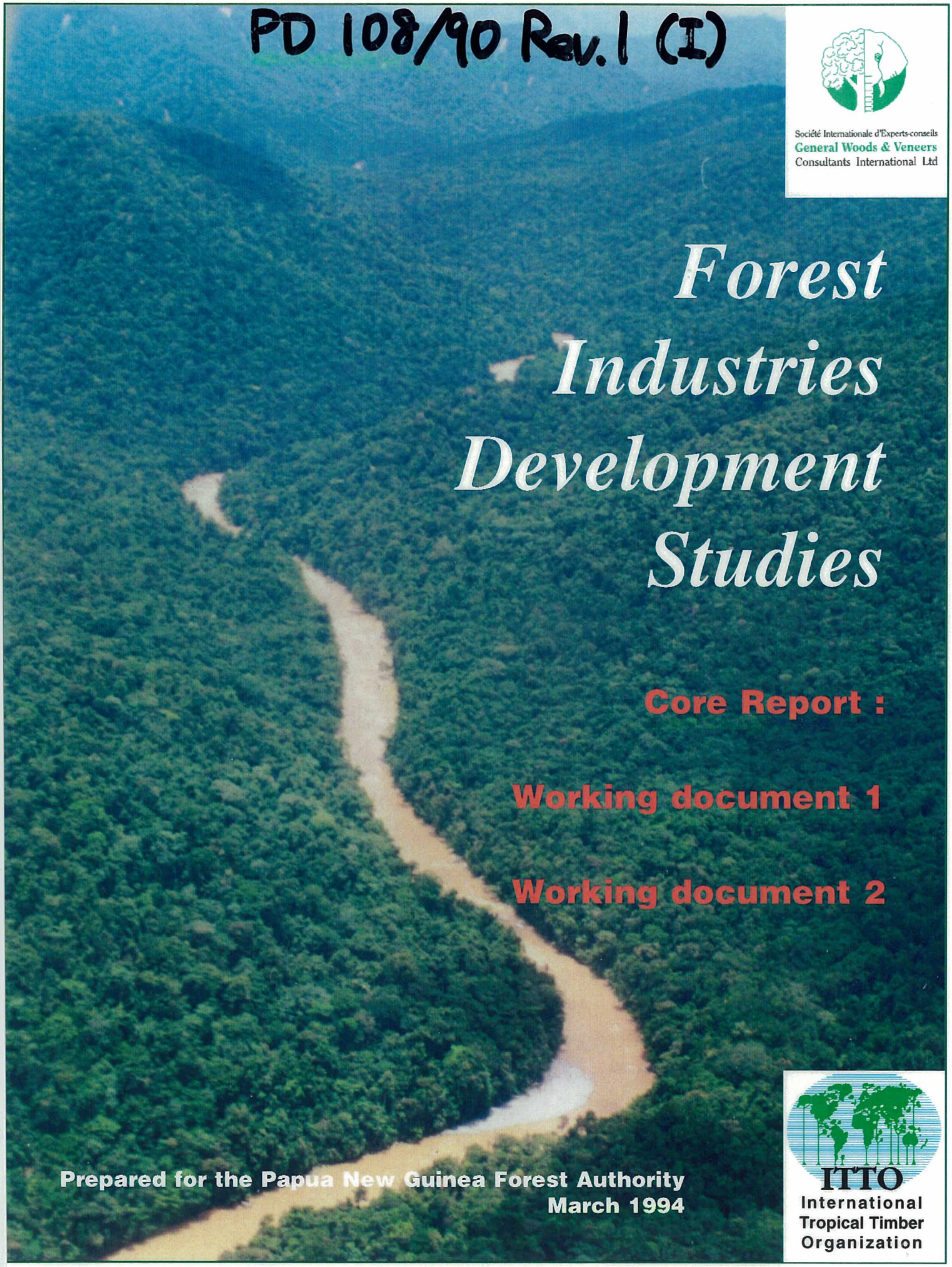
PD 108/90 Rev.1 (I)



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Forest Industries Development Studies

Core Report :

Working document 1

Working document 2

Prepared for the Papua New Guinea Forest Authority
March 1994

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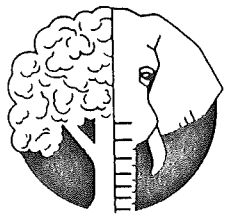

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FOREST INDUSTRIES DEVELOPMENT STUDIES
International Tropical Timber Organization
Project PD 108/90 Rev. I (I)

Core Report:
Summary, Conclusions and Recommendations

Working Document no. 1:
ITTO Terms of Reference
FIDS Project Inception
Sector Background Working Papers
Forest Sector Review

Working Document no. 2:
Industrial Processing Sector - Case Studies

Prepared for the

Papua New Guinea Forest Authority

by

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March 1994

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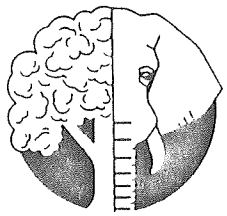

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1. INTRODUCTION

1.1 Background

The Forest Industries Development Studies Project (FIDS) has been conducted in PNG since July 1992, within the new National Forest Service of PNG (NFS), under the new National Forest Authority (NFA) and Forest Act. These new institutions, and plans for the FIDS Project were developed within the 1991 National Forestry and Conservation Action Plan (NFCAP) for PNG, led by the World Bank and a broad group of international donors.

Direct funding for the FIDS Project has been provided by the International Tropical Timber Organization (ITTO - Project PD 108/90 Rev. I (1) Yokahama) under the International Tropical Timber Agreement (ITTA). The Government of Papua New Guinea has also been a major contributor, through both direct project budget support and inputs from NFS staff.

Following an early situation report and detailed project plan, (Inception Report - September 1992), the project developed a detailed review of the status and trends of forest sector development in PNG (Sector Review - April 1993). This report included an outline strategy for the Government of PNG, together with the private sector timber owners and forest industry, to move towards government objectives of sustainable sector development, with enhanced domestic economic impact.

Since April 1992, more detailed case studies have been analyzed in forest revenue collection/distribution; domestic and international markets for PNG forest products; and potential small- to medium-scale, decentralized forest industry developments. These reconnaissance studies have provided background for more detailed forest sector policies and development strategies.

In May 1993, the new National Forest Authority drafted the National Forestry Development Guidelines, which have fundamentally re-oriented PNG forest policy. The FIDS team fully supports the new Guidelines.

The report presents the findings of the study team, and does not represent official policy of the Government of PNG, International Tropical Timber Organization, or other official national or international agency.

Background data and reasoning behind the conclusions and recommendations is provided in a series of Project Working Documents.

1.2 Objectives and Terms of Reference

The objectives and Terms of Reference for the Forest Industry Development Studies (FIDS) have undergone modifications since the original call for tenders. The resulting changes were necessary as new information became available in the form of sector working papers and the urgent timetable set by Government to establish a new Forest Authority and National Forestry Development Guidelines.

The Terms of Reference which covered this study can be found in the following documents:

- ITTO Call for tender documents - December 1991
- General Woods & Veneers/Nawitka Technical Proposal - January 1992
- Inception Report - September 26, 1992

1.3 Report Structure and Content

The overall study report is composed of:

i) the core report which crystallizes salient points of each of the FIDS sub-sector technical field reports. The information is intended for use by decision makers in drafting forest policy and national forestry development guidelines.

ii) Six separate working documents which provide technical details and analyses based on field studies which provide the detailed supporting information for the final report. They are:

Working Document no. 1	:	ITTO Terms of Reference FIDS Project Inception Report Sector Background Working Papers Forest Sector Review
Working Document no. 2	:	Industrial Processing Sector - Case Studies
Working Document no. 3	:	Harvesting and Transportation Review and Projection
Working Document no. 4	:	Financial and Economic Incentives in the Management of PNG's Forest Resources
Working Document no. 5[1]	:	Domestic Market Study
Working Document no. 6	:	International Market Study

This document is the Core Report. This study report provides a summary of the conclusions and recommendations of the FIDS team to the National Forest Service of PNG, for operational follow-up action to achieve the newly defined sustainable development objectives within the forest sector.

1.4 Round Table and Final Report

The draft report was distributed in December 1993 in Papua New Guinea by the PNG Forest Authority to representatives of the industry, NGO, landowners and Government for analysis and comments.

A national round table was held in Port Moresby on February 16, 1994 to present and discuss the report. No significant changes to the draft report were required from that Round Table. The final report was prepared in March 1994.

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[1] It is to be noted that WD 5 is not a study conducted by GWV or Nawitka Resources. It was a separate contract with Mr. M.N. Amin, Marketing Branch, PNG. It is however included in the overall study as the domestic component of the marketing analyses.

2. FIDS CONCLUSIONS - BY SUBSECTOR

2.1 Forest Resources

The historic importance of forests to community life across PNG is self-evident. During the 1990's the forest resources of the nation have become increasingly valuable economic assets, at the local level and in total, mainly through log exports.

Conservation of the natural wealth of these forest assets, while developing sustainable forest-based economic activities, is the principal goal of forest policy.

Economic pressure on these forests was in fact limited until the 1980's, due to inaccessibility and lack of knowledge of local species. The emerging economic value presents real opportunities for sustainable economic development, as well as significant risks to diverse natural systems and traditional uses.

Sustenance of forest ecology in PNG can no longer be assured by benign neglect and remoteness - it must become assured through explicit management systems.

Current forest information systems are clearly inadequate for modern forest management - inventory, growth and yield, and silvic systems are not defined at an operational level.

For purposes of the study, the FIDS team has accepted the initial CSIRO Rapid Resource Assessment (RRA) of 7.2 million hectares of production forest in the national forest estate. Using a conservative mean annual increment of commercial species of 0.5 m^3/ha provides an estimate of sustainable yield of 3.6 million m^3/annum. FIDS industry strategies have been limited to reaching this level, until adequate resource information becomes available.
The team believes that both the economic production forest area and the average mean annual increment can ultimately be increased (on a sustainable basis) through enhanced technologies of logging and silviculture.

2.2 Forest Ownership and Tenure

The dominant forest ownership pattern of PNG - through traditional Clan structures - presents important challenges in economic, social and environmental dimensions. This form of local ownership can closely approximate the efficiency and flexibility of private ownerships, while serving to nurture traditional family and community relationships during a period of tumultuous development and change.

The historic record is not too encouraging, however, as misunderstandings and exploitation by outsiders have tended to dominate over local control and equitable partnerships.

The FIDS team believes that improved systems of allocation to forest industries can and must be made more socially effective and economically efficient.

Three critical conditions have been identified for the achievement of improved tenurial relationships:

- enhanced local participation, training and control
- enhanced planning, programming and management systems (including trained staff) within the National Forest Service for this purpose
- reputable private sector partners with forest industry experience, equity capital and international market contacts.

The traditional approach of the Timber Rights Purchase (TRP) by the government, with subsequent issue of Timber permits (TP) to the industry minimized local (landowner) knowledge and participation, did not provide control or financing for forest management, and did not lead to development of sound partnerships or agreements with industry.

Further, the TRP approach tended to fragment timber holdings into units of uneconomic size, in relation to the scale requirements of factories in the forest industry and to the area needed for sustained forest yield.

The TRP-TP system definitely needed to be changed on grounds of effectiveness in achieving sector objectives, even without the extra impetus of the findings of the Barnett Commission - that there had been serious irregularities in the granting and monitoring processes.

The Forest Management Area (FMA) system proposed in the new National Forest Guidelines offers an improved approach to each of these problems:

- locally run partnerships/contracts with industries
- allowable harvest set at sustainable level
- current and new forest holdings consolidated into economic-sized units

2.3 Forest Revenue Systems

The forest tenure and forest revenue systems are the basic pillars of both conservation and economics in the forest sector of PNG. At the moment they resemble a tangle of impeding vines more than a solid foundation on which to build.

The forest revenue systems currently in place in PNG have also played a major role in the ineffectiveness of the forest sector in:

- achieving efficient/effective industrial development partnerships or other relationships for economic development of the sector
- achieving sustainable forms of forest management

Details are provided in the background documents, but the main resource revenue conclusions of the FIDS team are:

- a central stumpage system based on available resource rent should replace the current confusing mixture of royalties, export taxes and stumpage;
- an increased share of net forest revenue must be made available to landowner groups for investment (see below: Sec. 3.2 Forest Ownership and Tenure; Sec. 3.4 Forest Management for Sustained Production; Sec. 3.5 Forest Industries);
- the revenue system must also provide adequate support for sustenance of the National Forest Authority and National Forest Service to assure socially effective forest operations, sustained for the long term.

The recommendations of the FIDS team have been incorporated in National Forestry Guidelines for PNG, the contemporary blueprint of forest policy. Details are still under discussion with the Finance Department.

2.4 Forest Management for Sustained Production

A separate component of the National Forestry and Conservation Action Plan is dealing with detailed forest management prescriptions and definition of the basic new forest tenure - Forest Management Area (FMA) - for each local forest area.

However it is worth saying here that something over 80% of species and ecosystem conservation in most developed countries takes place in the production forest estate (that is where controlled harvesting takes place). The ratio may ultimately be different in PNG, but the principal is the same: genetic and ecosystem conservation can simply not be achieved through "lock-ups" of natural areas.

Socio-economic forces will ultimately dictate some human use for most lands in PNG -only appropriate forest management in production forest areas can establish forest values and assure their sustenance.

The FIDS project has focused its concern on particular areas of interaction with forest industry development, where sustainability of economic production may be at stake, and where industry practices may damage the sustainable productive capacity of the forest.

One of the primary areas of concern is in defining FMA's in terms of economically viable units, as well as ecologically sustainable units. The team believes that a close congruence between the rural processing centres and FMA's (in roundwood supply and ultimate ownership) will be essential.

The team also concluded that significantly increased care in harvesting can and should be exercised in PNG forest industry operations. This will require definition of improved harvest practices, formation of operational regulations, and monitoring of implementation.

The sustainable economic rate of harvesting needs better definition in all forest regions of PNG. The variables in need of improved definition include commercial volume per hectare, commercial size limits, and the sustainable ecological rate of harvest. Improved forest inventories and growth and yield information is a clear prerequisite.

The economics and the ecology of current residual stands need detailed study.

The FIDS team concluded that a relatively small area of industrial plantations would be economically viable and environmentally useful at widely disbursed locations in PNG. These plantations would serve the dual purpose of providing a sort of insurance policy on the production of valuable hardwood species, while offering an alternate supply to harvesting on steeper slopes and less ecologically desirable harvest zones, by about 2030 AD. (See below: Sec. 3.1 Forest Resources).

2.5 Forest Products Marketing

2.5.1 Domestic Markets - PNG

The total market for sawn and surfaced lumber in PNG is estimated to be 146,356 m^3. Plywood sales are estimated at 12,595 m^3, all of which is produced by PNG Forest Products of Bulolo. Particle board volume for 1993 is 9,027 m^3, imported from New Zealand and Australia.

The major markets are in the Central Province and the National Capital District (25%) mainly in Port Moresby - Morobe Province centered at Lae accounts for 25%. The Western Highlands Province centered at Mount Hagen accounts for 12%, West New Britain Province centered at Kimbe 8% and East New Britain, centered at Rabaul, 5%. Thus, about 75% of the local market will be in the major centers of these five provinces. Volumes are considered to be conservative because of the lack of an assured log supply by local producers resulting in irregular supplies and high internal costs. the local timber industry is protected by high import tariffs, e.g. sawntimber - 50%, plywood - 200%, furniture - 50% and fibreboard - 30%. The result, with few exceptions, has been high consumer prices and little incentive to modernize plants.

In terms of quality control, there is no national grading rule, although major producers do have their own in-house standards. Most producers offer unseasoned mixed species of "acceptable" quality with no official approval. Special species such as Kwila, Rosewood and Walnut are sold at premium prices.

The significance of the domestic market study is that when new modern plants are established in PNG, the local market is very limited. For detailed plant feasibility studies, special attention should be given to remanufacture of falldown items into exportable value-added products, such as solid door core panels, parquetry flooring, furniture components, pulp chips and as feedstock for a particle board plant.

2.5.2 International Markets

International trade in forest products by PNG is now virtually all in the form of log exports to Japan and to draw on for other forest products, the strategy should be to examine world markets and identify "target markets" best suited to PNG.

As a result of discussions with industry and trade officials in Australia, Singapore, Thailand and Japan, it has been concluded that extensive potential markets exist in Pacific Rim countries. The outlook is positive with regard to prices and growth potential in volumes which far exceed future PNG supply capabilities. Initially, target markets have been identified as Australia, Japan and California in the United States.

A) Australia

Annual imports of tropical sawn and surfaced timber are within the order of 170,000 m^3 and plywood of 70,000 m^3. The majority of these imports are sourced from Malaysia, the Philippines and Indonesia. Because of historical ties, Australian buyers have full knowledge and acceptance of over 20 PNG species. Very favourable bilateral trade agreements are in place and the market would be receptive to substantial contracts when steady assured supplies become available. Initially, the demand will be for rough and surfaced lumber in break bulk shipments. In value-added products, the most attractive products will be container shipments of mouldings, window frames and door stiles for housing construction.

B) Japan

In international terms, the world's largest importer and consumer of tropical timber is Japan, accounting for 50% of all tropical timber imports by industrialized countries and over 20% of world trade in tropical timber products. Wood consumption is directly correlated with housing starts. Tropical hardwood lumber imports in 1990 were 1,371,000 m^3 and plywood, 2,718,000 m^3. In 1989, 3.5 million m^3 of wood products was used in the furniture industry with a value of $ U.S. 9,600 million.

The diminishing supply of tropical hardwood logs will seriously impact on the timber industry in Japan. this will open the door to substitute materials, increased imports of temperate softwoods and replacements in value-added form. Value-added products will increase substantially, particularly in building products such as mouldings and joinery. The value of this category is expected to rise from $ U.S. 10 million in 1989 to $ U.S. 100 million by the year 2000. For the same period, imports of furniture parts will go from $ U.S. 100 million to $ U.S. 200 million by the turn of the century.

In summary, Japan is a huge and highly competitive market with demanding quality standards. The major PNG species are known and there will be a continuing strong demand for tropical hardwood forest products.

C) United States of America

The United States are essentially self-sufficient in softwoods and temperate hardwoods. Imports of tropical hardwood lumber are not large at 241,000 m^3, while plywood volume is substantial at 1,180,000 m^3. The most significant growth area in value-added products is furniture and furniture components which increased from $ U.S. 626 million in 1980 to $ U.S. 2,082 million in 1990. Initial market development should be directed at the Los Angeles, California area.

Additional markets with positive growth potential but requiring further research include China, Korea, Taiwan and Thailand. Steady but highly competitive markets exist in the United Kingdom and Europe.

2.6 Forest Industries

Production in the log export segment of the forest industry has grown at the rate of about 13% per annum over the past decade, including increases of over 50% per annum during the past two years. The average price per cubic metre has also increased, including a spike in value of nearly 100% during the past year.

The domestic wood processing industry is relatively obsolete and inefficient (with a few notable exceptions). In both the recovery of valuable product of m^3 of roundwood input, and in meeting international product standards, the industry could be radically improved with relatively small investments in technology and training.

The sawnwood and panel industry is currently stagnated in a weak supply position for even the domestic market by a range of economic, institutional and social factors. These are reported to include high internal costs, a volatile forest tenure system, the diverse nature of PNG forests, and the pressure of log export demands. Unless a major overhaul or reform of the industry is feasible within the private sector, the economic prospect for the sector is more of the same.

The economic opportunities for the sector should be much better. The PNG forest contains many valuable species, with growing market acceptance. There are excellent prospects in both export and domestic markets for quality products. Improved technologies of utilization (at relatively small scales) are now available. At normal efficient production costs, there is significant margin for profit at current prices, in both domestic and export markets.

Domestic prices of sawnwood are relatively high, even for mixed species (K350-K450/m^3). This is due in part to a protective tariff structure for sawnwood (20% for lumber, 50% and higher for panels and manufactured items). High prices are also due to a general scarcity of locally available timber, according to sawmillers and lumber wholesalers. The prices for high quality species (e.g. kwila, rosewood, walnut) are approximately equivalent to FAS (dock) export prices for sawnwood (k450-k750/m^3).

The current prices and the outlook for pulp and paper, or pulp chips are less favourable, but this set of products is not a major factor in PNG for the foreseeable future.

Log export values provide a generally sound expression of the economic value of the resource, given the existing industry structure of the region. One of the major factors is the existence of efficient manufacturing capacity in Japan, Korea and other centres - essentially based on log imports. Thailand has recently joined the ranks of log importers, due to overcutting and agricultural clearing in its own forests.

Several countries of the region with valuable forests still standing have expressed their unease with this structure by banning log exports (e.g. Indonesia, Malaysia). In fact these bans have been a major factor in the current price escalation.

The Government of PNG has also expressed its unease with the strength of the log export market, and the apparent weakness of domestic processing. Log export bans have been discussed in both academic and official conferences.

The FIDS team has concluded that a gradual phasedown of log exports, using the high resource rents generated to enact a locally based transformation of the wood processing industry, would provide a more sound path to sector development.

Both time and capital will be required to work through the initial stages of establishing an efficient wood manufacturing subsector in PNG forest industry. Financially strong, technically competent partners with international market connections must be sought. Some degree of log exports can provide positive assistance to each of these steps. Purely domestic (PNG) problems must also be addressed.

In their analysis of the industry, the FIDS team has identified a few basic problems or constraints which must be overcome to achieve the potential of the PNG forest sector. They are as follows.

2.6.1 Timber Ownership

Timber ownership or, more accurately, the separation of economic timber rent from timber ownership (through government purchase arrangements and export taxes), which exacerbates the current local structure of timber ownership versus industry ownership.

There is no direct means of arbitration/remediation between timber owner and industry, when the rent is in the hands of government. Further, local knowledge of the industry realities is weak to non-existent. In the past these "created" economic conflicts within timbersheds have led to landowner dissatisfaction and lack of decision information at the local level: These problems in turn have led to many disruptions of economic operations.

