dimensions of Funtumia logs utilised by SLMICO from 1985 to 1995

The small diameter *Funtumia* trees could also be used for carving of spoons, clothes "paddles" and other small household items. The current demand from this end use is likely to be sustained as some of the carvings sold in Freetown are actually made in the other regions. In addition, other tree species are also utilised in carving (Glyn-Davies and Richards, 1991) This further reduces the demand for *Funtumia* for carving. The 81,746 *Funtumia* trees forecasted as a demand for the year 2005 for match splint production could be met from plantations within or in close proximity to the Western Area (refer to Tables 6.4 and 7 7) This entails the establishment of at least 236,131 *Funtumia* trees per year from the year 2000 to 2010 in order to sustain supplies. *Funtumia* plantation establishment should be deferred to the year 2000 for similar reasons given in Paragraph 7.3. A total planting area of 1,635ha will be required over the ten-year period. Current supplies should continue from existing sources until the plantations mature in the year 2010

The rotation of the species will be 10 years. Savill and Fox (1967) found that *Terminalia ivorensis* (which is a fast growing light demander like *Funtumia*) attained a height of 9.3m in 6 years and added a mean diameter increase of 2 43cm per year on a good site in the country If this growth performance could be applicable to *Funtumia*, a DBH of about 24cm could be attained in 10 years The Sierra Leone Match Industrial Company which had utilised logs with diameters ranging from 18cm to 40cm (a mean of 27cm) over the period 1985 to 1995 could utilise the small diameter logs. The pole species trial experiments (Project S2) (refer to Paragraph 7 4) would determine the optimum rotation of all the species *Funtumia* thinnings would be utilised for carvings of small household items and also for firewood. The proximity of the plantation to Freetown would reduce transport costs immensely.

At least 164ha of *Funtumia* plantations should be established annually for 10 years in order to sustain part of future supplies The actual plantation area required after the year 2000 will increase annually in line with the changing demand trend

Since there was no positive trend in the demand for *Funtumia* trees by SLMICO, the maximum consumption figure of 50,185 for 1986 was accepted for 1995 and increased by a trend of 5.0% per annum (in line with annual population growth for poor

communities in the country and making provision for exports) to obtain 81,746 trees in the year 2005 (refer to paragraph 6.3.3). The reason is that SLMICO confirmed, during this study, that the 1986 consumption figures should be attainable after the end of the civil conflict (refer to Paragraph 5.3.3).

Funtumia forecasts for the year 2005 (trees)	81,746
Planting density @ 3.0m × 3.0m (s.p.ha)	1,111
Stand density at clear-felling (s.p.ha)	500
Land requirement in year 2000 (ha)	163
Land required for sustention	1,635
Seedling requirements in year 2000 (inclusive of 30% allowance for beating up)	236,131

(Values rounded to the nearest whole number, but actual values including decimals were ued in the calculations)

s.p.ha = stems per hectare

Table 7.7: Determination of land and seedling requirements for Funtumia plantings in the year 2000 and for sustainable production

7.4 Development strategy

The following project profiles address the development of forest resources in the short-term.

Project S1

Extension coverage on the value of *Anisophyllea laurina* and *Funtumia africana*.
The main activities of this project will entail:

(a) Training workshop for field staff on the above;

(b) Sensitization of the local communities and

(c) Production of extension packages on the two species for both extension agents and farmers.

Project S2

Tr... for pole species in the Western Area.

The following categories of species should be tried on the basis of their growth performances in other parts of the country as reported by Savill and Fox (1967).

(a) Indigenous species:

Xylopia aethiopica

Anisophyllea laurina

Avicennia africana

Macaranga barteri

Harungana madagascariensis

Rhodognaphalon brevicuspe

Pentadesma butyracea

Allophylus africanus

Blighia welwitschii and

Trema guineensis

(b) Exotic species:

Eucalyptus grandis

E. camaldulensis

E. tereticornis

E. deglupta

E. urophylla

Albizia falcataria

Gliricidia sepium

Sesbania grandiflora

Acacia auriculiformis

A. mangium and

Leucaena leucocephala

National Academy of Sciences (1983) describes the growth requirements and uses of these exotic species.

Project S3

Identification of high density natural stands of *Anisophyllea laurina*, *Funtumia africana*, *Terminalia ivorensis* and *Gmelina arborea* in the North-central, North-western, South-western and Western Area regions.