Private/community ownership should be an advantage, not a disadvantage. The team believes that one helpful approach to the problem will be to generate and sensibly allocate increased capital, technology and infrastructure at the local level to enable meaningful local participation in forest industry development.

To effect this enhancement of local capacity, the FIDS team has proposed that a portion of log export revenues be deposited in a series of local development funds (FMA Trust Funds) during a transition period of log export phase-down (see below: Sec. 3.3 Forest Revenue Systems).

This would go a long way towards increasing local participation and easing many of the communications/conflict-of-interest problems.

All such investments, out of FMA Trust Funds, should be subject to bank-type financial criteria, and local development criteria being satisfied.

Continuing separation of the bulk of forest revenue from the legal forest owners will be a sure prescription for expanded forest destruction, and likely forest sector stagnation or decline.

2.6.2 Geography of Forest Resources and PNG Communities

The geography of forest resources and PNG communities may impede industrial development. Scattered along five thousand kilometres of marine shoreline, including vast swampy rivers and/or steep terrain, PNG forest resources present great challenges of economic location.

The FIDS has concluded that a decentralized industry structure at the primary industry base offers the best practical development strategy under PNG conditions. This will be coupled with centralized final manufacturing and export facilities at major ports (See below: Sec. 3.5 Forest Industries).

This basic strategy for viable local forest industries will require development of a few innovative intra-industry and export marketing structures/organizations.

An additional requirement is an enhanced marine transport sub-sector within the forest sector (see below: Sec. 2.7 Essential Infrastructure).

2.6.3 Domestic Shortage of Skilled Manpower and High Wages

A domestic shortage of skilled manpower and relatively high wages due to demand in the mining sector and other rapidly developing sectors; exacerbated by a relatively small pool of skilled PNG personnel and a weak school system.

Production plant labour has been observed by the team to be relatively effective in performance of job activities and responsibilities. Many of the larger plants have developed their own apprenticeship-training programs, for specialized skills such as "saw-doctors", mechanics and electricians.

The FIDS team concluded that this problem is soluble in the short term through the use of modern intermediate technology which is labour saving, but not excessively complex, supplemented by an active program of seeking competent international partners. The bulk of training will take place within each mill centre, with some specialized trades supported by the industrial training school at Lae.

For the longer term, local skills must be expanded through both domestic and international training.

2.6.4 PNG Tree Species Unknown to World Market

PNG tree species are not well known in world markets. The steady expansion of log exports from PNG, with recent acceleration, indicates that this problem is being eased, and that producers in Japan and Korea at least find valuable properties in many of these species. The list of high value species is still relatively short, but can be expected to increase with time and further application of technology.

One of the objectives in maintaining some flow of log exports is to continue to obtain the knowledge benefits of the application of foreign technology in each target market.

The principal export problem for a revitalized wood processing industry in PNG will be to maintain a high level of quality control in all operations. This should also be an objective for the domestic market - providing sub-standard products locally, behind tariff protection is not a sound path to sustained development.

Market prospects for tropical hardwoods in general appear favourable through the 1990's and beyond. Potential export market "niches" available to the processing sector include all of those end uses to which export log buyers are currently applying PNG logs. In addition, processors should ultimately reach offshore markets for tertiary, high value manufactured products (furniture, fixtures).

2.6.5 Grades, Standards and Inspection Services

In commercial trading of forest products, a sales contract is an agreement between buyer and seller based on a mutually agreement as to grades and/or standards. An independent impartial third party inspection service is needed to certify that the species, quality and tallies are correct. These papers in turn are vital documents in final clearance for shipping and processing payments to the exporter. Such an inspection service must be established in PNG.

The most successful model to follow would be the Malaysian Grading Rule and its system for inspection services. The draft PNG grading rule, which was reportedly shelved for lack of interest, should be reinstated and completed. An updated PNG timber handbook on commercial species is also needed for this basic support package and made available for industry and the market place.

2.7 Essential Infrastructure

The main questions of sector infrastructure are governed by the expected/planned location(s) of the industry. The satellite mill is intended for location fairly close to logging operations, and preferably adjacent to a coastal log yard. There are a large number of suitable locations (e.g. south coast of New Britain, West and East Sepik, Northern Province, Milne Bay, Central and Gulf coasts, and in barge accessible regions of the large rivers).

The integrated mill complexes would likely require grid electric power and a proficient deep-sea port facility.

At present there are several ports in PNG capable of shipping quality forest products overseas (e.g. Port Moresby, Lae, Madang, Rabaul). There is ample capacity in international shipping, and reasonable rates for bulk shipments. Some of these centres might require significant electric power supplements for some ultimate forest industry proposals. These should be largely self-financing.

The team concluded that no massive investment in infrastructure (e.g. new ports, major power supplies) was feasible, or needed in the first stages. The existing serviced port centres (Moresby, Lae, Madang) would suffice for some time during initial sector development investments. Decentralized centres can use relatively small diesel-electric power systems and domestic marine transport to ports.

However, an important conclusion of the team is that parts of the domestic marine transport industry do need reform or restructuring for defined forest sector purposes. There are many crude log load-outs placed along the PNG coast at present, but few are capable of handling anything but very small barges. Most could be inexpensively upgraded to handle larger (say 110 m.) crane barges, onto which both logs and timber could be efficiently loaded.

The coastlines and large river systems of PNG are similar to those in may other countries. There is little need to invent new systems. Some modification of systems already in place (e.g. on slow-moving, winding river systems) should lower the cost of transport.

Specific actions will be needed to facilitate interchange of forest products along the coast of PNG, at each stage of intermediate product - logs, rough-sawn green lumber, sawmill residuals (sawdust, wood chips) and finished products.

Most of the required services could be provided by the existing industry, but current costs appear excessive. Many studies in other sectors have reached the same conclusion, but the PNG marine transport industry has been slow to change. The forest sector will have to organize independent action in this field if these costs cannot be reduced.

Effective marine transport will enable efficient utilization of each species and size of log, at the most appropriate centre. It will also link the decentralized processing centres together into one viable industry, with the potential to export valuable products at international standards.

3. FIDS RECOMMENDATIONS - BY SUBSECTOR

3.1 Forest Resources

The team recommends that all harvesting from natural forests be placed on a sustainable basis as a top priority in Government of PNG sustainable development and environment protection policy.

This will require carefully planned and sequenced actions in forest monitoring, forest tenure allocation and cut control, industrial harvesting practices, and forest renewal (see following sections).

The recommended principles involved include:

- there must be improved forest resource information systems, including growth and yield information, to assure sustainable forest management in each defined FMA unit;

- permitted harvesting practices must be defined in sufficient detail to enable monitoring of operator performance (sample activity definitions and regulations are included in the project working document on harvesting and transport);

- existing Timber Permits should be revised in an equitable manner to assure their original intent: sustained yield of commercial forest products;

- allowable harvest must be projected for each FMA based on scientific inventories of existing volumes, and temporary estimates of growth and yield, until data on the latter can be accumulated in practice. This dictates a conservative approach in the short run, to assure sustainability;

- a mixed strategy of selection harvest in natural stands, coupled with a plantation program of valuable hardwoods on previously deforested lands should be pursued to provide a relatively secure and ecologically balanced approach to sustaining local harvest of valuable wood in each FMA (see Sustainable Forest Management below).

Many details need further work, but strategic forest resource advantages foreseen through such a program include:

- assurance of sustainable, local, forest-based economic development;
- future conservation of less accessible, more environmentally sensitive hill forests;
- improved biotic conservation of selectively logged stands for future production of valuable wood and as habitat for all natural flora and fauna;
- future reductions of harvesting and processing costs;
- significant involvement land/forest owner groups in all FMA activities;
- more economic land use with positive soil/water impacts.

The team recommends a focussed approach to bilateral donor agencies (e.g. FMA-centred basis) for technical assistance in ecological baseline-forest inventory, plantation studies and FMA development/management pilot programs. NFA-NFS will have to develop guidelines and standards (with technical assistance if necessary), but several pilot studies could proceed once this is done.

The required forest inventory, forest monitoring and FMA development effort during the next five years should be made a major vehicle for training NFS staff. There are few better ways to train field-oriented foresters.

3.2 Forest Ownership and Tenure

The team recommends that local ownership, control, and management of communal forests (including re-investment in forest sustenance), together with local investment in forest product processing, be strengthened in all cases as a matter of long run forest policy.

Likely the most important tool to achieve this objective is forest revenue policy (see below: Forest Revenue Systems).

A second important tool in enhanced local control and resource sustenance is the proposed new forest tenure system: Forest Management Areas (FMA), to be defined as local units of sustainable production forest.

The FIDS team recommends that existing TP agreements be converted and consolidated within new FMA agreements as soon as possible, to create sustainable forest management units, linked to economic forest product manufacturing units - of the recommended satellite and central processing types (see below).

A second important area of change should be in local knowledge and control of forest management. The team recommends that local persons, with an emphasis on youth, be trained in field forestry techniques during all FMA inventories and field studies. NFA-NFS should assure the training of local FMA officers/foresters in each timber supply area.

As industrial partners are found and feasible operations defined, local persons should be involved and trained at each stage. Whether or not the community decides to invest in wood processing, a basic knowledge of industry operations by the land/timber-owner is essential to a harmonious economic relationship with the industry-owning partner, within any structure.

With regard to "new" forests, the FIDS team recommends that plantation areas be sought first in existing areas of heavily degraded secondary forest, and abandoned cleared lands within each FMA. The plantations should ultimately be owned and managed by the local (FMA) landowner group.

All such investments should be subject to bankable economic analysis, to assure payback of capital and local target ROI, to assure economic sustenance.

Plantation establishment can also provide significant involvement of "shoreside" landowner groups in initial FMA activities, even though their best natural timber may have already been harvested (these lands also frequently contain/govern access, ports, infrastructure, industry sites and trained people - so a harmonious and equitable involvement is highly desirable).

Each local FMA strategy can achieve involvement of both timber-owning and plantable land-owning groups with careful physical and financial planning.

3.3 Forest Revenue Systems

The team recommends immediate adoption of the proposed simplified stumpage system to collect forest revenues. In 1993 alone the system would have collected over K 100 million in additional revenue for the Government of PNG and the landowners.

With respect to the distribution of Royalty and stumpage revenue, the team also recommends distribution of revenues to provide the bulk to the landowner, with provision for NFS supervision of forest conservation and of basic equity in FMA agreements. The Team suggests that the sector strategy should recognize the critical role that landowners will play in establishing a competitive, sustainable forest products manufacturing sector.

The team suggests that beneficial economic development of the PNG wood industry can not be achieved without the long term support and participation of the landowners. A principal factor in developing this support will be the proportion of the wealth of the forest asset which is returned to the landowners, and the manner in which it is distributed.

The team recommends that a large proportion of the wealth revert to the resource owner in a manner that promotes further beneficial reinvestment in the forest-based community. There are several possible approaches to achieve this objective:

- deposit the resource owner's main fund in a Trust Account. The Trustee (or Board of Trustees), composed of highly respected individual(s), would assist landowners to identify sound investment opportunities;

- deposit the respective resource owner's share in an income-earning account from which annual withdrawals (of accrued interest and principal) would be made over a rotation period (e.g. 40 years);

- return a portion of the resource owner's share (e.g. 25%) as a direct current payment each year. The remainder could be entrusted to the Forest Authority to initiate investment projects in the respective forest area;

- return a major portion of resource wealth directly to individual families within landowner groups, coupled with an expanded program of local technical assistance in banking and investment facilities/procedures - oriented to sustainable forest sector development.

It is evident that many variations/combinations of the above scenarios are conceivable and feasible. The team recommends as simple and consistent an approach as possible, across all provinces.

The principal objective of the recommendation is to turn the wealth of the forest into productive individual and community **savings**, to create further sustainable economic and social development. If the wealth goes mainly to current consumption and/or consumer goods, without development of further income-generating activity, the community will suffer in the longer run.

The team recognizes that if a substantial share is not returned to the resource owners, there will be little medium or long term interest in the beneficial development of PNG's forests. Secondly, if the forest wealth is not distributed thoughtfully over time, landowner interests will not align with the potentials of sustainable forest sector development.

The team is confident that returns on investment in the local, regional and national forest industry, and selected reforestation will offer sound socio-economic prospects to these communities. The essential catalyst is a workable system to get the current resource wealth converted into savings and sound long-term investments.

The following table provides a summary of the recommended distribution of surplus at various average log prices (Surplus = Log Price - Logging Cost). The exact schedule for start-up of the new system likely needs further negotiation with Government of PNG and the industry.

Table 3.1
Distribution of Surplus (K/m^3)

Log Price	Surplus	Minimum Stumpage	Additional Stumpage	Operators' Share of Surplus
100	20	20	17	3
120	40	20	34	6
140	60	20	52	8
160	80	20	71	9
180	100	20	90	10

(Source: internal working papers)

Preliminary FIDS analysis indicates that at the projected 1993 log export level (about 2 million m^3), and project prices (remaining relatively high), the net contribution to general government revenues would be roughly equal, with either continuance of log export taxes or implementation of the proposed new system.

However, the land-forest owner's situation would be markedly improved, through the proposed sale of his assets (on a sustainable basis). Table 3.2 provides an example case.

Table 3.2

Distribution of Forest Revenues to Forest Owners
(in Millions Kina)

Log Price (K/m^3)	Minimum Stumpage	Additional Stumpage
100	12.9	36.9
120	12.9	60.8
140	12.9	84.8
160	12.9	108.8
180	12.9	132.8

(Source: internal working papers)

Note: Based on an assumed annual log export volume of 1.88 million m^3; domestic processing of .7 million m^3.

The Guidelines in total propose a number of policy initiatives that are intended to re-orient the forest sector. Initiatives include reduction of log exports, implementation of sustainable forest production, consolidation of some tenures, while at the same time exercising caution about monopoly of tenures (in addition to changes in the revenue system). Therefore negotiations between government, landowners and the industry will have to deal positively with the whole package.

The objectives of the sector cannot be achieved through sterile revenue conflict with the industry. The private sector must be the continuing vehicle of change and development in the PNG forest sector.

3.4 Forest Management for Sustained Production

The FIDS team recommends that operational forest inventories which are proposed for each new FMA should include all species and sizes of trees in each forest type. There are two principal commercial reasons:

- provision of information for future utilization changes;
- provision of information necessary for development of satisfactory residual stand characteristics (ecological and economic).

The team recommends development of an ongoing program of growth and yield measurement in typical residual stands, and in all types of forest plantation established in PNG. The team also recommends an expanded programme of monitoring published natural forest management and forest plantation data from other parts of the region, coupled with occasional focussed field visits to these sites.

The team recommends that ultimate natural forest management plans be coupled to reforestation plans which include a limited area of high value hardwood plantations. Initial estimates suggest that an area equivalent to no more than 5% of current area harvested would suffice to ensure sustainable production of high value wood products.

The team suggests that plantations be limited to proven high-value international performance species, with known local silvic success, in the initial stages (e.g. Teak, Mahogany, Terminalia, Balsa etc.)

As results are proven in trials, plantations can be broadened to include valuable local species.

The FIDS team recommends that plantation areas be sought first in existing areas of heavily degraded secondary forest, and abandoned cleared lands within each FMA. The plantations should ultimately be owned and managed by the local (FMA) landowner group.

As mentioned previously, the required forest inventory, forest monitoring and FMA development effort during the next five years should be made a major vehicle for training NFS forest managers.

3.5 Forest Products Marketing

3.5.1 Domestic Markets

To revitalize the domestic market, local producers must have an assured log supply. When new grades and standards are established in PNG, they should also form the basis for pricing and construction specifications.

3.5.2 International Markets

To support new forest industrial development, the Government must consider action on the following support services with regard to export marketing. It is recommended that:

- A new PNG grading rule and standards be published and made readily available to all interested parties;
- A timber inspection bureau be established in order that shipping documents can be certified by a grading inspector and accepted by the producer, shipping line and buyer. It is recommended that this high profile bureau be patterned after the established grades standards and inspection services currently practised in Malaysia;
- A new PNG timber handbook be completed as soon as possible;
- A forest products market intelligence section be established to monitor prices of all tropical forest products and to establish a data base for marketing and stumpage appraisals;

- The Government continue a program to encourage the formation of a private enterprise marketing organization. The timing must be in concert with new forest industrial development and establishment of the above-mentioned grades standards and inspection services.

3.6 Forest Industries

The FIDS team recommends adoption of a general forest sector strategy which would encourage:

- development of the solid wood products industry as a first priority, including sawmills, finishing plants and veneer mills; development some form of wood-based panel mill to utilize solid wood mill wastes, once an adequate industry is established; continuation of the Jant/Honshu development (if desired by the community) as an initial venture in the pulp sector;

- a series (40 to 60) of satellite sawmills, each producing about 9000 m^3/annum of rough sawnwood (input 20,000 m^3 of roundwood) to supply local requirements, a portion of direct sawnwood exports, and supply to centralized milling complexes for further manufacturing;

- centralized sawmilling complexes (11 to 15) producing approximately 60,000 m^3 sawnwood/annum (input 200,000 m^3 roundwood), with associated dry kiln/ treatment plants of 90,000 m^3 annual capacity to supply both rough sawnwood and finished products to export and domestic markets;

- plywood plants with about 30,000 m^3 annual production each, targeted primarily at export markets;

- at least one medium density fibreboard (MDF) plant to use economic residuals from the sawmill and plywood complexes, with annual output of about 30,000 m^3 targeted mainly for export, with some use in domestic markets and some inclusion in export furniture or other products;

- some "wokabout" or portable sawmills for part-time or special uses in village settings.

The reconnaissance study returns on investment (ROI) of each of these mills (except wokabouts) is highly positive, exceeding bankable standards.

Table 3.3

Expected Return on Investment in Defined Mills

Internal Rate of Return

Satellite Sawmill	21%
Centralized Sawmill	28%
Dry Kilns/Treating Plant	19%
Planer/Moulding Plant	90%
Plywood Mill	19%
Med. Density Fibreboard Mill	4%
Wokabout Sawmill	negative

These returns are based on particular options which are defined in detail in the industry background paper, and April 1993 log and product market prices. The returns are generally robust for most processing options, remaining positive in analysis of sensitivity to likely unfavourable price and cost shifts.

The wokabouts are not very profitable - mainly due to intermittent use and their general ability to meet the standards of an integrated industry aiming at export as well as (protected) domestic markets.

The FIDS team recommends that the above general structure should be encouraged through favourable private sector investment policies, and gradual development of appropriate norms or standards of product recovery from roundwood, and of employment (working) conditions in the sawmill and wood products industry.

The team recommends that reasonable pressure be exerted on existing TP holders, to live up to existing manufacturing commitments in a realistic manner. Log export restrictions and log export taxes may be the only short-term tools available. this will require new agreements with Finance Ministry regarding wealth distribution, if landowners are to be willing participants.

At the same time incentives can be offered to industry developers through improved long term resource commitments through FMA's,

As drafted for the new National Forestry Guidlines, the team recommends stumpage incentives (fixed at minimum of $\$20/m^3$) for domestic processors. Again, the team believes that the (short run) problem of reduced stumpage for landowners can be best approached though gradual development of equity in the forest industry, through economic investment of FMA trust funds.

The team also recommends a careful program of seeking private sector manufacturing partners in the international arena - starting with reputable, performing current industry participants and tenure-holders.

While the strategy focusses on wood products as the principal area of opportunity, the FIDS team has not ignored pulp and paper products. The team has recommended that the Honshu-Jant timber supply lease be extended.

Further, the team recommends that the NFS should remain open to opportunities in the export chip market, as the industry develops a number of centralized wood product complexes with significant volume of residual materials. the team does not recommend further ventures in large scale roundwood chipping at this time.

3.7 Essential Infrastructure

The team recommends an early initiative to encourage further development of transport and distribution systems, and local plus export marketing structures/mechanisms in the forest sector. The long coastline of PNG, and existing ports, offer many short-term opportunities for enhanced value of domestic production.

Elements of the initiative should include:

- definition of a technical assistance project in forest products valuation and marketing, to augment and develop NFS capabilities in this field immediately;

- formation of an industry marketing association made up of willing participants, with explicit terms of reference, terms of membership, and means of funding;

- detailed investigation of the current destination and use of PNG log exports in final markets;

- formation and/or adoption of sound wood product standards for export markets in Australia, Japan, the EEC, USA and other Pacific market centres.

The team recommends a cautious approach to developing marine transport infrastructure in the short run. There is already excess capacity in PNG. Every effort should be made to induce the existing industry to adopt more economic pricing policies - based on the prospect of greatly increased domestic forest industry traffic.

If this is not possible, reconnaissance-level calculations indicate a highly positive R.O.I. on appropriate equipment such as:

- self loading/unloading 95m barges with 27 m ocean-going tug

- improved, powered steering river and short-haul scows

The FIDS team recommends the immediate formation a stimulative industry organization for the purpose of analyzing and reforming marine transport as required. The proposed marketing organization could fullfill this function.

Ultimately, an organized forest industry marketing association/cooperative might want to invest in specialized forest product vessels to improve market-focussed international delivery services for manufactured forest products.

4. SOCIO-ECONOMIC IMPACT OF PROPOSED STRATEGY

4.1 Framework

The FIDS team has conducted wide discussions within the PNG forest sector community regarding the aspirations of the Government, the industry and the landowners. In broad terms, the following goals were derived:

- all PNG forest extraction will be placed under sustainable management systems as soon as possible;
- manufacture of forest products will be increased rapidly, and export markets will play a major role;
- returns to land/timber owners will be equitable from the new industries and these owners will be encouraged to participate in new forest industry ventures.

These general goals are compatible and coherent, but their successful achievement will depend on a few critical, inter-related elements of the total sector strategy:

- effective reform of the NFA/NFS to develop improved information systems and operational field controls;
- reform of the timber revenue system to collect fair value and distribute it efficiently and equitably;
- negotiation of sound FMA agreements between landowners and industry investors - which lead to economic industry investments.

There are many feasible paths to improved manufacturing performance within these broad guidelines. The strategy proposed has analyzed and accepted several additional guiding principals of constraints:

- decentralized local manufacturing will play a significant role with local ownership where feasible;

- a significant part of timber "rents" from log sales/exports will be tagged for reinvestment in efficient, sustainable expansions of forest and mill production;

- current marine transportation problems/constraints can and will be remedied within the sector if necessary;

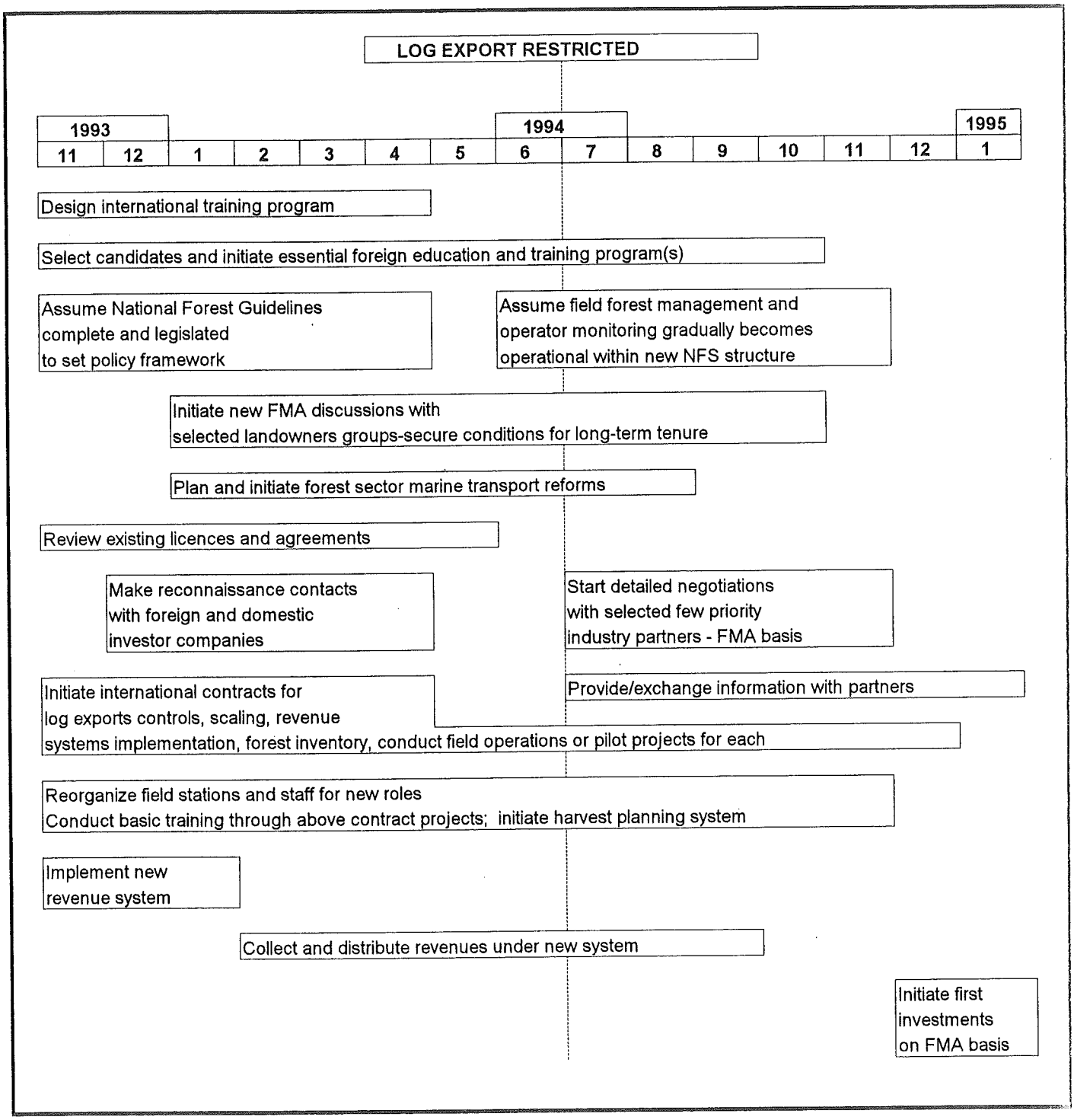
- efficient and equitable access to lumber, panel and other wood product markets in Asia, Europe and North America can be obtained by efficient PNG producers;

- sufficient short-run improvements in NFS, industry and landowner competence in the forest sector can be achieved through "on-the-job" training, if sound international assistance is obtained through international agencies and industry partners - longer run technical enhancements/HRD will depend on international training to the turn of the century at least;

- log exports will be restricted - to zero for permittees who do not manufacture, after 8 months from September 1993; some log exports will be permitted by manufacturers.

Chart 4.1 provides a sketch of the principal tasks which will be undertaken during the fifteen months following the FIDS strategy report.

CHART 1 - DRAFT SCHEDULE: FIFTEEN MONTHS - POST FIDS REPORT



4.2 Impacts of the Sector Development Strategy

The expected impacts of implementing the FIDS strategy can be projected in general terms at this stage, even though detailed impacts can only be projected after actual industry investment proposals are in hand. The following projections are based on likely combinations and timings of mills of the types analyzed in the FIDS case studies.

The base scenario used is an optimistic one - the best feasible rate of progress (on the critical strategy elements) which the team can envisage at this stage.

Figure 4.1 shows the forecast total harvest of the industrial wood from PNG forests 1993-1999.

After an initial decline (post log-export restriction), the total of production for the growing domestic manufacturing industry, plus log exports granted to these operators, will rise for five years, At present, the forecast is constrained at the "consensus" sustainable harvest of about 3.6 million m^3, until the turn of the century.

By that time, improved forest inventories and forest management systems may prove that further sustainable expansion is feasible. The feasible production on the industry side seems unlikely to exceed this constraint before the year 2000.

Figure 4.2 outlines the expected industry mix, as the manufacturing establishment expands through domestic and international investment.

FIGURE 4.1

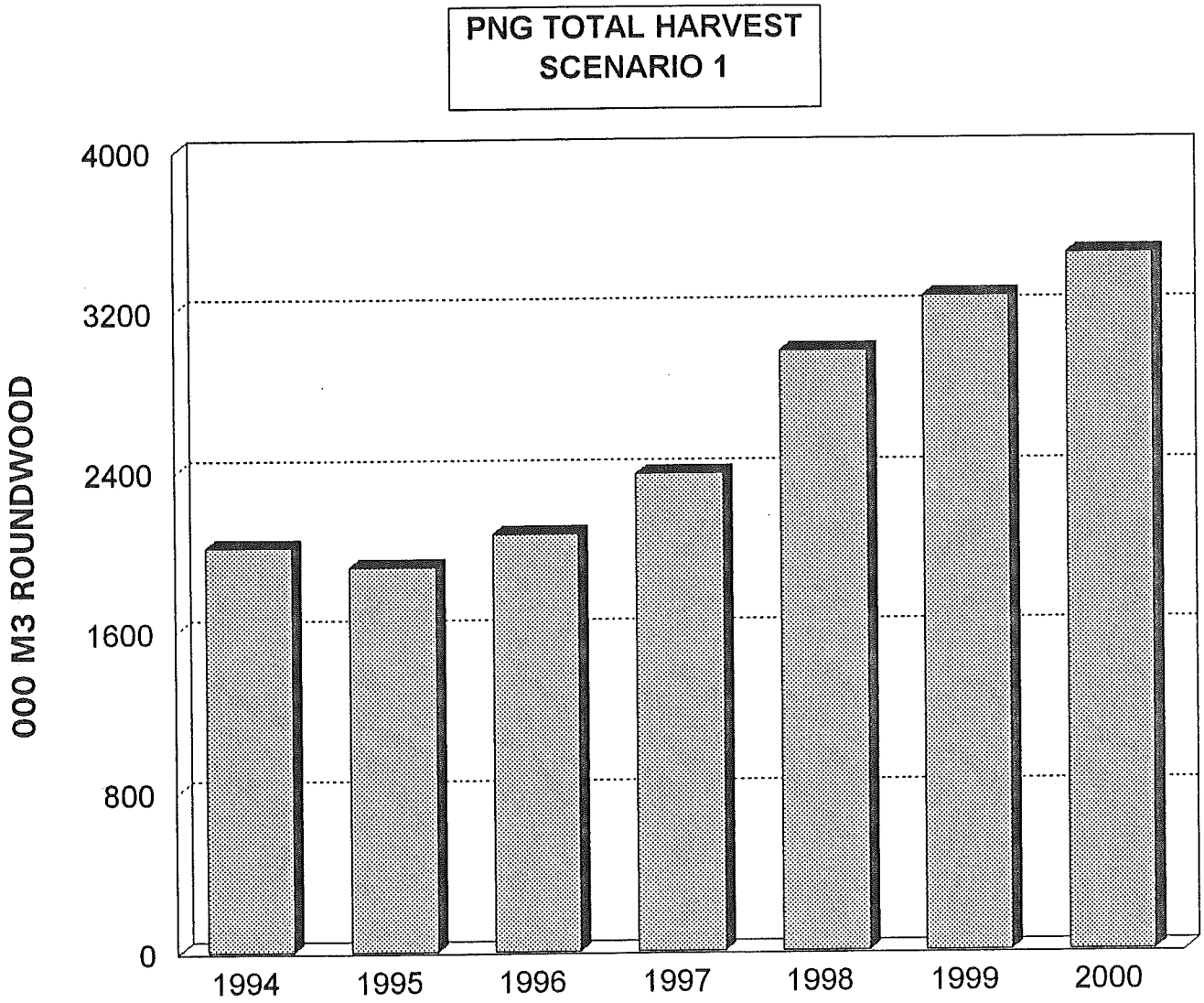
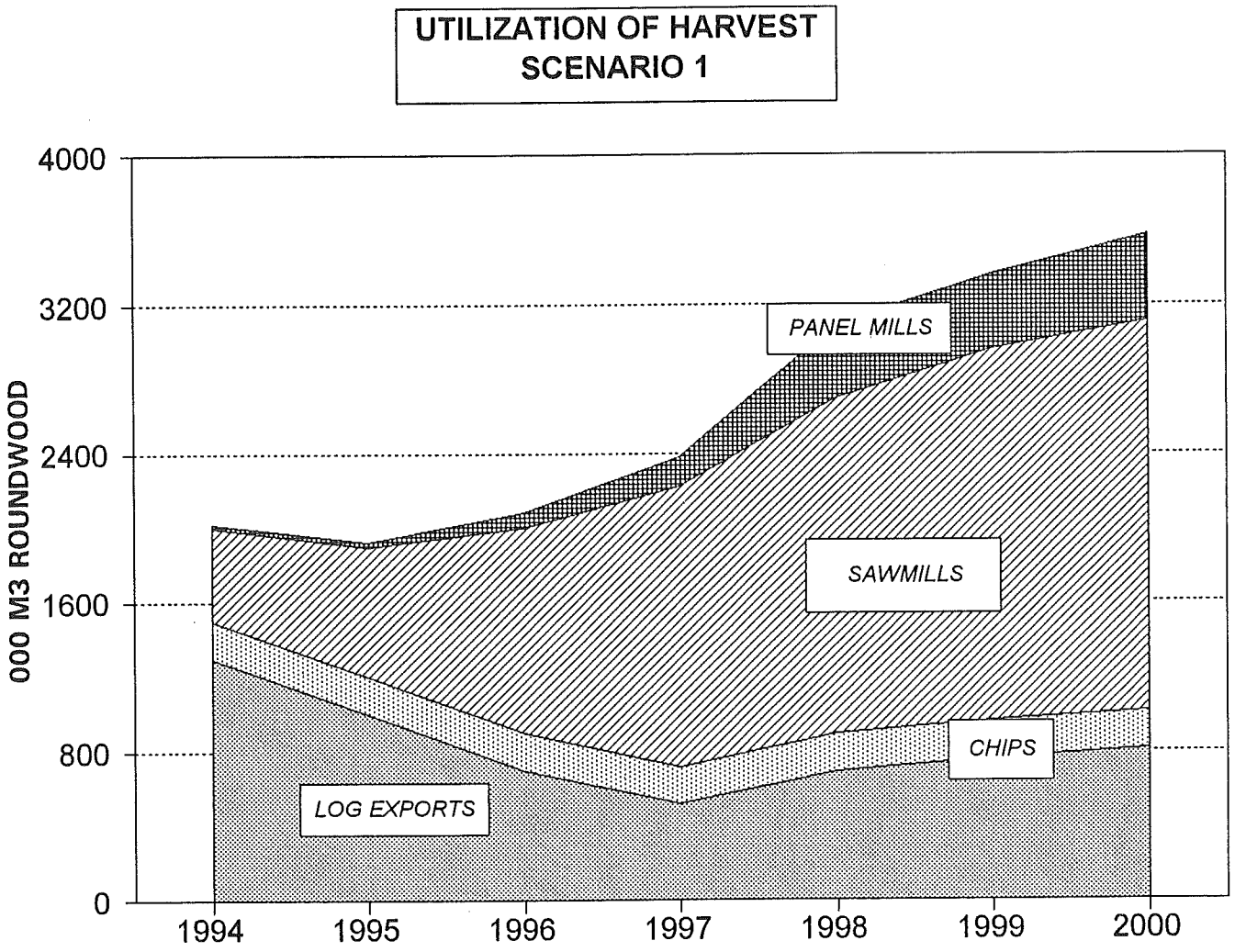

PNG TOTAL HARVEST
SCENARIO 1
000 M3 ROUNDWOOD
4000
3200
2400
1600
800
0
1994
1995
1996
1997
1998
1999
2000

FIGURE 4.2


UTILIZATION OF HARVEST
SCENARIO 1
000 M3 ROUNDWOOD
4000
3200
2400
1600
800
0
1994
1995
1996
1997
1998
1999
2000
PANEL MILLS
SAWMILLS
CHIPS
LOG EXPORTS

The largest expansion will occur in sawnwood and derived manufactured products. Wood-based panels (veneers, plywood and MDF/particle board) will also play a major role. Log exports are assumed to be constrained at 33% of roundwood used in mills. The Jant chip mill is assumed to be renewed and to continue in operation at current levels.

Details of the forecast mill construction schedule, together with other elements of the impact forecast, are provided in Tables 4.1 and 4.2.

Gross sales from the forest sector should rise to over K700 million by the turn of the century, at current prices. If the relative price of quality hardwood products continues its rise in final markets over the period, these values could be even higher.

The bulk of the new manufactured products (up to 75%) will be exported. Figure 4.3 provides a sketch of the growth in gross sales value and expected gross foreign exchange earnings.

Even with a high proportion of imported capital goods to build the mills, there will be a high fraction of local construction costs and continuing domestic wages. If the landowner savings/investment plans work, there will be high domestic capital paybacks and further local development will ensue.

All forest sector jobs will pay competitive salaries to the PNG industrial/resource sectors.

The expected PNG wages and salaries component (direct only) is show in Figure 4.4 by industry segment.

TABLE 4.1
BASIC ECONOMIC IMPACT - FIDS STRATEGY PROJECTION
SCENARIO 1: BEST FEASIBLE RESPONSE

WAGES - BASE	
Current min. wage (K/ann) (legislated)	6,968
Benefits package	2,786
Total labor Cost (K/ann)	9,754

sawmill, panelmill wages above this level at various skill levels estimated average including fringes: 12,000

WAGES - SAWMILL COST - k/m3	Satellite Sawmill	Sawmill/Mfr Complex	Accounting Shed. Rep.
Labor cost including fringe benefits	5.76	12.3	10.5
Salaries & overhead (management)	8.45	4.5	8.3
Est. average: wages/salaries/fringes		15.505	

GROSS SALES RETURN SAWMILLS	k/m3 log inputs	% Output	Aver. sales return
Average sales return - exportable	250	75%	200k/m3
Average sales return - domestic mark	131	25%	rdwood input

GROSS SALES RETURN PANEL MILLS		
	Veneer/plywood mills	350 k/m3
	MDF panels	210 k/m3

ASSUMED TARGET PRODUCTION	ROUNDWOOD INPUT - 000M3						
	1994	1995	1996	1997	1998	1999	2000
Sawnwood	500	700	1,100	1,500	1,800	2,000	2,100
Veneer/plywood	20	20	80	160	300	300	360
Other panels	0	0	0	0	100	100	100
Pulp chips	200	200	200	200	200	200	200
Export logs	1,300	1,000	700	520	693	759	812
Industry harvest	2,020	1,920	2,080	2,380	3,093	3,359	3,572

Note: veneer/plywood: mill residues used - no new roundwood required

EXPECTED GROSS ECONOMIC IMPACTS OF FOREST SECTOR		'000 K					
		1995	1996	1997	1998	1999	2000
Harvest for Domestic Industry	Direct	8,640	14,160	19,920	26,400	28,800	30,720
	Indirect	10,800	17,700	24,900	33,000	36,000	38,400
Sawmills/mfrs	Direct	10,854	17,056	23,258	27,909	31,010	32,560
	Indirect	13,567	21,319	29,072	34,886	38,762	40,701
Wood-based panels	Direct	310	1,240	2,481	6,202	6,202	7,132
	Indirect	388	1,550	3,101	7,752	7,752	8,915
Log & Chip exports	Direct	14,400	10,800	8,640	10,716	11,508	12,142
	Indirect	18,000	13,500	10,800	13,395	14,385	15,177
TOTAL	Direct	34,204	43,256	54,298	71,227	77,520	82,554
	Indirect	42,755	54,070	67,873	89,034	96,900	103,193
GROSS SALES OF IND.		318,000	382,000	471,000	611,950	246,850	275,770
INDIRECT GNP DERIVED		349,800	420,200	518,100	673,145	271,535	303,347
DIRECT GROSS FOREIGN EXCHANGE EARNED	US$	238,500	286,500	353,250	458,963	185,138	206,828

TABLE 4.2
ESTIMATED INDUSTRY CAPITAL REQUIREMENTS

	Capital/plant 000 US$	No. New Plants x Capital/plant				
		1995	1996	1997	1998	1999
Satellite sawmills	1,000	10	15	8	4	
Capital requirement/yr		10,000	15,000	8,000	4,000	
Central Sawmills	10,000	2	2	1	1	1
Capital requirement/yr		20,000	20,000	10,000	10,000	10,000
Kilns & Planers	6,000	1	1	2	2	1
Capital requirement/yr		6,000	6,000	12,000	12,000	6,000
Veneer/plymills	17,000	1	1	2		1
Capital requirement/yr		17,000	17,000	34,000		17,000
MDF/Fibreboard panel	22,000				1	
Capital requirement/yr					22,000	
Pulp chip mill renewal	7,000		1			
Capital requirement/yr			7,000			
TOTAL CAPITAL REQUIRED		53,000	65,000	64,000	48,000	33,000
FIVE-YEAR TOTAL:	263,000					

Note:
It is assumed that the existing industry cxan produce at least 100,000 m3 additional sawnwood with enhanced efficiency and log availability, under the new conditions; the existing plywood mill can also produce 20,000 m3 more;
capital requirements for new production are assume to be met entirely within the year previous to the production.