The main activities of the project should entail the determination of the yield potential of stands of these species through the steps indicated below:

(a) Identify suitable stands of the four species;

(b) Estimate sizes of productive areas;

(c) Estimate age of forest or planting date, as applicable;

(d) Conduct a 5% inventory of stands to estimate standing timber volume and

(e) Plan the management of the communual lands with the local communities.

Project S4

Trial introduction of exotic pole species to the Western Area market.

The following species could be introduced for the provision of pestles, fencing materials, burial poles, and other rough construction work where *Anisophyllea* poles may be too valuable to use:

Cordia alliodora

Acacia mangium

A. auriculiformis

Gmelina arborea and

Leucoena leucocephala (K8 variety).

The first four species are readily available within 80km of Freetown. This study revealed that four other pole species were accepted on the market at the height of the rebel ambushes on the highways. Customers generally did not demand poles by species, they were rather interested in the physical characteristics. *Gmelina* poles are already used in the provinces (refer to Paragraph 7.2.2).

Project S5

Assessment of the pole and timber production potential of the Portloko District.

Most of the poles and rough-sawn timber currently supplying Freetown come from the Portloko District. The objective of this project is to either rehabilitate or completely plant-up some of these lands with *Gmelina arborea* and *Terminalia ivorensis* which dominate the rough-sawn timber market. The following activities should be undertaken:

(a) Estimate volume of timber in plantations and on communual lands;

(b) Estimate stand density for *Anisophyllea* and other alternative pole-producing species;

(c) Plant degraded areas with appropriate timber species and

(d) Identify natural stands of timber and poles for management in collaboration with the community.

Project S6

Trial introduction of other species to the match industry.

The following new species could be introduced to the industry for trial in match production as the use of only one species has proved to be risky at the time of civil conflicts:

Gmelina arborea

Gliricidia sepium

Acacia mangium

A.auriculiformis

Cordia alliodora

Canarium schweinfurthii and

Maesopsis eminii.

According to Gwaitta-Magumba (1996) the last two indigenous species are used by a match company in Uganda. All the species exhibit some degree of straightness, low density, cylindrical shape and low colouration, which are the main attributes preferred for match production. According to the SLMICO management, soaking of *Gmelina arborea* logs for 24 hours reduces their hardness thus making them more suitable for match production.

Project S7

Strengthen collaboration with the Guma Valley Water Company (GVWC) on catchment protection.

Management of the proposed project should enhance the management of the Guma catchment through some innovative steps in collaboration with GVWC. These could include:

(a) Funding of radio and television programmes on forest conservation in the Western Area;

(b) Support for the replanting of degraded portions of the catchment;

(c) Support for forest protection efforts around the Guma catchment and

(d) Produce extension materials for public education and hold consultative meetings with the local communities for ideal resource management practices.

Project S8

Strengthen collaboration with the local communities on forest management in the Western Area.

The main activities of this project could entail:

(a) Appointment of honourary forest guards;

(b) Harmonization of receipts and permit systems;

(c) Identification and replanting of heavily degraded areas;

(d) Regularization of the pricing system for forest products;

(e) Training of charcoal producers on efficient production methods and

(f) Involvement of wood cutters in tree planting and plantation maintenance.

The following project profiles address the long-term production strategy:

Project L1

Establishment of construction pole and *Funtumia africana* plantations (both within and outside forest reserves).

The following species could be established, within the Western Area as indicated below:

Anisophyllea laurina (960ha) and

Funtumia africana (1,635ha)

Other suitable construction pole species revealed by the pole species trial indicated in Project S2 should be planted in appropriate proportions as demanded by the market (refer to Paragraph 5.1.1)

The areas of plantations will be adjusted in line with the five-yearly reviews of this plan.

Project L2

Establishment of timber plantations both within and outside forest reserves.

The following timber species should be established in timber plantations over 25 years as indicated below:

Terminalia ivorensis (1,000 ha);

T. superba (280ha);

Gmelina arborea (1,000ha);

Tectona grandis (280ha) and

Triplochiton scleroxylon (280ha).

Although this list is based on the growth performances of the species within the country, site conditions would determine the choice of species for the Western Area. Additional fast growing species should be added as necessary to supply the sawnwood demand. This study revealed that most of the "white" sawnwood on the market in the Western Area comprises of *Terminalia ivorensis* and *Gmelina arborea*. The two species are also doing well on good sites in the country. Hence the need for their high planting proportions.