FIGURE 4.3

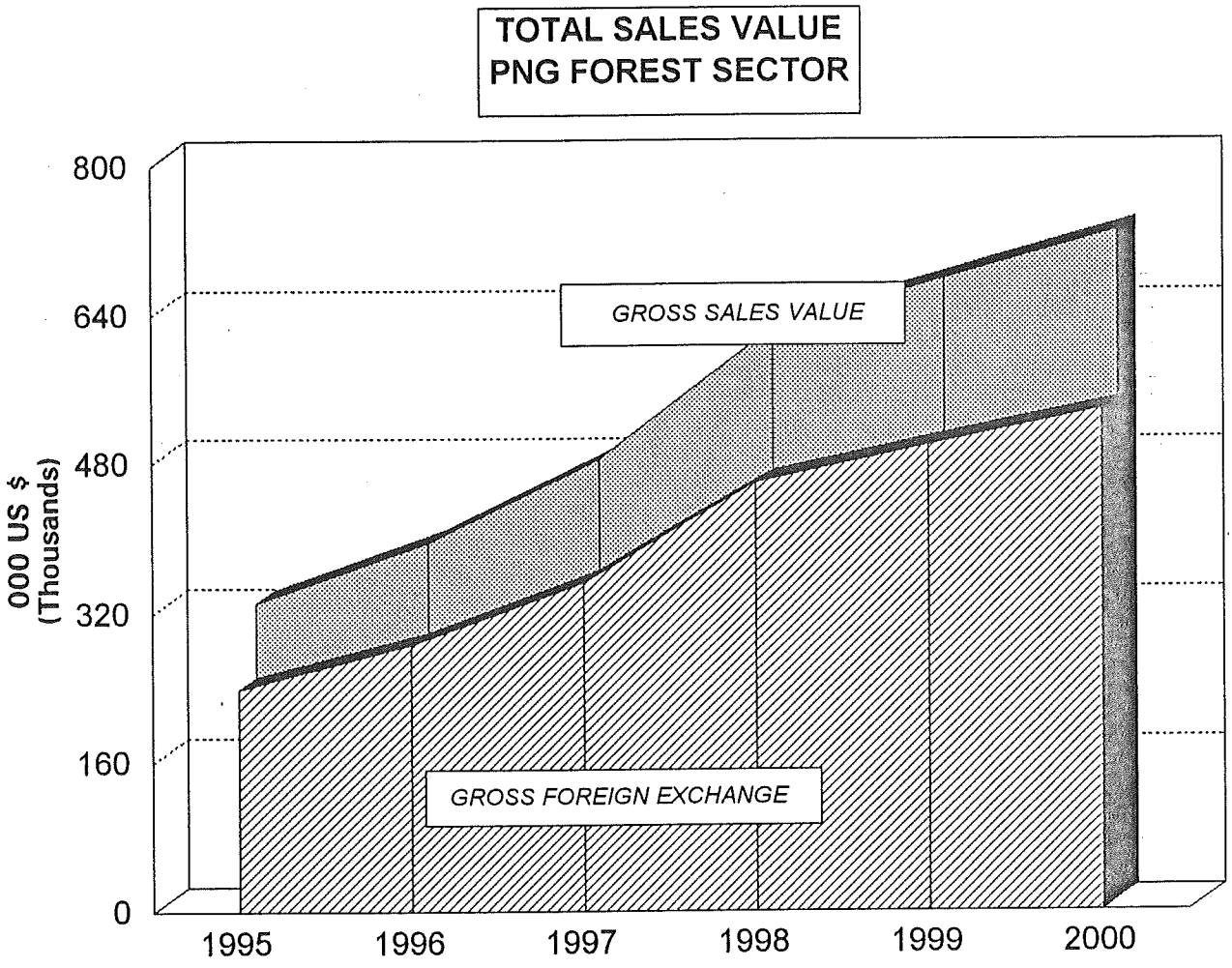
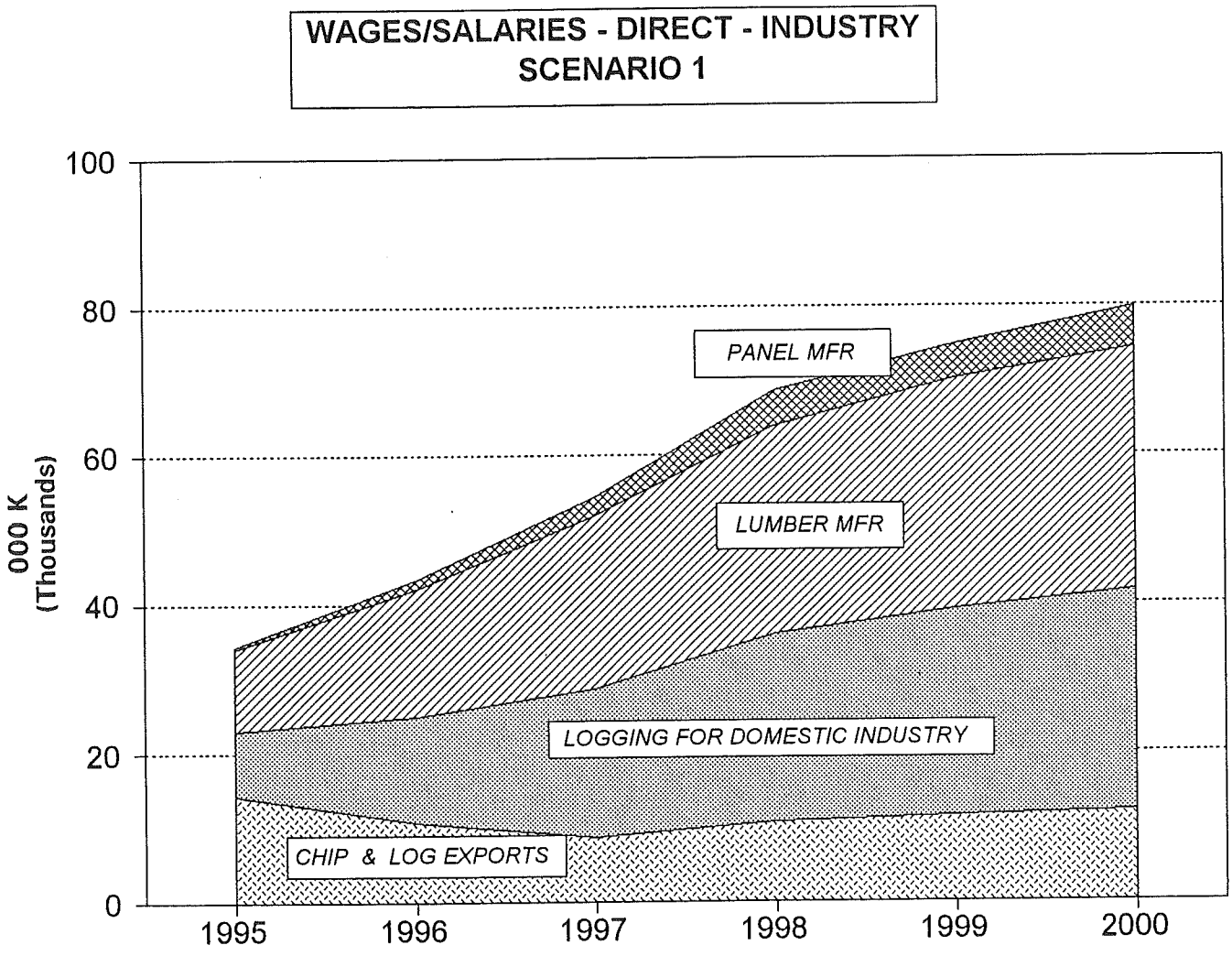

TOTAL SALES VALUE
PNG FOREST SECTOR
000 US $
(Thousands)
800
640
480
320
160
0
GROSS SALES VALUE
GROSS FOREIGN EXCHANGE
1995
1996
1997
1998
1999
2000

FIGURE 4.4


WAGES/SALARIES - DIRECT - INDUSTRY
SCENARIO 1
000 K
(Thousands)
100
80
60
40
20
0
1995
1996
1997
1998
1999
2000
PANEL MFR
LUMBER MFR
LOGGING FOR DOMESTIC INDUSTRY
CHIP & LOG EXPORTS

The direct training and technology absorption components of these industrial jobs will ultimately be spread to many other sectors. Embodied skill transfers will include mechanical, electrical, construction and heavy equipment operation, as well as wood technologies and management/supervision.

The indirect (derived) income effects in other sectors as a result of servicing the forest sector are likely to be slightly greater than the direct effects (see Table 4.1).

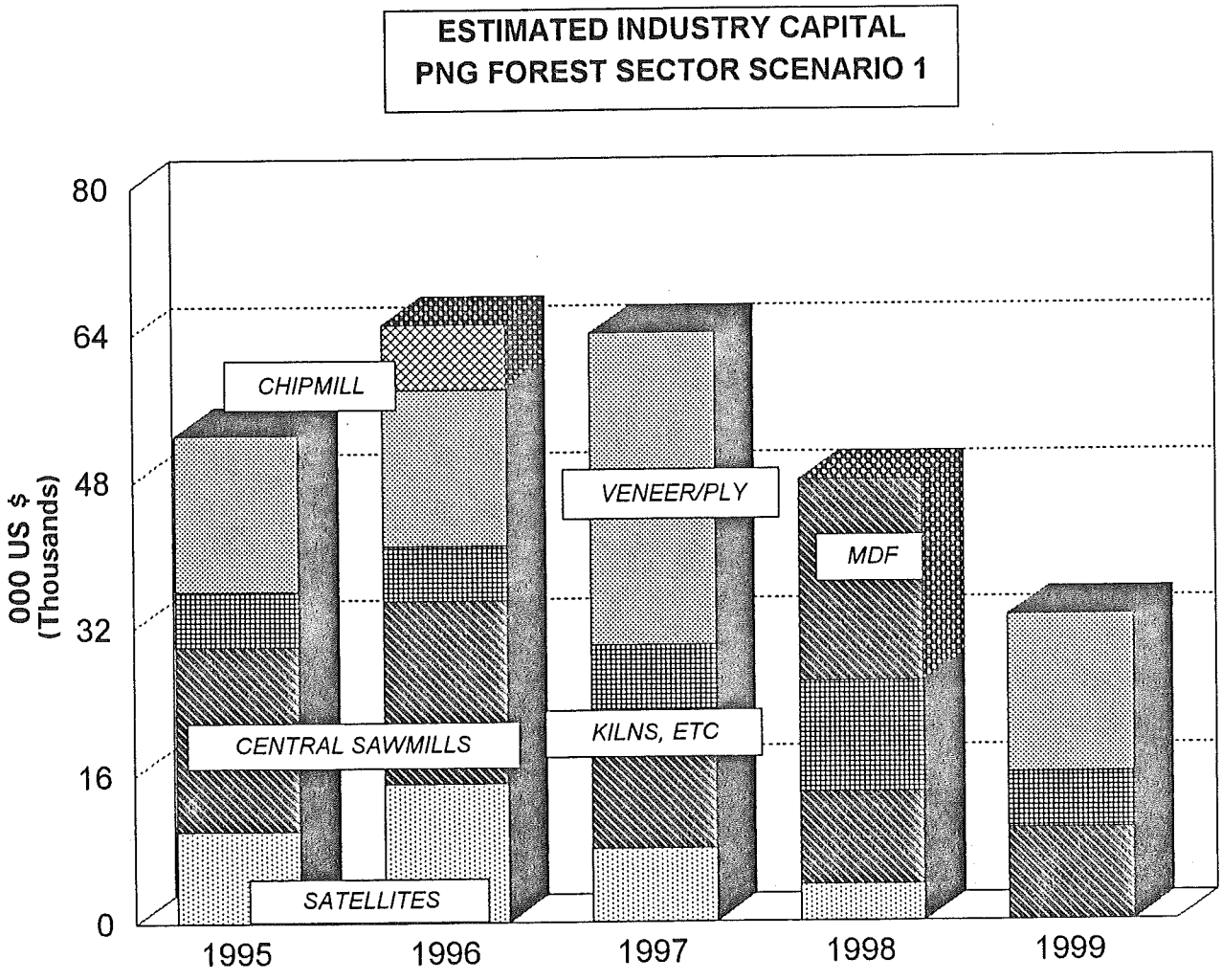
The yearly private capital requirements to achieve the forecast industry expansion are shown in Figure 4.5, based on the capital estimates of the FIDS case studies and the expected construction schedule outline in Table 4.2.

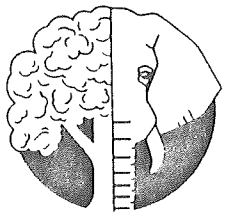
This investment schedule accentuates the urgency of getting the framework outlined in Section 4.1 in place by the end of 1994.

The schedule, together with the expected rates of return (see case study analyses) also outlines the outstanding potential for profitable landowner involvement in the forest sector - leading to direct owner interest in forest sustenance in PNG.

In summary, the FIDS strategy offers one of the most significant sustainable development opportunities in PNG for the next decade.

FIGURE 4.5


ESTIMATED INDUSTRY CAPITAL
PNG FOREST SECTOR SCENARIO 1
000 US $
(Thousands)
80
64
48
32
16
0
CHIPMILL
CENTRAL SAWMILLS
SATELLITES
VENEER/PLY
KILNS, ETC
MDF
1995
1996
1997
1998
1999



Société Internationale d'Experts-conseils
General Woods & Veneers
Consultants International Ltd

FOREST INDUSTRIES DEVELOPMENT STUDIES
International Tropical Timber Organization
Project PD 108/90 Rev. I (I)

Working Document no. 1:
ITTO Terms of Reference
FIDS Project Inception
Sector Background Working Papers
Forest Sector Review

Prepared for the

Papua New Guinea Forest Authority

by

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INTRODUCTION

A) Background

The Forest Industries Development Studies Project (FIDS) has been conducted in PNG since July 1992, within the new National Forest Service of PNG (NFS), under the new National Forest Authority (NFA) and Forest Act. These new institutions, and plans for the FIDS Project were developed within the 1991 National Forestry and Conservation Action Plan (NFCAP) for PNG, led by the World Bank and a broad group of international donors.

Direct funding for the FIDS Project has been provided by the International Tropical Timber Organization (ITTO - Project PD 108/90 Rev. I (1) Yokahama) under the International Tropical Timber Agreement (ITTA). The Government of Papua New Guinea has also been a major contributor, through both direct project budget support and inputs from NFS staff.

Following an early situation report and detailed project plan, (Inception Report - September 1992), the project developed a detailed review of the status and trends of forest sector development in PNG (Sector Review - April 1993). This report included an outline strategy for the Government of PNG, together with the private sector timber owners and forest industry, to move towards government objectives of sustainable sector development, with enhanced domestic economic impact.

Since April 1992, more detailed case studies have been analyzed in forest revenue collection/distribution; domestic and international markets for PNG forest products; and potential small- to medium-scale, decentralized forest industry developments. These reconnaissance studies have provided background for more detailed forest sector policies and development strategies.

In May 1993, the new National Forest Authority drafted the National Forestry Development Guidelines, which have fundamentally re-oriented PNG forest policy. The FIDS team fully supports the new Guidelines.

The report presents the findings of the study team, and does not represent official policy of the Government of PNG, International Tropical Timber Organization, or other official national or international agency.

Background data and reasoning behind the conclusions and recommendations is provided in a series of Project Working Documents.

B) Objectives and Terms of Reference

The objectives and Terms of Reference for the Forest Industry Development Studies (FIDS) have undergone modifications since the original call for tenders. The resulting changes were necessary as new information became available in the form of sector working papers and the urgent timetable set by Government to establish a new Forest Authority and National Forestry Development Guidelines.

The Terms of Reference which covered this study can be found in the following documents:

- ITTO Call for tender documents - December 1991
- General Woods & Veneers/Nawitka Technical Proposal - January 1992
- Inception Report - September 26, 1992

C) Report Structure and Content

The overall study report is composed of:

i) the core report which crystallizes salient points of each of the FIDS sub-sector technical field reports. The information is intended for use by decision makers in drafting forest policy and national forestry development guidelines.

ii) Six separate working documents which provide technical details and analyses based on field studies which provide the detailed supporting information for the final report. They are:

Working Document no. 1	:	ITTO Terms of Reference FIDS Project Inception Report Sector Background Working Papers Forest Sector Review
Working Document no. 2	:	Industrial Processing Sector - Case Studies
Working Document no. 3	:	Harvesting and Transportation Review and Projection
Working Document no. 4	:	Financial and Economic Incentives in the Management of PNG's Forest Resources
Working Document no. 5[1]	:	Domestic Market Study
Working Document no. 6	:	International Market Study

This document is Working Document no. 1, which contains the following:

I) ITTO Initial Terms of Reference of Forest Industries Development Study

II) General Woods & Veneers Consultants International and Nawitka Resource Consultants - FIDS Project Inception Report - September 26, 1992 - Port Moresby, PNG

III) General Woods & Veneers Consultants International and Nawitka Resource Consultants - Sector Background Working Papers:

- Forest Management - December 2, 1992
- Revenue, Costs and Surplus Distribution - December 3, 1992
- Timber Acquisition, Allocation and Exploitation - December 4, 1992
- Economic Prospects of the Forest Industrial Sector - January 26, 1993
- Commercial Climate of PNG - February 16, 1993

IV) General Woods & Veneers Consultants International and Nawitka Resource Consultants - Forest Sector Review (Draft Report) - April 1993 - Port Moresby, PNG.

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[1] It is to be noted that WD 5 is not a study conducted by GWV or Nawitka Resources. It was a separate contract with Mr. M.N. Amin, Marketing Branch, PNG. It is however included in the overall study as the domestic compenent of the marketing analyses.

ITTO INITIAL TERMS OF REFERENCE
OF FOREST INDUSTRIES DEVELOPMENT STUDY

ITTO

INTERNATIONAL TROPICAL TIMBER ORGANIZATION

PROJECT DOCUMENT

PART II - THE PROJECT

1. OBJECTIVES

1.1. Development Objectives

The project proposal is in line with the country's National Goals and Directive Principles and the revised forest policy which aims to ensure a greater onshore processing industry in the country.

1.2. Immediate Objectives

- to undertake a pre-industrial survey to determine where and how Papua New Guinea can utilize its forest resources to its optimum use within the country.

- to evaluate the economic worth of the current processing industries and recommend improvements and/or integration.

The basic objectives of the project will be to formulate a coherent and well-supported series of recommendations on the question of whether and how to pursue more intensive evaluation of specific forest processing possibilities, and to present these findings to GOPNG after extensive dialogue with government and industry agencies.

2. BACKGROUND AND JUSTIFICATION

The World Bank led a review of the Papua New Guinea forestry sector in early 1989 under the auspices of the Tropical Forestry Action Plan. In February, 1990, it presented its final report to the Government of Papua New Guinea, where it outlined a number of proposed projects for external funding to assist GOPNG to properly manage the conservation and utilization of its forest resources.

The TFAP report for Papua New Guinea refers to the need to study closely the economic feasibility of industries based on forest resources, prior to formulation of any major policy decisions on the sector, such as imposition of log export bans, introduction of special incentive packages, and so on.

The National Forestry Action Plan has provision for a project to undertake pre-feasibility studies for the forestry sector. These studies are intended to be broad sub-

sector level analyses, made with a view to setting priorities for more in-depth investment feasibility work.

Important policy decisions relating to the imposition of the log export bans are presently being considered to encourage domestic processing. Presently the natural resources of PNG are exploited mostly for log export as raw logs - there are currently about 6 large sawmills, 1 veneer mill and 1 chipmill in Papua New Guinea as compared to 32 log exporters.

There is a suggestion that the PNG processing sector is not internationally competitive, with high internal costs, low productivity and the diverse nature of forest resource being contributory factors. This requires a more systematic study as it may indeed be due to the decline in processing expertise since 1979 when the 1979 Forest Policy encouraged log exports. Now a new policy is in place and this will encourage the domestic processing of an increased proportion of its forest products.

The Government of Papua New Guinea needs to be assisted in its efforts to assess the potential for increasing socio-economic benefits through establishment of appropriate forest industries. This will require a systematic analysis of industry performance and viability and preparation of preliminary feasibility studies of selected processing options in the light of detailed resource analysis and marketing studies. It will be valuable also to attach to this project a study and analysis of forest policy and incentive options which might better encourage a viable onshore processing industries within Papua New Guinea.

3. OUTPUTS

At the present stage of development in PNG, three basic types of forest processing seem most worthy of consideration: an integrated sawing and board plant; woodchipping (for export) operations; and possibly a medium density fiberboard plant and a pulp mill.

Mobile sawmilling is also becoming popular in many areas and many see this as more appropriate development, partly because of the potential for greater participation by landowners and partly because it is seen as more environmentally friendly. It is unlikely however that mobile mills will replace the need for large scale processing development in Papua New Guinea. Other village level industries from forests including rattan and culture of orchids and shitake mushroom are gaining momentum also and these along with mobile sawmilling will be assisted by other projects within the National Forestry Action Plan.

Outputs of this project will therefore be in the form of:-

(i) An inventory of scope and type of small scale (village based), medium and large scale wood industries in PNG.

(ii) Report and recommendations on a policy and incentive environment to

encourage growth of the timber processing sector.

(iii) Analysis of committed and uncommitted timber resource data, by species and locations, to suit industrial/processing development.

(iv) Report on markets for timber processing, taking into account PNG resources and regional demand and supply for tropical hardwood timber.

(v) Reports indicating timing for industry development and provisional economic feasibility of selected sawmilling, wood-based panel, chipping and pulping plants in PNG for export production.

4. ACTIVITIES

The primary externally funded input to the project will be appointment of a forest industries specialist, for a period of 18 months. The expert will take major analytical responsibility for survey and evaluation of current forest industry economic performance, and will also be responsible for formulation of overall sector pre-feasibility findings. The latter task will require the specialist to supervise contract studies to be implemented under the project, and to incorporate findings from these into the main output from the project.

Specifically, the forest industries specialist will:

(i) Complete the necessary data gathering and analysis to formulate a comprehensive report on economic performance of the current forest processing sector in PNG.

(ii) Assist GOPNG to design and schedule inputs from contract specialists in: forest industry policy analysis; market analysis and marketing for PNG forest products (domestic and international); and selected pre-feasibility studies.

(iii) Co-ordinate inputs from private sector forest industry organizations, and organize workshops to discuss findings and formulate recommendations on the sector. This task will be especially relevant as support for the activities of the policy analyst, who must be given access to private sector and GOPNG decision-makers in a forum allowing exchange of views.

(iv) Co-ordinate GOPNG surveys and data compilations, in support of market analyses.

(v) In close co-operation with GOPNG, design a framework for, and participate in the implementation of, selected pre-feasibility studies, utilizing contract inputs from industry investment analysts as required.

(vi) Integrate the analytical outputs from the project into a major, policy oriented report on the forest industries sector of PNG. Issues papers and

recommendations should be circulated widely amongst interested parties in PNG, so that the eventual presentation of views to GOPNG reflects the range of opinion and the realities of implementation of any recommended change in approach.

(vii) Carry out needed administrative and management tasks to fully implement all elements of the project.

5. INPUTS

5.1 ITTO Contribution

(i) Provide the external funding indicated in the Project Budget (Part IV) for contract technical assistance in the form of:

- a Forest Industries Specialist	18 m/m
- a Forest Industries Policy Analyst	2 m/m
- a Forest Marketing Specialist	2 m/m
- Specialists for Feasibility Studies	5 m/m

(ii) Assistance in recruitment of specialists.

5.2 GOPNG Contribution

(i) Provide the internal financial contribution indicated in the Project Budget (Part IV).

(ii) Management of the Forest Industries specialist and short term technical assistance and assistance as required in implementing the various studies proposed.

6. PREPARATION OF WORK PLAN

This will be an 18 month project. The initial action will be to recruit a Forest Industries Specialist who will then work with the Department of Forests in preparing the project work plan.

This plan will identify an appropriate timing and detailed terms of reference for contract studies and will recognise opportunities arising from other relevant projects in the National Forestry Action Plan, including the report on the Rapid Resource Appraisal and the report on Forest Revenue Studies.

7. FRAMEWORK FOR EFFECTIVE STAFF PARTICIPATION

This project will require effective participation from the Department of Forest, Provincial Forestry Departments and the Forest Industry Association. A National Counterpart to the Industries Specialist will be identified and be responsible for ensuring this participation and will additionally provide logistical assistance to the project.

8. DEVELOPMENT SUPPORT COMMUNICATION

The National Counterpart and the provincial departments will be responsible for informing landowners (the resource owners) of the purpose of the project and will assist in ensuring their participation in any feasibility studies that will concern them.

9. INSTITUTIONAL FRAMEWORK

The project will managed and administered by the Head Office of the Department of Forest, in Port Moresby. It will require close collaboration with the PNG Forest Industry Association and Provincial Forestry Departments.

10. PRIOR OBLIGATIONS AND PRE-REQUISITES

The only major prior obligation is the formal acceptance of a new Forest Act which will establish a new Forest Authority and provide a better basis for implementing the revised Forest Policy. This is expected in July 1991. It will also be to this projects advantage to have access to the preliminary findings of the Rapid Resource Appraisal to better understand the nature of the committed and uncommitted forest resources, and the report on Forest Revenue Studies which will provide a lead on economic rent. Both projects are part of the National Forest Action Plan and key results are expected to be available by December 1991.