Project L3

Replanting of low-lying forest estates in the Western Area (Waterloo and Fabaina Forest Reserves).

The following main activities could be undertaken:

(a) Assess the extent of degraded areas,

(b) Replant areas with original or other species (as applicable) and

(c) Protect estates against wild fires in particular

Some of the recommended species in Project L1 above, could be planted in these reserves.

Project L4

Development of inland valley swamps.

These swamps will provide alternative farmlands to areas with high densities of *Anisophyllea*, *Terminalia*, *Funtumia* and *Gmelina* stands on communal lands. All swamp development programmes should be preceded by environmental impact assessment studies

The following main activities should be undertaken

(a) Determine areas of swamps in the regions concerned,

(b) Assess the status of development of the swamps,

(c) Determine the ownership of the swamps,

(d) Negotiate with landowners for joint management of *the Anisophyllea* stands,

(e) Seek funding for the development and or maintenance of developed swamps and

(f) Plan the use of swamps by families whose properties in the uplands are selected for the management of the four species.

7.5 Execution of the plan

7.5.1 Responsible agency

It is proposed that the Forestry Division of the Department of Agriculture and Forestry will, in collaboration with the following institutions, implement and execute the plan:

(a) Department of Lands, Housing and the Environment;

(b) Guma Valley Water Company;

(c) Sierra Leone Match Industrial Company ;

(d) The four rural district councils of the Western Area;

(e) The National Tourist Board and

(f) Department of Internal Affairs and Rural Development.

Natural resource management projects have recently developed a more participatory approach by incorporating local ideas into scientific resource amnagement (Watts, 1994 and Tanz and Howard, 1991). The executing agency should therefore ensure the full participation of the local communities at all stages of the project cycle in order to win their support and co-cperation.

The implementation of this plan will be effected under the aegis of the following policy documents which may have direct influence on it:

(a) The National Environmental Action Plan,

(b) The Agricultural Sector Master Plan and

(c) The National Forestry Action Plan.

The sawmills will collaborate indirectly in terms of the payment of reforestation fees which could partly support this plan. The proximity of these mills (at least 200km) to the Western Area could prohibit direct collaboration.

Funding agencies are expected to provide the necessary financial and logistical support for the implementation of the projects identified in this plan. The institutional capacity of the Forestry Division in terms of staff calibre and strength was described in Paragraph 2.6. The physical location of the proposed projects within close proximity to the Forestry Division Headquarters could be an added advantage in terms of follow-up visits by senior forestry staff and donor representatives.

7 5 2 Time frame

The implementation phases of this plan will be divided into three distinct time periods as follows:

(a) Short-term: This phase ranges from 3 to 5 years Projects S1 to S8 should be implemented during this phase as indicated in Paragraph 7 4 The first major review of the plan will be done at the end of this phase.

(b) Medium-term. This phase ranges from 5 to 10 years in which projects L1 to L4 should be implemented as indicated in Paragraph 7 4 The second major review of the plan will be done during this phase

(c) Long-term This phase ranges from 10 to 20 years Two major reviews of the plan will be effected in order to determine demand forecasts for all products for the next five years following the expiration of the 25-year period

The demand forecasts in Chapter 6 were limited to only 10 years but are subject to five-yearly reviews due to the advice of a number of authors Beckenstein (1979 and 1982), Lasserre and Thanhaiser (1982), Helmer (1979), Makridakis and Wheelwright (1982), and Page (1982) all cautioned against long projections as the forecasts could be overtaken by events and further stressed that forecasting the direction of change in a long term trend is, equally as important as the trend

7 5 3 Limitations

The supply of most of the products from plantations could be affected by some of the following conditions

(a) There is a fairly high incidence of wildfires in the lowlands of the Western Area. Plantations have to be established in these lowlands despite the high population densities and the relatively high incidences of fires. This is because the rugged terrain and environmental considerations for most of the highlands, weigh against production forestry practices there.

(b) Farmers may need assistance at all stages of the plantation work. These could include simple tools, chainsaws and transport facilities for the delivery of inputs and products. Funds for the engagement of additional labour would be required, as the farmers will still continue subsistence farming programmes.

(c) Some willing migrant farmers may not easily acquire land on a long-term basis for *Funtumia* log or pole production. This is due to the risk of ownership claims which are normally influenced by one's length of stay and the ownership of permanent crops on a piece of land.