11. POSSIBLE FUTURE ASSISTANCE

There are no requirements for future assistance envisaged.

PART III - MONITORING, EVALUATION AND REPORTING

1. MONITORING REVIEWS

The project will be subject to periodic technical monitoring in accordance with the policies and procedures of the ITTO, the financial contributing institution or Government, and the Government of Papua New Guinea. Quarterly reviews may be required by GOPNG.

2. EVALUATIONS

The project will be subject to evaluation in accordance with the policies and procedures of ITTO, the financial contributing institution or Government, and the Government of Papua New Guinea. Specific review periods other than internal quarterly monitoring exercises will be agreed when ITTO and other funding agencies interests are known.

TERMS OF REFERENCE OF EXPERTS

FOREST INDUSTRIES SPECIALIST

Background

The TFAP report for Papua New Guinea refers to the need to study closely the economic feasibility of industries based on forest resources, prior to formulation of any major policy decisions on the sector, such as imposition of log export bans, introduction of special incentive packages, and so on.

The National Forestry Action Plan has provision for a project to undertake pre-feasibility studies for the forestry sector. These studies are intended to be broad sub-sector level analyses, made with a view to setting priorities for more in-depth investment feasibility work.

A project document outlining the objectives, activities and outputs for an eighteen month project has been prepared by GOPNG, and the International Tropical Timber Organization has formally agreed to fund this project.

The basic objectives of the project will be to formulate a coherent and well-supported series of recommendations on the question of whether and how to pursue more intensive evaluation of specific forest processing possibilities, and to present these findings to GOPNG after extensive dialogue with government and industry agencies.

The primary externally funded input to the project will be appointment of a forest industries specialist, for a period of 18 months. The expert will take major analytical responsibility for survey and evaluation of current forest industry economic performance, and will also be responsible for formulation of overall sector pre-feasibility findings. The latter task will require the specialist to supervise contract studies to be implemented under the project, and to incorporate findings from these into the main output from the project.

Terms of Reference

Specifically, the forest industries specialist will be responsible to the Chief Technical Advisor of the NFCAP Technical Support Project, and will be required to:

(i) complete the necessary data gathering and analysis to formulate a comprehensive report on economic performance of the current forest processing sector in PNG.

(ii) assist GOPNG to design and schedule inputs from contract specialists in: forest industry policy analysis; market analysis and marketing for PNG forest products (domestic and international); and selected pre-feasibility studies.

(iii) co-ordinate inputs from private sector forest industry organizations, and organize workshops to discuss findings and formulate recommendations on the

sector. This task will be especially relevant as support for the activities of the policy analyst, who must be given access to private sector and GOPNG decision-makers in a forum allowing exchange of views.

(iv) co-ordinate GOPNG surveys and data compilations, in support of market analyses.

(v) in close co-operation with GOPNG, design a framework for, and participate in the implementation of, selected pre-feasibility studies, utilizing contract inputs from industry investment analysts as required.

(vi) integrate the analytical outputs from the project into a major, policy oriented report on the forest industries sector of PNG. Issues papers and recommendations should be circulated widely amongst interested parties in PNG, so that the eventual presentation of views to GOPNG reflects the range of opinion and the realities of implementation of any recommended change in approach.

(vii) carry out needed administrative and management tasks to fully implement all elements of the project.

Location & Term

An 18 month assignment, based in Port Moresby. Consultant will be required to travel extensively in Papua New Guinea.

FOREST INDUSTRY POLICY ANALYST

Background

No rational decisions on the future shape and direction of the PNG forest processing sector can be made, without a comprehensive review of the existing policy framework and the effect that has had on industry development so far, and of the policy options that are available to GOPNG in this area.

Policy analysis under the project will need to evaluate the historical and current impact on the processing sector of macroeconomic policies, as well as sector specific ones. It is axiomatic that this study must make no prior assumptions about the intrinsic desirability of a forest processing sector. Rather, the analyst must combine prior analyses of economic performance in the sector with estimates of the impacts and costs of policy instruments available, to reach overall conclusions on the optimum policy environment for the sector.

Terms of Reference

The consultant will be responsible to the Forest Industry Specialist, and will be required to:

(i) review forest sector and relevant macroeconomic policy developments in PNG, and make a determination of which policy variables have had major impacts on forest industry progress and development (or the lack thereof).

(ii) review the impacts on forest processing developments, and on overall economic growth, of major policy interventions in the forest processing sectors of other countries of Asia. Compile an interpretation of the lessons these experiences indicate for PNG.

(iii) estimate the likely costs, in terms of economic revenue rents foregone or opportunity costs manifested elsewhere in the economy, of applications of the common types of forest sector policy interventions: log export bans (complete or partial); other forms of subsidization of raw material or other factors of production; tariff and non-tariff protection of domestic markets; taxation concessions; and so on.

(iv) estimate the benefits, in terms of downstream income or employment generation, of the interventions.

(v) examine the extent to which likely adjustments in macroeconomic policy in PNG would impact upon the forest processing sector.

(vi) compile an analysis of the optimal settings of policy for forest industry development in PNG, within the context of overall economic growth, development and efficiency aims of GOPNG.

Location & Term

A 2 month assignment, based from Port Moresby

MARKETING SPECIALIST

Background

Any new large scale processing development in Papua New Guinea must be guided by a clear vision of future export markets and an understanding of the scale and nature of the forest resource which would form the basis of that industry.

It is generally thought that the domestic market is reasonably well catered for by the existing small to medium scale processing facilities. As any new industry will at least in part look to the domestic marketplace, it will be necessary to consider the likely this on the existing facilities, and particularly so from a marketing point of view.

Terms of Reference

The consultant will be responsible to the Forest Industry Specialist, and will be required to:

a) Analyse the competitive environment, generally and by specific target market areas, for exports from PNG of processed forest products in the light of possible or expected changes in that environment;

b) Assess the prospects of exports from PNG being able to compete in that environment, with particular reference to quantities, price levels and trends, quality and delivery requirements;

c) Consider in broad terms how the domestic demand for processed timber products might contribute to industry viability or otherwise be supported by a primary export oriented processing industry;

d) Specify any interventions which would need to be and could be taken by and within PNG to improve PNG's competitive capacity and/or secure a continuing viable market share.

e) Assist the Forest Industry Specialist to identify any areas, types and scales of industry and locations, which on the strength of market indicators and resource availability, may be worth more detailed investigation in the form of indicative pre-feasibility studies.

f) For any new industry so identified for further study, assess the likely consequences of such development on existing processing facilities from the point of view of competitiveness and market share of the domestic demand.

Location & Term

A 2 month assignment, based in Port Moresby.

GWV CONSULTANTS INTERNATIONAL
AND
NAWITKA RESOURCE CONSULTANTS
FIDS PROJECT INCEPTION REPORT
SEPTEMBER 26, 1992 - PORT MORESBY, PNG

8th October, 1992

The Director General,
National Forest Service,
P.O Box 5055,
Boroko, NCD,
Papua New Guinea.

Dear Sir,

I herewith submit for your acceptance and approval the Inception Report for the Forest Industries Development Studies, Project PD 108/90, dated 26th September, 1992.

This Inception Report was presented to the Steering Committee on the 28th of September, 1992, where general agreement was indicated that the submitted course of action should constitute the project activities and budget of the Forest Industries Development Studies Project. This Inception Report, which supersedes the Project Proposal submission, was developed within the framework of the project objectives, the current policy environment and the realities of the current structure and performance of the Papua New Guinea forest industrial sector.

I ask for your formal acceptance of the Inception Report.

Yours faithfully,

Conrad F. Smith, R.P.F.,
Forest Industries Specialist,
Forest Industries Development Studies Project.

Accepted.....
Director General

Date.....13/10/92.....

INCEPTION REPORT

26th, September, 1992

FOREST INDUSTRY DEVELOPMENT STUDIES

PROJECT PD 108/90

presented to

NATIONAL FOREST SERVICE
OF
PAPUA NEW GUINEA

by

General Woods and Veneers
Consultants International Ltd.
and
Nawitka Resources Consultants

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

AIDAB	=	Australian International Development Assistance Bureau
Asian DB	=	Asian Development Bank
CSIRO	=	Commonwealth Scientific and Industrial Research Organisation
DOF	=	Department of Forests
FAO	=	Food and Agriculture Organization of the United Nations
FID	=	Forest Industries Development
FMA	=	Forest Management Agreement
GDP	=	Gross Domestic Product
GoPNG	=	Government of Papua New Guinea
IBRD	=	World Bank
INA	=	Institute of National Affairs
ITTO	=	International Tropical Timber Organization
K	=	Kina
LTP	=	Local Timber Purchase
NFCAP	=	National Forestry and Conservation Action Plan
NFS	=	National Forest Service
NG	=	New Guinea
ODA	=	Overseas Development Administration
PNG	=	Papua New Guinea
TRP	=	Timber Rights Purchase
TST	=	Technical Support Team
UN	=	United Nations
UNDP	=	United Nations Development Programme
UNEP	=	United Nations Environment Programme

INCEPTION REPORT

FOREST INDUSTRIES DEVELOPMENT STUDIES

1.0 BACKGROUND

1.1 The Economy

Papua New Guinea's population is approaching 4 million in 1992. Real GNP is rising rapidly, fuelled by resource developments, principally in the minerals and petroleum sector. Mining production, construction of major petroleum and gas projects and exploration activities are all accelerating; real growth in this sector was estimated at 46% for 1991, with real investment rising by 60%. Real growth in GNP was estimated at 9% for the same year (PNG Banking Corporation).

In general, mining investments are heavily in imported capital goods, and forward production linkages to the rest of the economy are relatively weak. Revenue flows from these non-renewable resources are known to have a fixed life - the success of their re-investment holds the key to the economic future of PNG.

Plans are currently being drawn to reduce PNG dependence on foreign budget support, notably from Australia. However effective private industries are needed to generate economic jobs and income. Government expenditure remained at 48% of Gross National Expenditure in 1990, and the distribution is as shown in Figure 1.

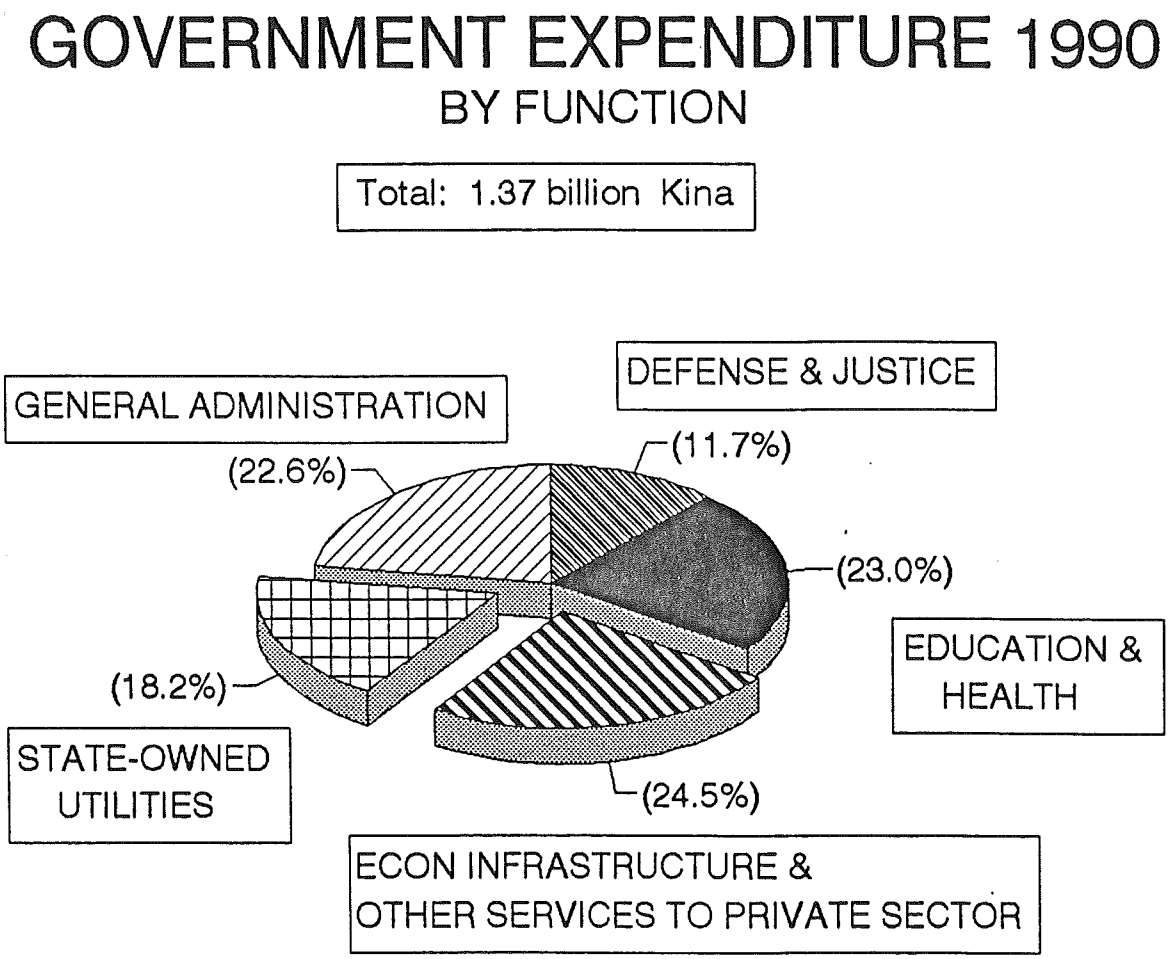
PNG is heavily dependent on imports, of both food and manufactured goods. Australia has been the traditional dominant supplier, but links are growing to Japan, the ASEAN Region, and New Zealand.

Total export revenue rose by about K 351 million in 1991 (32%) in spite of declining real prices and production for coffee, copra and palm oil. Supply problems in some parts of the Region (eg Philippines) may improve the price outlook for these commodities in 1992. New petroleum export revenues are forecast to earn a further K 500-600 million by 1993.

A key concern of the government is in employment, and development of linkages to domestic industries to efficiently support the expanding resource developments, replace imports, and eventually develop export markets for selected PNG manufactured products.

Further strong growth is anticipated in the construction, transport and manufacturing sectors in support of the mining-petroleum boom.

FIGURE 1.


GOVERNMENT EXPENDITURE 1990
BY FUNCTION
Total: 1.37 billion Kina
DEFENSE & JUSTICE
(11.7%)
GENERAL ADMINISTRATION
(22.6%)
(23.0%)
EDUCATION & HEALTH
(18.2%)
STATE-OWNED UTILITIES
(24.5%)
ECON INFRASTRUCTURE & OTHER SERVICES TO PRIVATE SECTOR

Employment in the private sector grew by 4 to 5% in 1991, or about 8,000 new jobs. Prices of some goods heated up in 1991, but overall inflation stabilized at about 6.5% in 1991 and is forecast to fall about a point in 1992. Non-mining GDP and non-mining private sector credit are each expected to grow by 9-10% in 1992.

The principal constraints to industrial development remain the same:

- widely distributed, diverse population with a few market centres;
- rugged terrain, dense forest, long coastlines, transport problems;
- cultural diversity (700 languages) and strong local loyalties;
- scarcity of technical-industrial skills in workforce, and;
- infrastructure still under development.

However in view of extensive forest resources, and growing world market interest in PNG timbers, the Government has strong hopes and ambitions for the forest sector to play a lead role in rural development and industrialization.

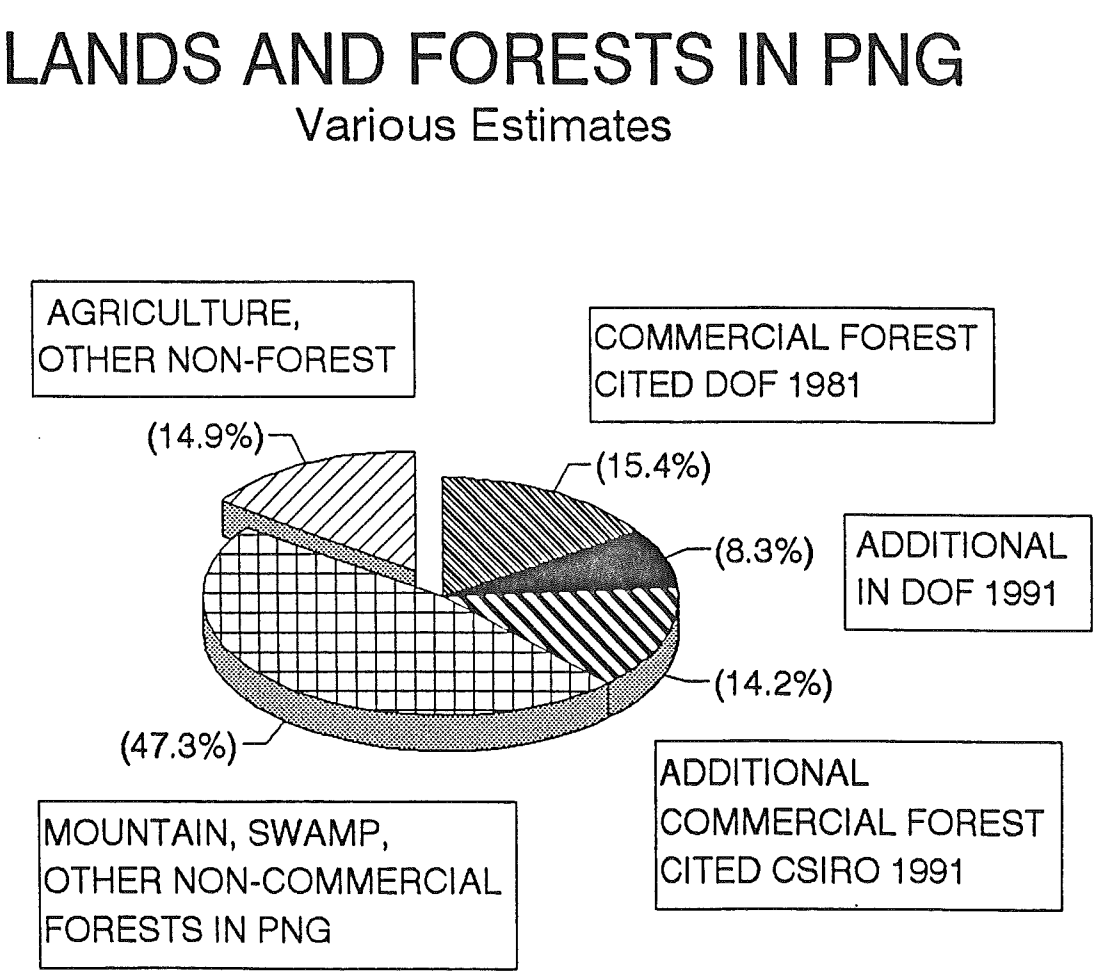
1.2 The Forest Sector

1.2.1 Forest Resources

Papua New Guinea is a nation rich in natural forest resources. Over 85% of land area is covered with forests (see Figure 2.). The largest block of deforestation is in the densely populated portions of the Highlands. In this region burning and shifting cultivation has expanded to a stage which creates the expansive hillsides of kunia (imperata) grasses familiar elsewhere in Asia. Most other regions are greater than 90% forested.

Ranging over the great elevation changes of the main island, and across the outer islands, representing sets of both Malay and Gondwanaland flora and fauna, they are among the most biodiverse national forests in the world. PNG flora alone comprise some 11,000 species; the principal commercial forest - lowland rainforest - contains more than 1,200 tree species.

FIGURE 2.


LANDS AND FORESTS IN PNG
Various Estimates
AGRICULTURE, OTHER NON-FOREST
COMMERCIAL FOREST CITED DOF 1981
(14.9%)
(15.4%)
(8.3%)
ADDITIONAL IN DOF 1991
(14.2%)
(47.3%)
ADDITIONAL COMMERCIAL FOREST CITED CSIRO 1991
MOUNTAIN, SWAMP, OTHER NON-COMMERCIAL FORESTS IN PNG

This can be contrasted to the situation in the largest forest product exporter of the world (Canada) where ten species account for over 90% of forest area and annual harvest. Even in the other tropical producer-countries of South-East Asia, ten species will account for over 50% of many commercial stands, while six species in Central and West Africa often constitute 70%.

As forests belong under custom law to the diverse local clans of PNG, they are also among the most socially diverse assets of any nation, with many types of traditional use.

This diversity has been a strong protective factor during the past century. World forest product markets and industries were simply not able to make major economic use of the PNG mix of species, under local development conditions.

However during the 1980's total harvest and exports have been increasing in the sector, principally through the export of roundwood (see Figures 3. and 4.). Some PNG species - in various mixtures - have found market niches elsewhere in Asia. This fact alone points to the need for a fresh appraisal of forest industry development in PNG in the 1990's.

1.2.2 Institutions

A recent major review of the PNG forestry sector was conducted under the auspices of the Tropical Forestry Action Plan (World Bank 1990). It concluded that "a completely new approach to forest administration in PNG" was necessary to limit environmental damage through logging, and to guide sector development into further manufacturing activities.

Known as the National Forestry and Conservation Action Plan in PNG, this programme included coordination of UNDP, UNEP, Asian DB, FAO, and other international agencies, as well as bilateral forestry programmes of Australia and New Zealand.