(d) Reliance on natural stands especially from the east could entail higher prices for sawnwood due to high transport costs.

(e) The results of the species trial plantings will determine the choice of pole species. The adaptability of the fast growing exotics could ensure short rotations otherwise longer rotations would be envisaged.

(f) The acceptance of exotic species by the market will be crucial to the choice of alternative pole species.

(g) Food aid was very helpful in the development of farmer's woodlots referred to in Paragraph 7.3.1. This assistance should be only terminated when the first harvests generate funds to support subsequent operations.

(h) An annual deforestation rate of 6,000ha (refer to Paragraph 2.2) applies to all product supply regions. In addition, the two northern regions are also prone to more rampant wild fires in the dry season than the Western Area.

7.6 Recommendations for further research

This study has identified a few areas for further investigation. The categories of sawnwood producers, sawnwood substitution and the volumes of imported rough-sawn timber on the market could influence future forest management. Specifically, the following investigations are recommended:

7.6.1 Rattan use and trade

Rattan (*Eremospatha macrocarpa**) is a locally-produced furniture-timber substitute, that has lately become popular with both local and foreign customers. Local communities within and around rattan-growing areas, weave and sell rattan baskets, winnowing fans, fish traps and other household utensils. They now also sell rattan canes in bundles of 15 to 20 billets, to rattan furniture companies mostly based in Freetown (Forwai, 1995). While the shifting cultivation practices continue to deplete forest resources, it will be necessary to investigate the following aspects of rattan utilization and trade:

(a) Rattan species used in the weaving and furniture industries;

(b) Main locations of these species within the country;

(c) Regenerative potential of rattan and the edaphic, climatic and human influences on this potential;

(d) Possibility of swapping or reserving parcels of land with high densities of these rattan species to encourage their growth and regeneration and

(e) A comparative study of the profitability of the rattan furniture business to that of the wooden, metal and plastic types.

* *E. macrocarpa* is the preferred species for rope because of the ease with which it can be split and also due to its exceptional strength. *Laccosperma secondiflorum* is a large thick stemmed species (diameter 3 to 4cm) used to make furniture frames. *Eremospatha hookeri* is commonly used as chewing stick.

If rattan could partly substitute sawnwood in the furniture industry, some pressure could be released on Sierra Leone's forests for furniture timber. Experience from Nigeria suggests that rattan furniture has great potential in West Africa (Morakinya, 1994).

7 6 2 The value of the pitsawing industry

The pitsawing industry provides substantial volumes of rough-sawn timber for both the rural and urban markets Despite this significant contribution, the total number of sawyer groups and their annual output of sawnwood is unknown During the forestry sector review in 1989, this sector was targetted for training in the areas of environmental protection and conservation, improvements in log recovery, tree planting and plantation maintenance The following major investigations could throw light on their activities

(a) Number of pitsawyers and their annual production output,

(b) The number of saws and men per group,

(c) Types of saw maintenance equipment and tools used,

(d) Sustainability of groups and the frequency and seasonality of their operations and

(e) Previous attempts at the regeneration of exploited areas

7 6 3 Utilization of lesser-known indigenous species

Exploitation of timber species in Sierra Leone has been mostly influenced by local experience and the desire to satisfy First World markets Presently, only 30 out of the 200 timber species in the forests are harvested for sawnwood (Schatens, 1989) Some research into the potential timber species presently not utilised could be useful Policy measures in favour of the use of those species could help to reduce pressure on the so-called commercial timber species Timber species such as *Ceiba pentandra* are important commercial species in Ghana (Sarre, 1994) while they are mostly used as 1/2"x3"x12ft cover strips in Sierra Leone Thus the review of the lesser-known indigenous species used by neighbouring countries could make a good starting point.

7 6 4 The utilization of packaging wood

It was found in this study that packaging wood is currently used in the construction of pallets, cheap furniture, market tables and for doors and windows of low-standard

buildings. The official source of entry of this material is the Queen Elizabeth II Quay Determination of the volume of wood indirectly imported in this capacity annually, could indicate the minimum demand for imported rough-sawn timber. Sawmills may be producing this type of wood in remote areas where it may not be in demand. The value of this sawnwood however, may not justify the high cost of transportation to urban areas. The substituting role of rough-sawn timber could enhance the planning of future timber needs.

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