Critical sector issues/problems were identified:

- forest environment problems due to present logging methods and patterns;
- inadequate institutions and legislation to manage PNG forests on a sustainable basis;
- insufficient involvement of local landowners or local governments in forest use decisions and management;
- inefficiencies in domestic and export market processes;

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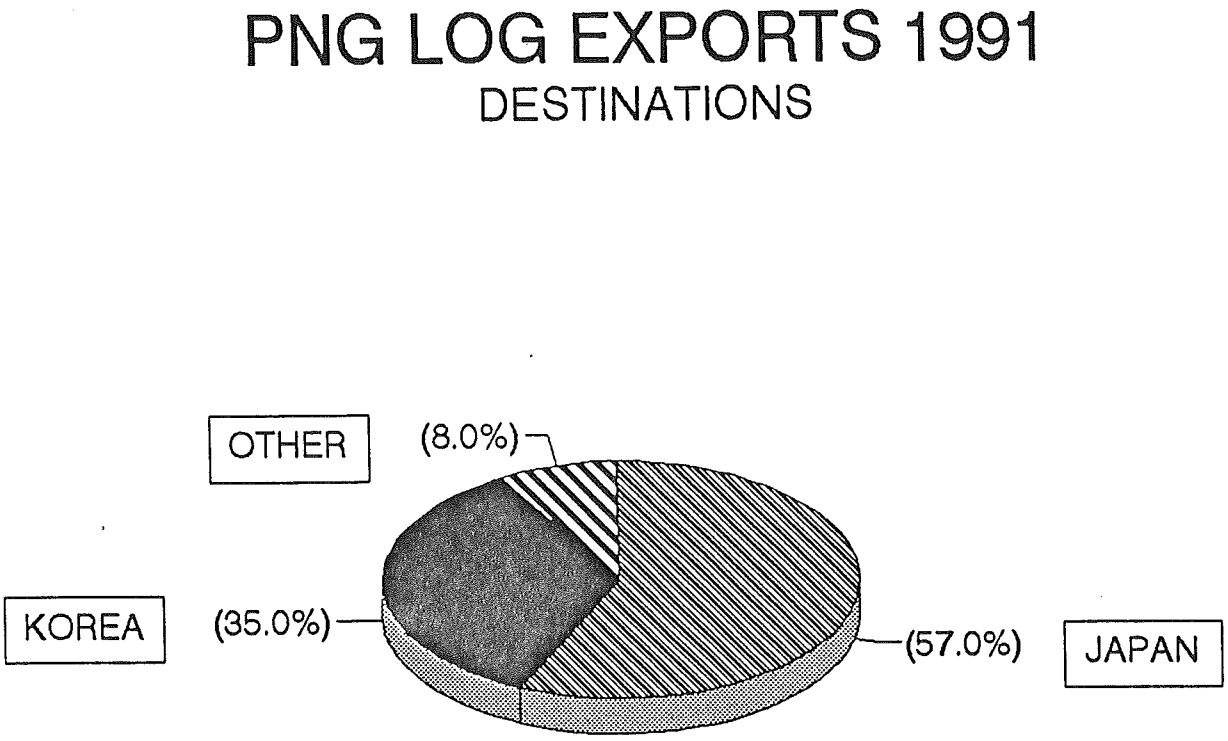
FIGURE 4.


PNG LOG EXPORTS 1991
DESTINATIONS
OTHER
(8.0%)
KOREA
(35.0%)
(57.0%)
JAPAN

- inadequate consideration of forest sector development policy options;

- insufficient forest resource data to support effective planning or management at local or national level, and;

- lack of coherent resource conservation policy.

With the assistance of a subsequent World Bank/UNDP Technical Support Team (TST) project, GoPNG has developed a new Forest Law, at least the outline of a new National Forest Authority and Forest Service, and several important follow-up sector studies (World Bank 1991, AIDAB 1991).

National elections intervened, and PNG now has a new Government including a new Minister of Forests. At this stage the outline plans for a new order in the forest sector are basically in place, but the operational systems to provide it, and the specific paths to achieve it, are not yet defined or funded.

It will be useful to review briefly two other important aspects of sector policy and economics before proceeding to the objectives of this project, because they bear critically on the work of the project. They are closely inter-related:

- forest tenure and taxation systems, and;

- current structure and performance of forest industries.

1.2.3 Forest Tenure and Taxation Systems

One of the most basic elements of forest sector development is the forest tenure or contract system - the means by which lands and forests are sold, leased, licensed etc. to the forest industry for economic use. Regardless of forest ownership, the conditions of these tenures/ contracts (and their enforcement) provide the major impetus to forest revenues, sector development, and forest sustenance.

To abbreviate a long and complex history, two basic arrangements have dominated, in the transfer of harvest rights from local landowners to industrial users:

- national timber rights purchase (TRP), and;

- local timber purchase (LTP).

Both have involved the use of an intermediary agent, representative or government between the landowner and the purchaser. One of the essential questions for forest industry investors has been that of which level of government acts as this intermediary. Many technical differences have been cited and some exist, but the essential question has remained - who is authorized to act for the local landowners. This question, and local issues related to it have played an important role in past sector developments.

Figure 5. shows the development of what has become the largest form of timber rights purchase - the national TRP. These are mostly (83%) long-term purchases of 20-40 years (see Figure 6.). The rapid acceleration in the early 1990's is evident.

This is a good point at which to re-stress the importance of operational forest resource information in strategy/policy formation. Figure 7. illustrates the accumulation of TRP and LTP purchases (i.e. allocated/ committed forest) in relation to various estimates of productive forest area. The difference in "room to manoeuvre" forest policies is evident, yet, none of the estimates has a sound empirical basis in field data, leaving no real basis for policy decision.

Figures 8. and 9. show the same TRP and LTP data against different regional production forest area estimates. One region, NG Islands, shows as already over committed under one forest area estimate.

Since the liberalization of log export authorities in 1979, most active TRP's have been involved in shipments of logs overseas. Some are still providing logs for domestic processing, some are not.

Sales revenue from log exports has increased dramatically during the 1980's, from about K 10 million to over K 100 million at the peak in 1987, and remain high to 1991 (see Figure 10.)

However, not surprisingly, both the scale and the distribution of those revenues has become an important issue to governments, landowners, and the industry (see AIDAB 1991). Figure 11. provides a summary of revenue distribution from export log sales in 1991.

One key issue involves the selling price of these logs, which governs total revenue and therefore various residual (stumpage and surplus) calculations and tax rates. The effectiveness of current and past systems in tracking "market" log prices for shipments from PNG has been widely debated (see for example INA 1988 and 1990, as well as AIDAB 1991).

Figure 5.

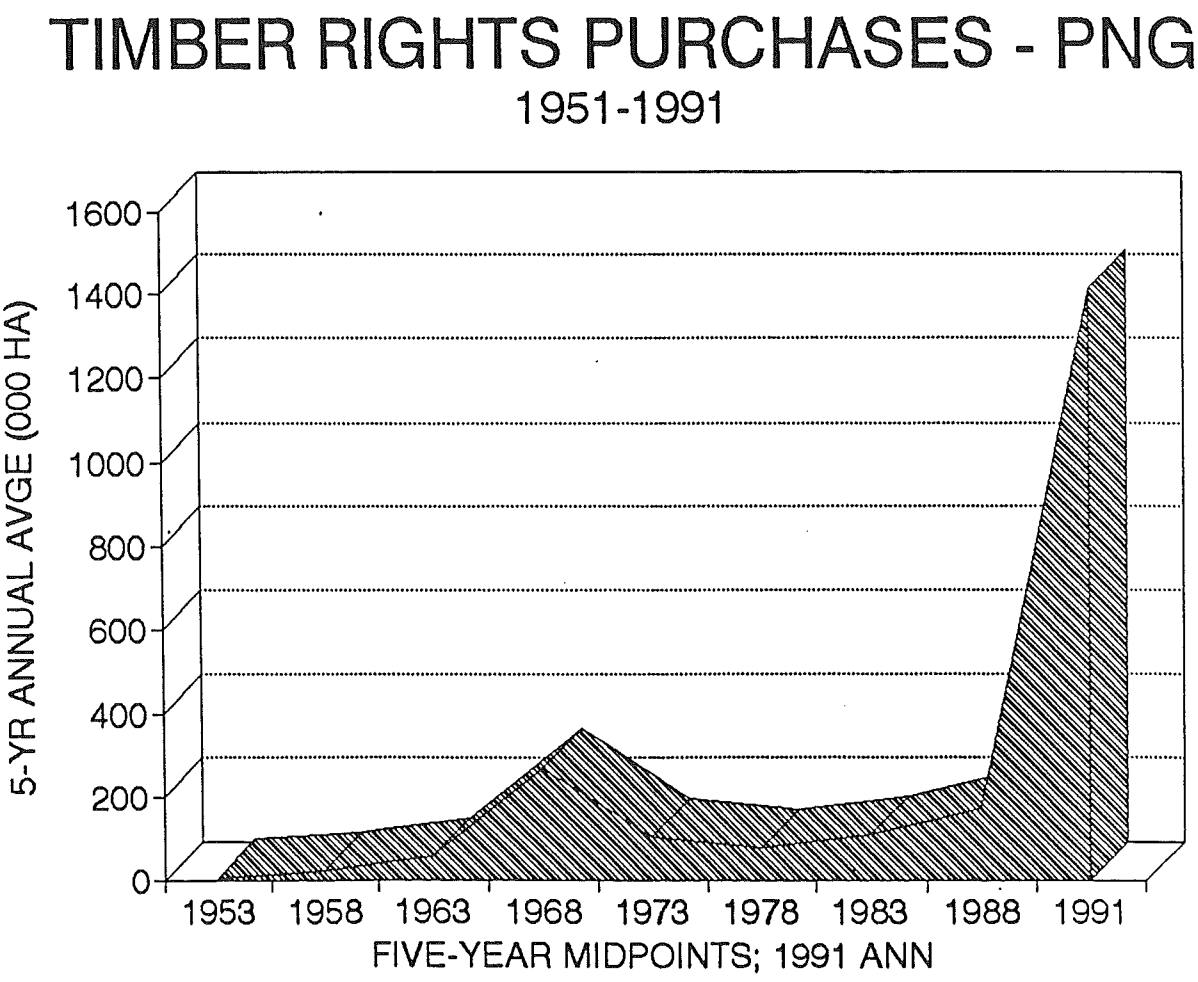

TIMBER RIGHTS PURCHASES - PNG
1951-1991
5-YR ANNUAL AVGE (000 HA)
1600
1400
1200
1000
800
600
400
200
0
1953
1958
1963
1968
1973
1978
1983
1988
1991
FIVE-YEAR MIDPOINTS; 1991 ANN

Figure 6.

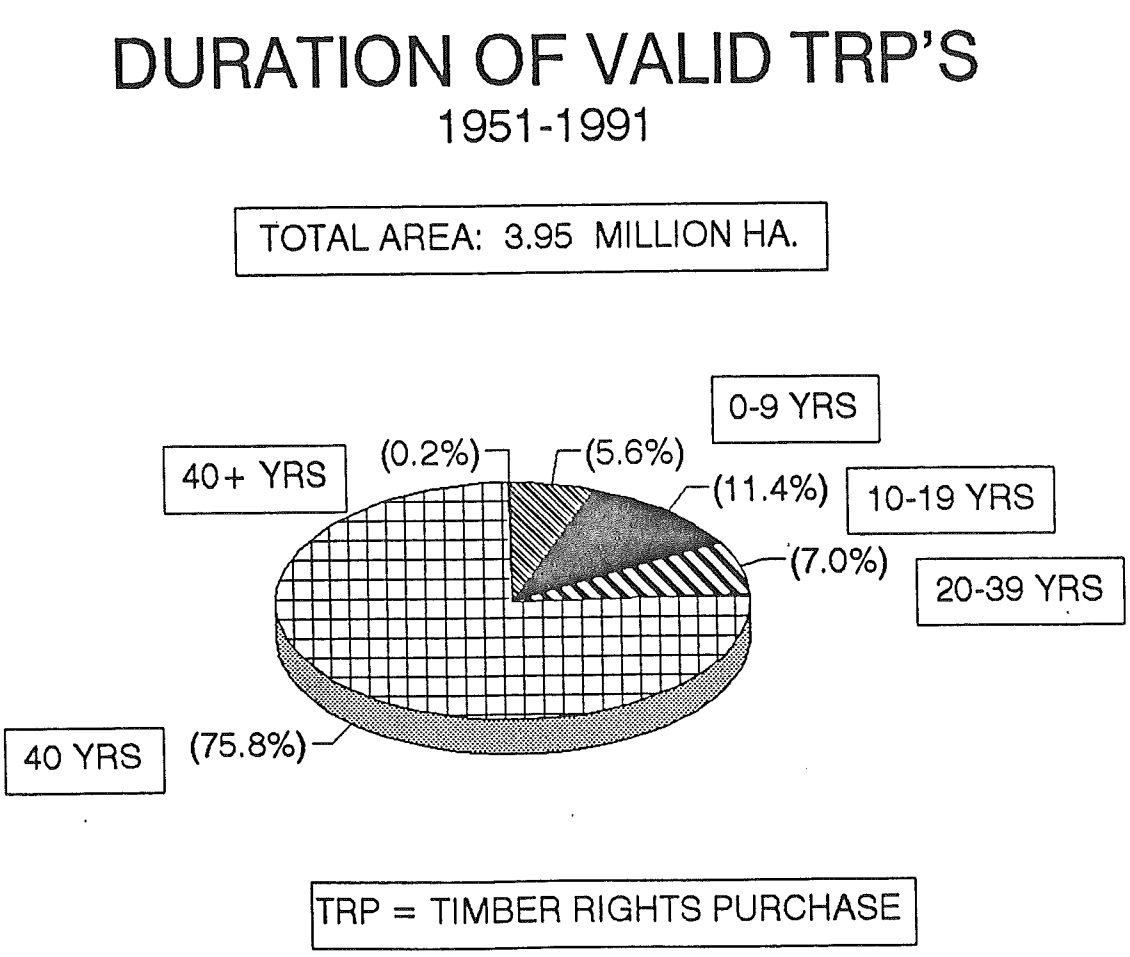

DURATION OF VALID TRP'S
1951-1991
TOTAL AREA: 3.95 MILLION HA.
0-9 YRS
(0.2%)
(5.6%)
40+ YRS
(11.4%)
10-19 YRS
(7.0%)
20-39 YRS
40 YRS
(75.8%)
TRP = TIMBER RIGHTS PURCHASE

Figure 6A.

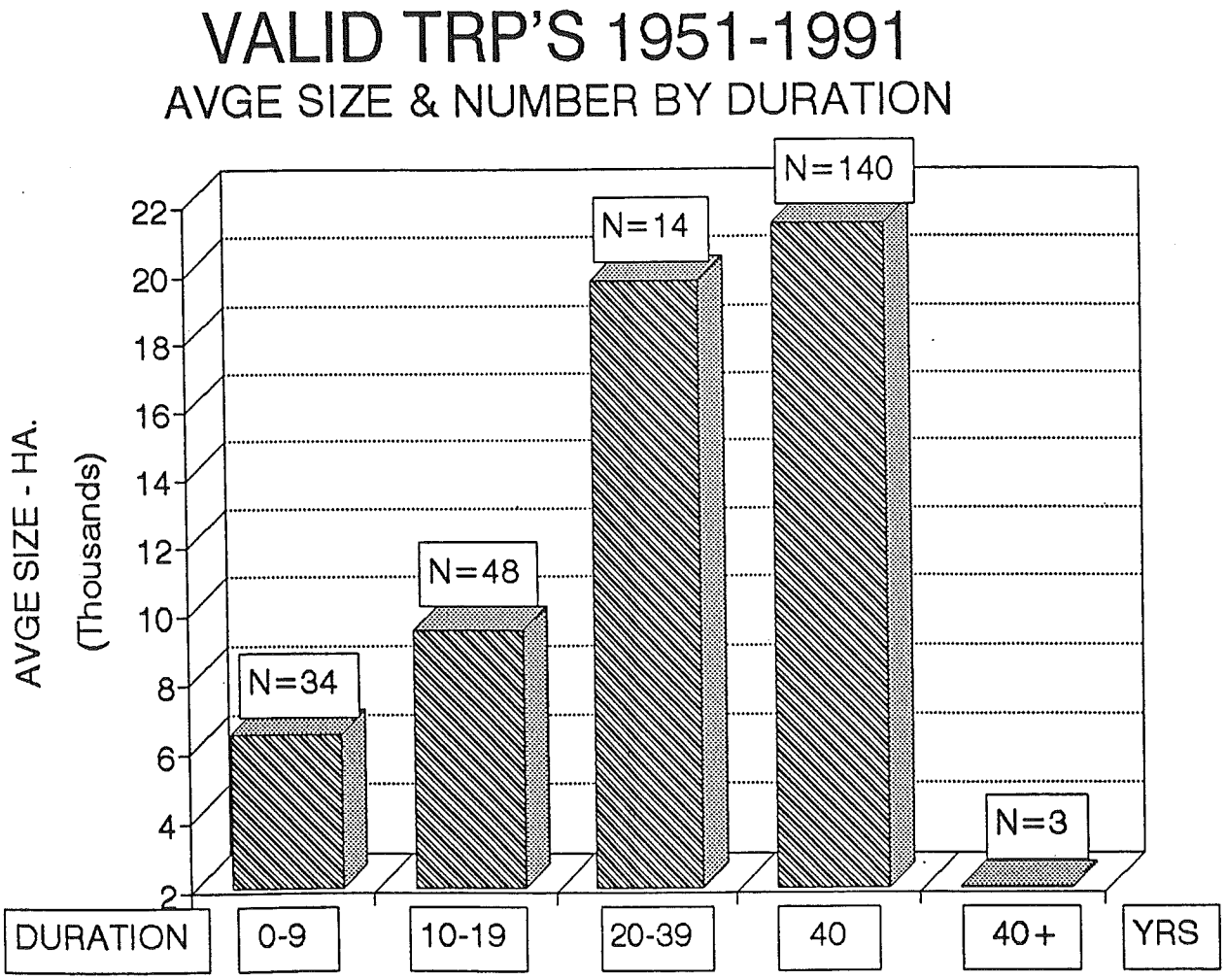

VALID TRP'S 1951-1991
AVGE SIZE & NUMBER BY DURATION
AVGE SIZE - HA.
(Thousands)
22
20
18
16
14
12
10
8
6
4
2
N=34
N=48
N=14
N=140
N=3
DURATION
0-9
10-19
20-39
40
40+
YRS

Figure 6B.

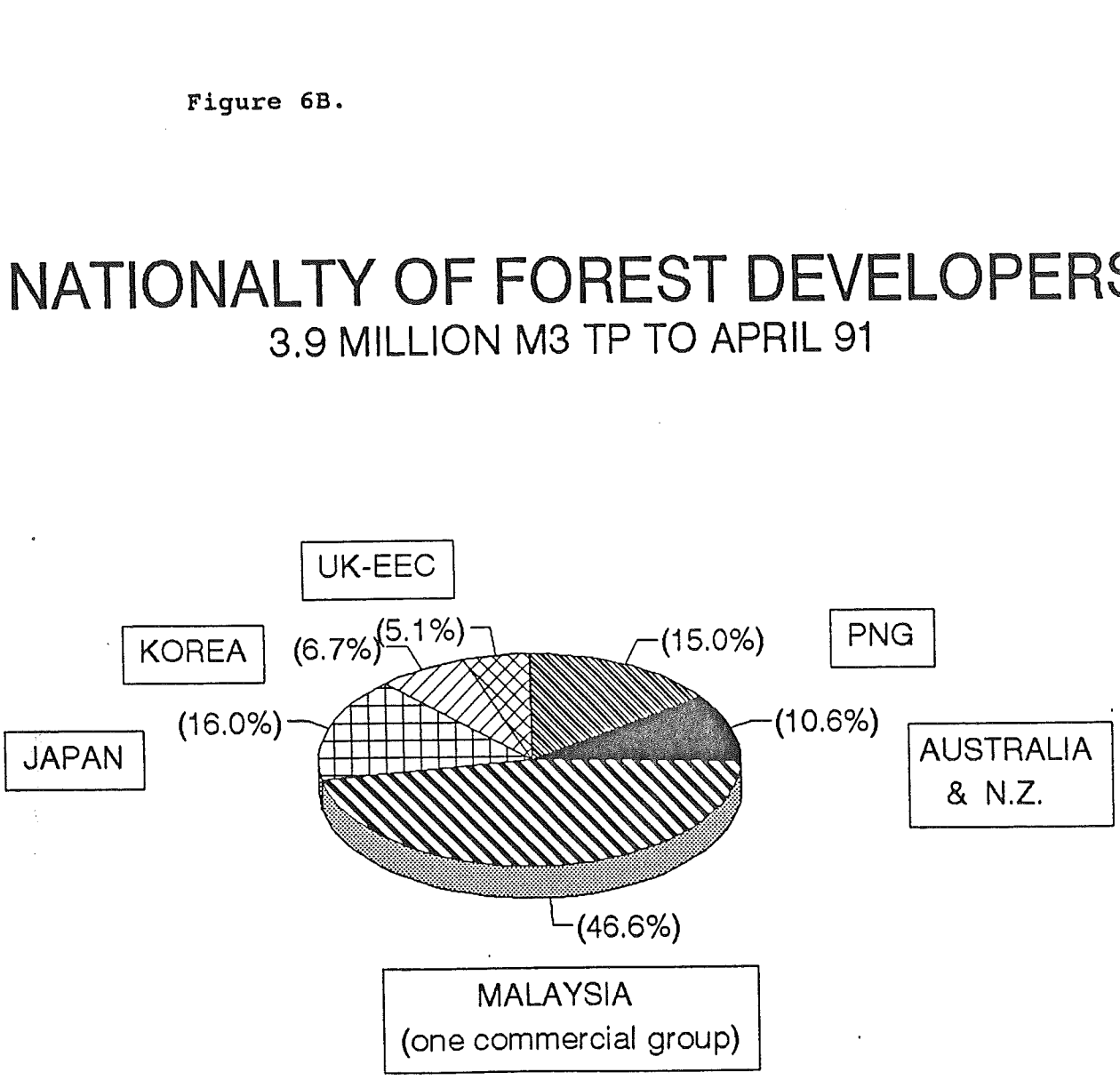

NATIONALTY OF FOREST DEVELOPERS
3.9 MILLION M3 TP TO APRIL 91
UK-EEC
KOREA
(6.7%)
(5.1%)
(15.0%)
PNG
(16.0%)
(10.6%)
JAPAN
AUSTRALIA & N.Z.
(46.6%)
MALAYSIA (one commercial group)

Figure 7.

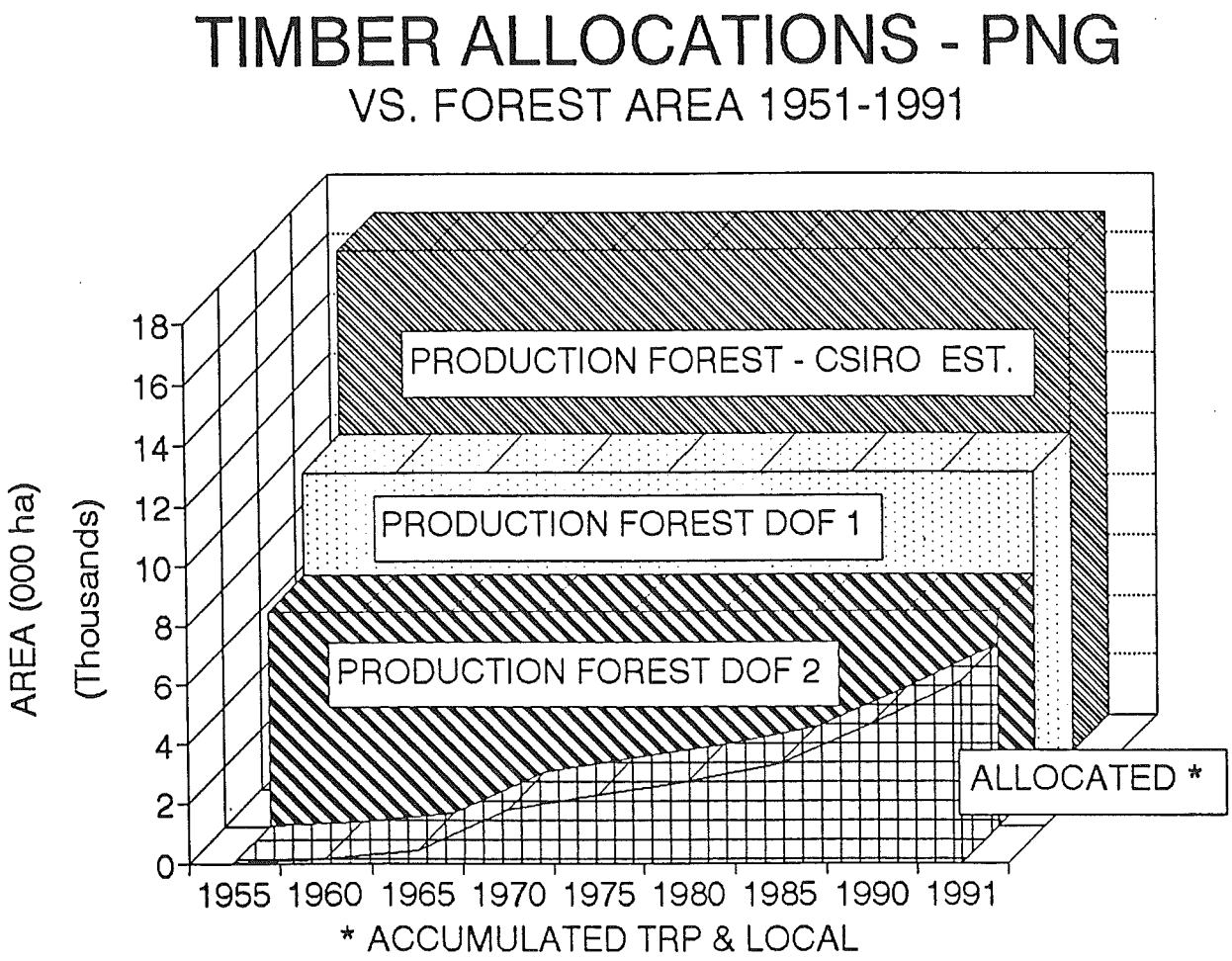
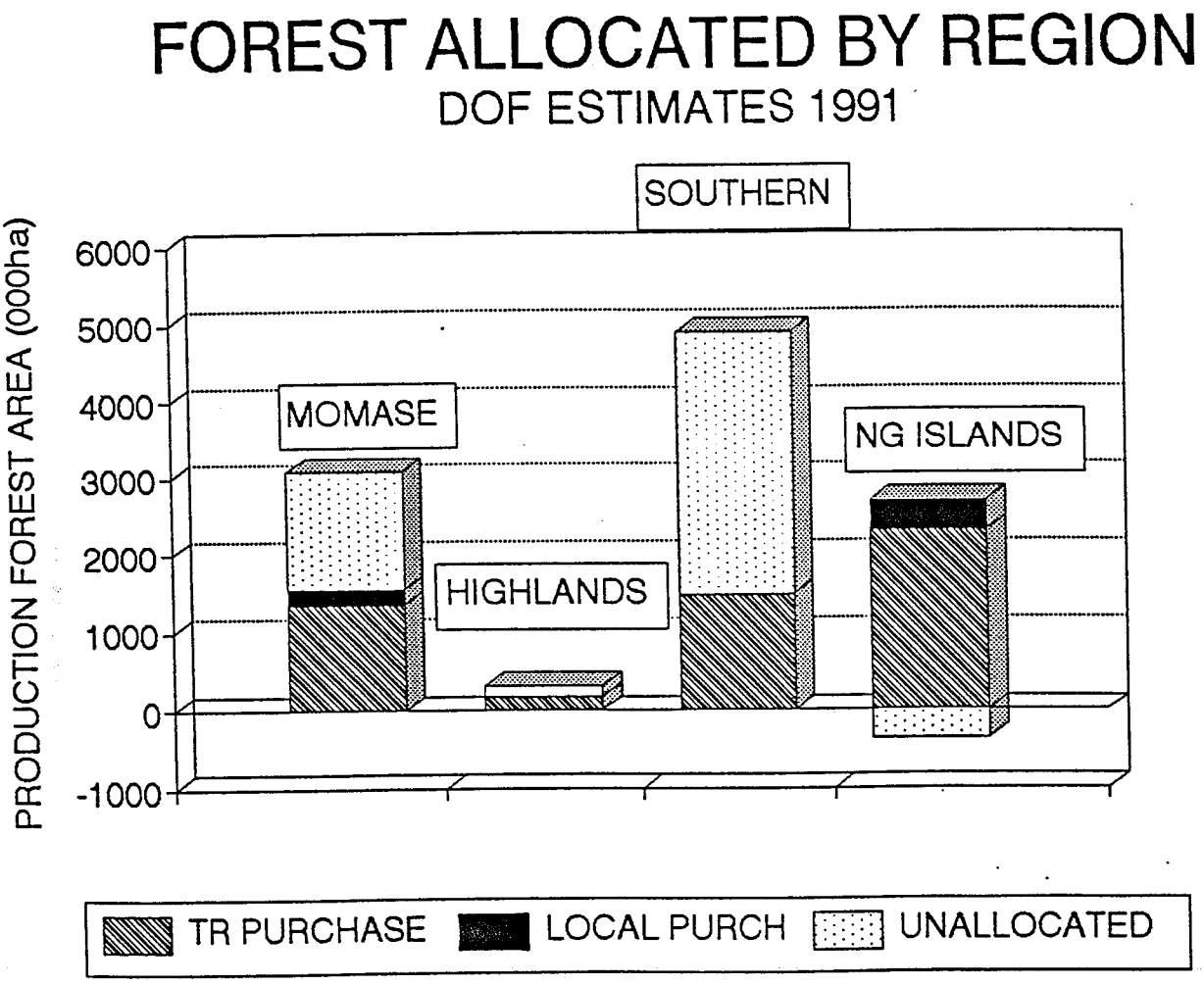

TIMBER ALLOCATIONS - PNG
VS. FOREST AREA 1951-1991
AREA (000 ha)
(Thousands)
18
16
14
12
10
8
6
4
2
0
PRODUCTION FOREST - CSIRO EST.
PRODUCTION FOREST DOF 1
PRODUCTION FOREST DOF 2
ALLOCATED *
1955 1960 1965 1970 1975 1980 1985 1990 1991
* ACCUMULATED TRP & LOCAL

Figure 8.



No page 16

Figure 10.

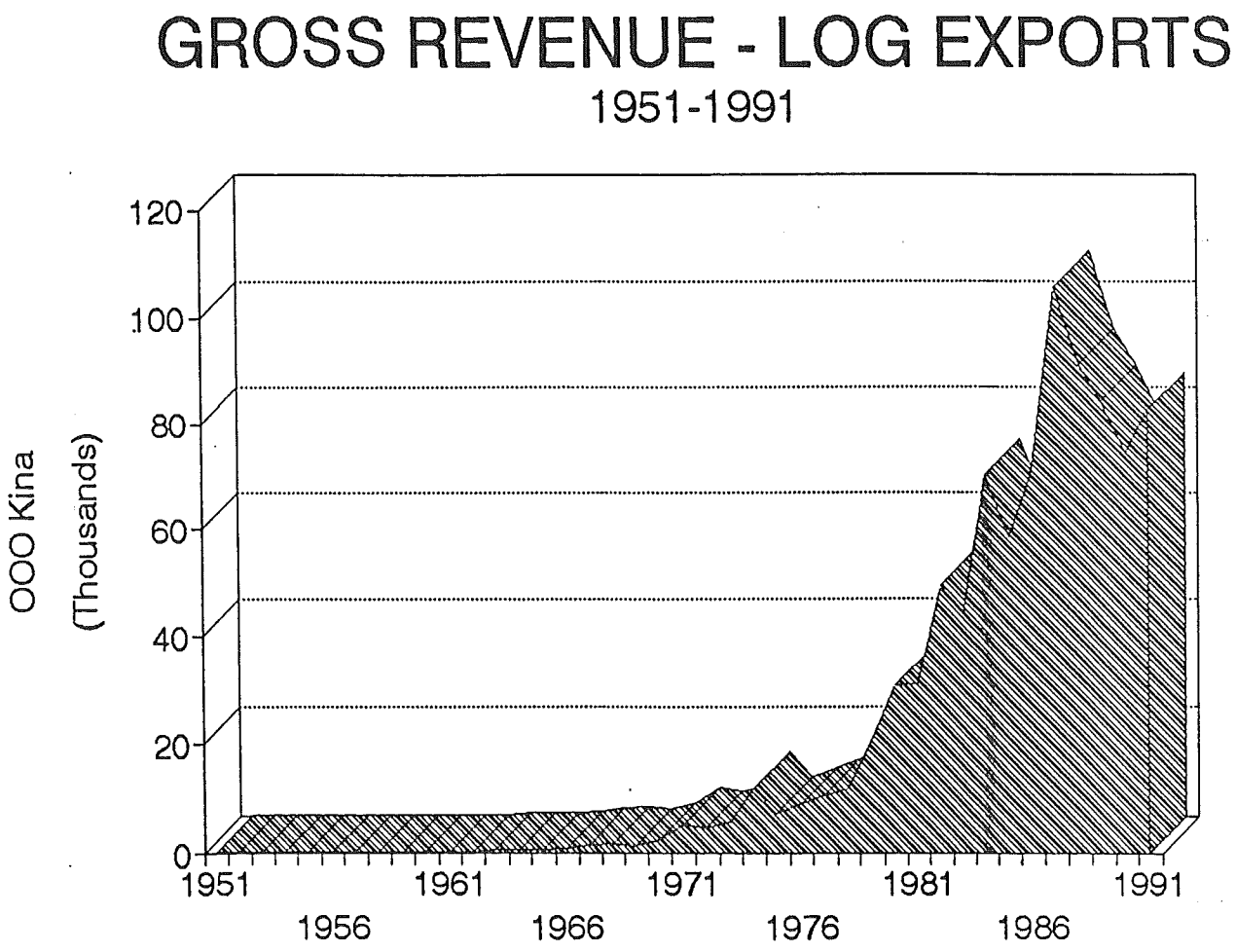

GROSS REVENUE - LOG EXPORTS
1951-1991
OOO Kina
(Thousands)
120
100
80
60
40
20
0
1951
1956
1961
1966
1971
1976
1981
1986
1991

Figure 11.

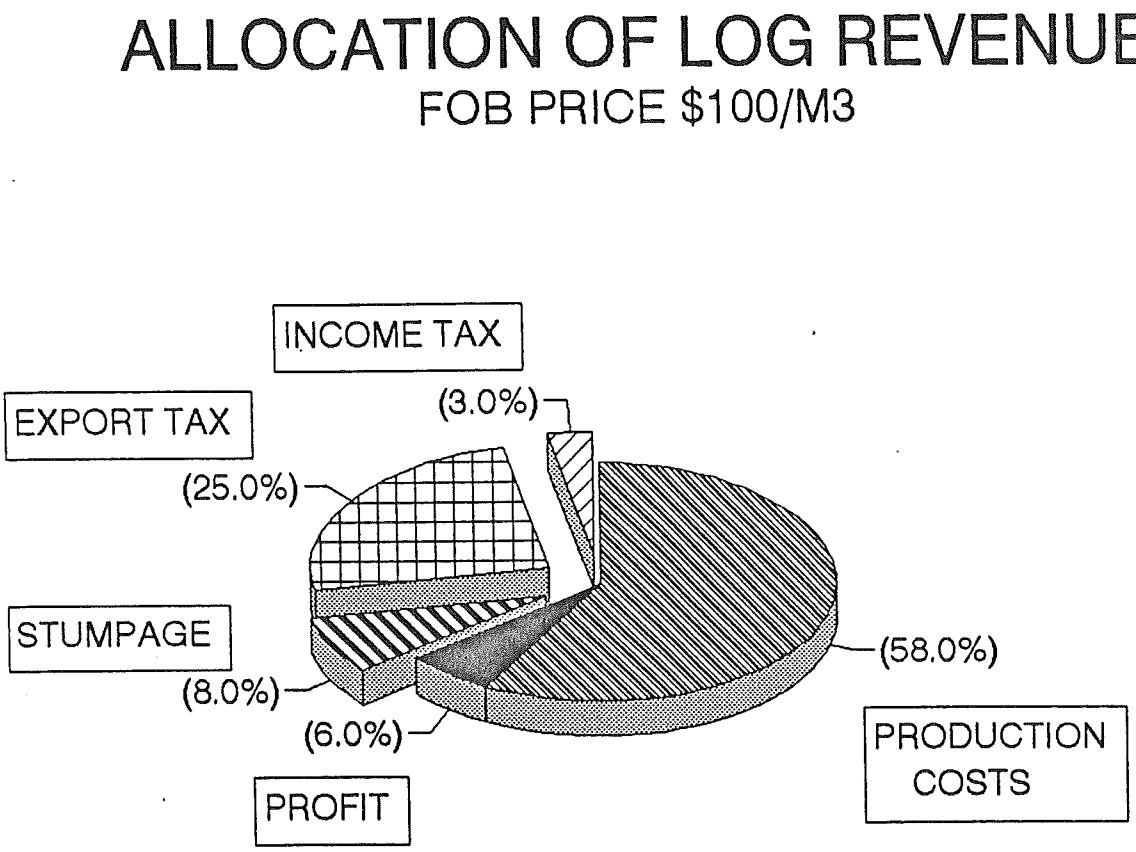

ALLOCATION OF LOG REVENUE
FOB PRICE $100/M3
INCOME TAX
(3.0%)
EXPORT TAX
(25.0%)
STUMPAGE
(8.0%)
(6.0%)
PROFIT
(58.0%)
PRODUCTION COSTS

Figure 12. shows the trend of average sales price over forty years. Two evident peaks in the last two decades roughly coincide with pricing policy moves which could have been expected to raise the effective price. However they also coincide with general market improvements during the same time periods. The data on log species also is reported to contain significant weaknesses.

Perhaps an even more important issue involves the appropriate share of the revenue by the land/timber owner. No single issue weighs more heavily on the ultimate sustainability of the forest sector as a viable economic presence in PNG. This clearly is also governed by the related issue of what the owner or his agent(s) do with payments for original forest resources.

The national government has exercised its right to tax raw material exports, and as a result currently collects about three times that which land/timber owners collect for each cubic metre of roundwood exported from a TRP or LTP area. A range of other, more minor, taxes and transfers further complicate and confuse the basic sector issues such as:

- reforestation and forest management (therefore sustainability of harvest), and;
- profit for investment/reinvestment in infrastructure and equipment (therefore development of the sector).

The new National Forest Service, the NFCAP-TST advisors within the related Transition Management Committee, and the Finance Department have not yet agreed on a single strategy/policy line in this field. Figure 13. illustrates one of the current debates, i.e., what marginal rate of export tax should apply to logs as their value increases.

An **integrated policy** will be critical to achieve increased forest product manufacturing in the sector. Perfect revenue policies should not be the objective. They are near impossible to achieve in any event, and even harder to document (ref. Figure 12.). Rather policies should focus on the ultimate objectives of sector development:

- establishment of efficient industries of appropriate types for PNG conditions over time, able to compete in international markets;
- effective transfer of necessary technologies and achievement of necessary human resource development, and;

Figure 12.

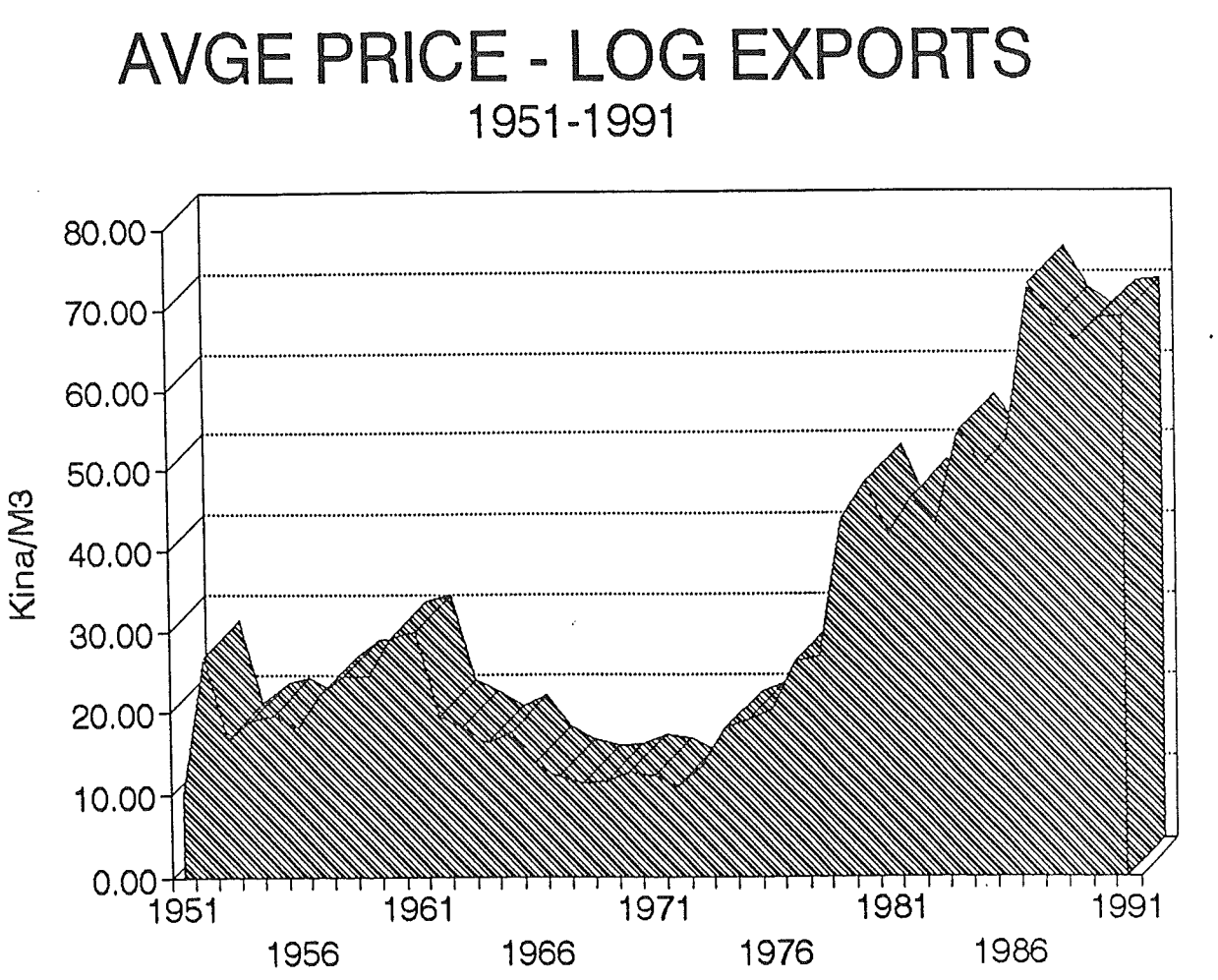
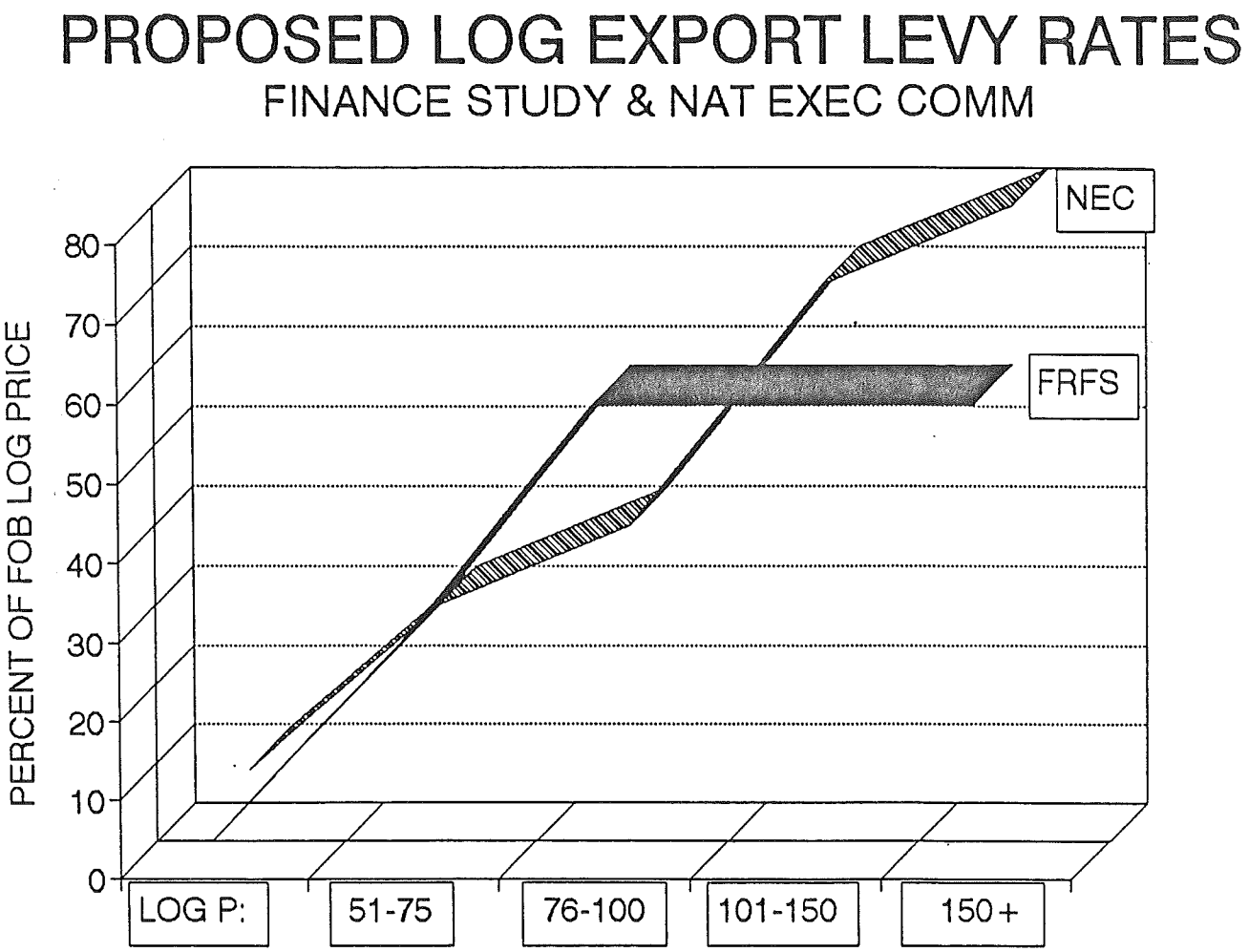

AVGE PRICE - LOG EXPORTS
1951-1991
Kina/M3
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1951
1956
1961
1966
1971
1976
1981
1986
1991

Figure 13.


PROPOSED LOG EXPORT LEVY RATES
FINANCE STUDY & NAT EXEC COMM
PERCENT OF FOB LOG PRICE
80
70
60
50
40
30
20
10
0
NEC
FRFS
LOG P:
51-75
76-100
101-150
150+

- development of internal self-sustaining support systems for forests, dependent industries and the derived stream of socio-economic benefits.

It is in this regard that past policies have evidently not been successful. Is this simply an apt recognition of the economic realities of manufacturing in PNG, or a major policy failure?

1.2.4 Current Forest Industries

In early 1992, sixty five registered forest products operators were reported active in PNG. Thirty eight companies were engaged in log export operations, and sixteen of these also operated sawmills. Twenty seven companies were engaged solely in sawmilling, bringing the total registered sawmill operations to forty three. There are reportedly a larger number of small "walkabout" or mobile sawmills cutting timber for local use in various parts of the country (as many as 400?).

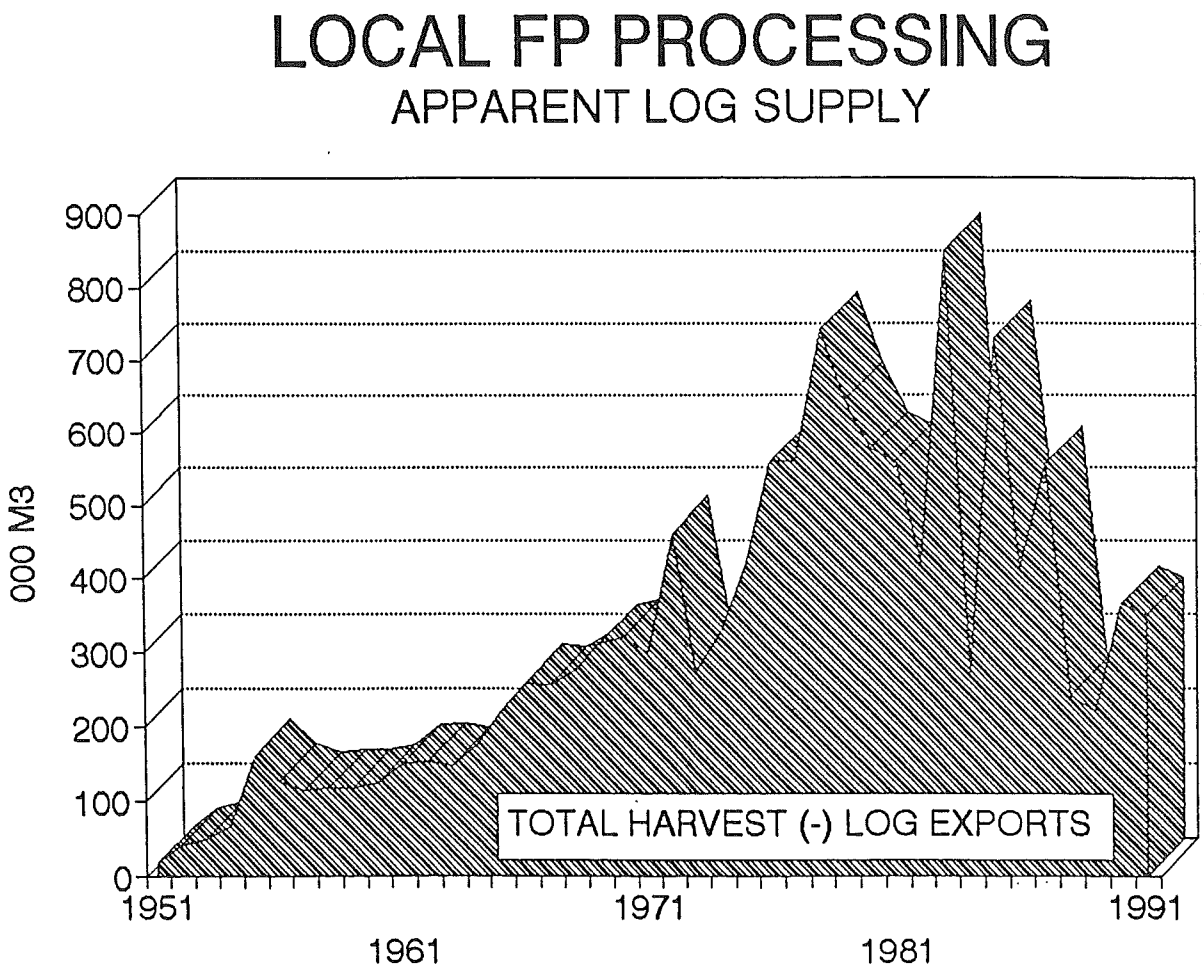
These mills in total have been supplying the domestic market with approximately 120,000 m3 of sawnwood in recent years, in the rapidly growing domestic economy. Figure 14. shows an estimate of the domestic log supply (total log harvests less log exports). However, this estimate needs adjustment for chip export.

An ad valorem import tax/tariff of 50% is applied to lumber imports, and to wood-based manufactures (furniture, house components etc.).

Only six domestic sawmills have log input capacity exceeding 20,000 m^3 per annum (one expression of minimum economic size), and only about 3000 m^3 of sawnwood was exported in 1991. Some of the reported inefficiency of the domestic processing sector is likely attributable to the tariff protection from imports. However another major factor is the general uncertainty and constraints imposed on investment by the tenure/contract/licensing systems over time.

One fairly old plywood mill exists at Bulolo, operating at minimum levels. There is virtually no utilization of sawmill residues in PNG (likely current volume of 200,000 m3 is mixed in species, scattered, and produced intermittently). Two major pulpwood chip operations have been established in PNG. Only one has operated commercially (near Madang), and the other has been moth-balled since its construction (East New Britain). Both operations have exported logs.

Figure 14.


LOCAL FP PROCESSING
APPARENT LOG SUPPLY
000 M3
900
800
700
600
500
400
300
200
100
0
1951
1961
1971
1981
1991
TOTAL HARVEST (-) LOG EXPORTS

The background and causal agents of the current situation in manufacturing has been widely debated in PNG (see for eg INA 1990). However meaningful information on real cases seems to be scarce. As with log exports, it is premature to draw firm conclusions on immediate steps for improvement.

One of the sector studies recommended in the National Forestry and Conservation Action Plan (NFCAP) was a study/advisory project in forest industries development to improve this situation. It was funded by the UN International Tropical Timber Organization (ITTO) and GoPNG. This is the Inception Report for this Forest Industry Development Studies, Project PD 108/90 and, as such, becomes the applicable operational Project Document.

2.0 DESCRIPTION OF THE PROJECT

2.1 Objectives

The basic objectives of the project are to formulate a coherent and well-supported **series of recommendations** on the question of whether and how to pursue more intensive evaluation of specific forest processing possibilities, and to present these findings to the GoPNG after extensive dialogue with Government and industry agencies.

The project is in line with the country's National Goals and Directive Principles and the revised forest policy which aims to ensure a greater onshore processing industry in the country.

2.2 Immediate Objectives

The immediate objectives of the project are:

- to undertake a pre-industrial survey to determine where and how Papua New Guinea can utilize its forest resources to its optimum use within the country, and;
- to evaluate the economic worth of the current processing industries and recommend improvements and/or integration.

2.3 Project Duration and Timeliness

The project is scheduled to cover an 18 month period, commencing 26th July, 1992, and extending to 26th January, 1994. This project comes at a time that:

- a new Forest Act has come into effect (25th June, 1992);

- the Department of Forests and the Forest Industries Council have been integrated into a new National Forest Service under the direction of a National Forest Authority which is under the administration of a yet to be appointed National Forest Board;

- major policy changes are under review vis a vis the forest revenue and finance structure of the forest sector;

- a significant reorganization is under-way in the area of timber acquisition, allocation and harvesting administration, and;

- major policy changes are being considered vis a vis the export of raw logs.

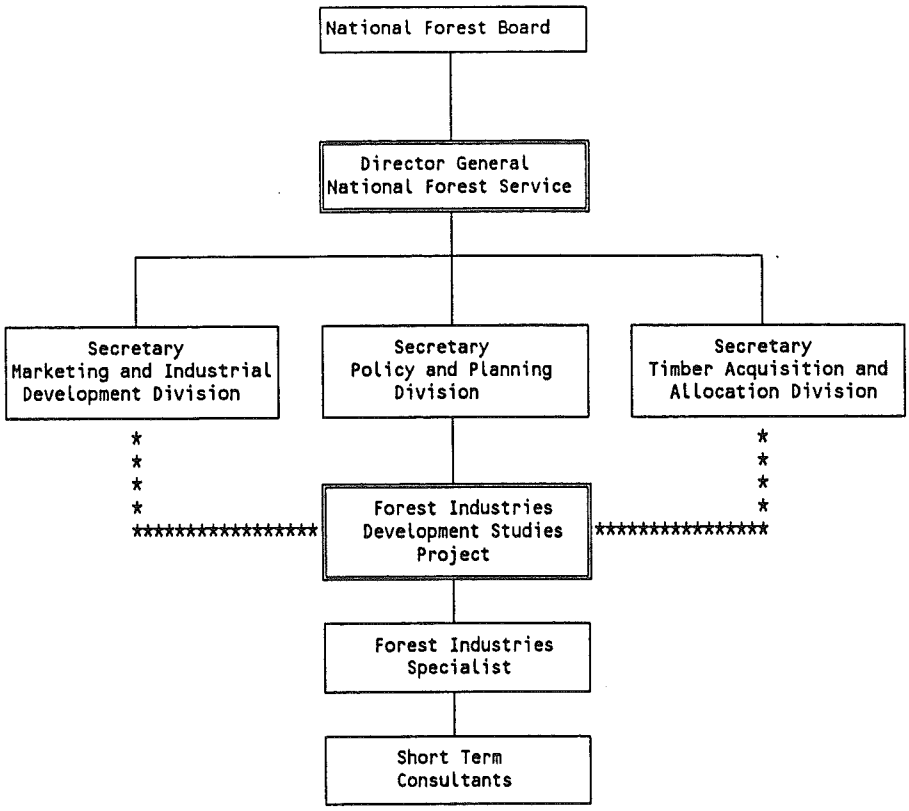
The final results of this project will provide timely and valuable guidance for the process of change already under-way.

3.0 PROJECT TASKS

3.1 Mobilization/Inception Report

Project commencement saw the mobilization of the Forest Industries Specialist and his establishment in Port Moresby at the offices of the new National Forest Authority. Project support was provided in the form of office space, transport and computing facilities. The organizational structure designed to guide and administer the project is given on page 26.

Under this structure, the Forest Industries Specialist is responsible to the Director General of the National Forest Service. For administrative and guidance purposes, he reports through the Secretary, Policy and Planning Division. He also has a close liaison linkage with the Secretaries, Marketing and Forest Industries Development, and Forest Acquisition and Allocation, Divisions. There is also close liaison to be established with the Forest Industries Association (who will have a Member on the National Forest Board), the Transitional Committee (created to assist and advise in the transition of the Department of Forests to a National Forest Service) and the IBRD/UNDP/ODA supported Technical Support Team (part of the operating wing of the Transitional Committee).



Within the first two month period, the Forest Industries Policy Specialist was also mobilized to commence his review of the current and evolving policy situation.

This Inception Report has been developed within the framework of the project objectives, proposal document and current policy environment. While the Inception Report, to some extent, has tried to anticipate the likely evolution of the Government's policy regarding the Forest Industrial Sector, it must be recognized that modifications may be needed to the project tasks in light of the developing situation. Such revision will take place at the Project Review periods (see Project Schedule, Page 32), as well as ad hoc, in discussion with the Director General, as needed.

3.2 Sectoral Reviews

There are two main subjects of the sectoral reviews. The first investigates the economic prospects of the Forest Industrial Sector in PNG in terms of:

- regional and global markets;
- general requirements of various forest industries;

- economic impacts by sector component, and;
- general feasibility assessments of alternate phased plan scenarios.

The second subject of the sectoral reviews investigates the current forest industry structure and performance in terms of:

- forest management;
- sawlog exports;
- sawnwood, both domestic and export;
- wood-based panels;
- wood-based manufacture, and;
- chips/pulpwood.

3.3 Stage No. 1 - Analysis

Based on the results of the sectoral reviews, selected case studies will be defined taking into account:

- market opportunities;
- resource opportunities including fuller utilization;
- prospects and systems for sound local operational and financial participation;
- domestic constraints, and;
- direct international competition in desired or favourable fields of production.

The terms of reference for the participants in the case studies will be prepared based on the parameters of the defined and selected case studies.

3.4 Stage No. 2 - Case Studies

The project will then move to the implementation of the case study stage. This will include studies of the Forest Industrial Sector system components in an effort to

identify release constraints. Given the results of the case studies and the release constraints, an analysis will be made of the Forest Industrial Sector that will develop conclusions that can be used as the basis of efficient and effective forest industrial development.

3.5 Stage No. 3 - Final Report Preparation

The derived conclusions from Stage No. 2 will be analyzed to develop recommendations for a stepwise achievement of increasing, bolstering and enhancing manufacturing in the PNG Forest Industrial Sector, all in keeping with the Government's forest industrialization policy.

3.6 Final Report Review and Acceptance

The draft final report will then be circulated to all interested parties and reviewed in depth in order to ensure that the recommendations encompass all available constructive input. It will be on this basis that a final report containing a well-supported series of recommendations on the question of whether and how to pursue a path leading to forest industrial development in PNG will be submitted.

3.7 Proposed Developmental Scenario Framework

The above project tasks will be set within the following scenario framework which seems to be the range of options under the current consideration of the Government as a Medium Term Forest Sector Strategy.

The principal objectives of forest sector development for the 1990's have been established by the new GoPNG as:

- rapid increase of processing/manufacture in PNG of national industrial roundwood harvest, and;
- defined, monitored systems of forest management to sustain industrial roundwood harvest from all production forests.

To achieve the objectives, two broad alternate strategy lines have already been proposed (NFCAP/TST):

3.7.1 Scenario I

A phased programme of new regulations, development incentives and institutional improvements will be put in place to achieve the first objective in stages, with a relatively smooth transition from log exports to wood products. Detailed regulations and methods of enforcement will be developed under the new Act.

A separate but related programme of new Forest Management Agreements for all timber purchases (existing and new), as set out in the new Forest Act, through the new National Forest Board and new National Forest Service, will develop efficient, locally focused programmes and institutions to achieve the second objective in stages:

- effective ground control of area harvested as well as species volume and grade removed from all FMA's (replacing TRP's);
- improved forest information systems to provide a scientific base for the definition of sustainable harvest in each Forest Management Area and nationally;
- national forest inventory, mapping and management planning system operational at 1:250,000 scale;
- establishment and operation of expanded National reforestation Trust Fund to reforest selected areas with industrial species annually, and;
- expand silviculture research to improve performance of selection harvest systems in PNG natural forests.

The above scenario has implications for financing and related policies as follows.

A phased plan will have to be developed in detail to achieve both the industry development and forest resource management objectives of the strategy. International technical assistance will be secured to speed and enhance the process at each stage.

GoPNG will have to commit resources to special infrastructure development (mostly marine transport/dock facilities) to enable assembly and export of manufactured forest products.

GoPNG will also have to commit resources to management of, and reinvestment in, renewable forest resources, at an economic level.

In this scenario it is suggested that the **revenue generated by log export taxes cum levies,** over the phase-down period, **be directed to the support of local infrastructure development, the National Forest Service and to reforestation.**

This would be achieved through a log export levy, with allocation and control by the new NFS/Board and technical consultants provided by NFCAP/TST/FID projects.

Many alternate schedules and reinvestment rates could be defined within Scenario I - the proposed Scenario strove to combine urgency with realism in achieving the main goals, and proposed to **use the export levy revenues from log exports to hasten and smooth the transition to manufacturing.**

The proposed development path in Scenario I will be difficult to achieve efficiently. Radical shortening of the time scale will result in inefficiencies or significant reduction in harvest and current benefits. Efficient planning and mill construction, together with marine transport/infrastructure, schedules will take at least 8 years to assemble on the scale envisaged.

It should be noted that lumber import duties should concurrently be phased down from the present 50% to 0% by 2000 so that the people of PNG can acquire locally supplied wood products at world prices.

3.7.2 Scenario II

In the absence of GoPNG direct reinvestment, through the export levy, in forest sustenance and forest products manufacturing and export infrastructure as described above, a different strategy could be indicated as follows.

A rapid phase-down of log exports, with the objective of preserving future options in forest products manufacture, until such a time as feasibility of assembly and export shipment becomes proven through strictly market responses.

Scenario II will likely result in a rapid reduction of production and attendant benefits from the forest sector. It will have the advantage of saving sawlog-timber on the stump until efficient processing can be installed. Financing reforestation, the National Forest Service, infrastructure etc., will have to be provided by private sources and from GoPNG general revenue.

This strategy will likely carry an increased risk of inefficient development paths for the industry if investments are rushed into place.

4.0 PROJECT PLAN

4.1 Project Operational System

The project will be conducted in accordance with the Project Tasks (Sec. 3.0) with activities being undertaken in well defined stages (see Project Activity/Manpower Allocation Chart, page 32). Due to the nature of the inter-relationship among the components of the Forest Industrial Sector, there will be analysis, review and feed-back of the impacts amongst the Forest Industrial Sector components and case studies at each stage. A situation report will be made at the completion of each component and case study and stage. These reports will be circulated to the principal interests within the Forest Industrial Sector with a request for further input. In this manner, close communication concerning the on-going development of the project will be maintained with the National Forest Authority, Ministries of Finance and Industry, the Forest Industries Association and the National Forest and Conservation Action Programme participants. Bi-Annual (September/April) reports will be prepared in accordance with ITTO requirements. These, and all relevant case study, component study etc. reports, will be tabled at the Bi-Annual regular Steering Committee Meetings.

The above operational system will lead to the development of clear recommendations that identify key actions needed, in order to achieve the desired level of forest industrialization, in a logical sequential action plan in terms of:

- what the Government needs to do through;
  - the Ministry of Finance,
  - the National Forest Board and its National Forest Service;
- what the demands will be on the financial institutions;
- what the demands will be on the Service Sector;
- what the land and timber-owners need to do[1], and;
- what the forest industrial investor/operator needs to do.

---

[1] In broad terms, intensive local discussions/communications will be needed to induce the local land and timber owners to enter into meaningful corporate style arrangements that will be respected by all parties.

PROJECT SCHEDULE

EXPERTISE	1992					1993												1994	STC[2] Char Days
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	
Forest Industries Specialist																			
Forest Industries Policy Specialist																			49
Forest Finance and Taxation																			25
Wood-Based Panels Specialist																			45
Processing and Manufacture Specialist																			38
Maritime Logging and Transport																			26
Forest Products Marketing																			43
PROJECT REVIEW		*						*						*		*	***		226

PROJECT ACTIVITY / MANPOWER ALLOCATION

Symbol	ACTIVITY	For. Ind. Specialist	For. Pol. Specialist	Finance Taxation	Panels Specialist	Processing Manufact.	Logging Transport	Products Marketing	Total	%
	Mobilization and Inception Report	40	10						50	9
	Sectoral Reviews	80	14		10	10	3	10	127	22
	Case Study Definition and T.O.R.	60	4		5	3	3	3	78	14
	Case Studies	85	6	20	25	20	15	25	196	34
	Analysis and Report Preparation	40	5	5	5	5	5	5	70	12
	Final Report and Project Completion	40	10						50	9
TOTAL WORKING DAYS		345[3]	49	25	45	38	26	43	571	100

2 Short Term Consultants - Chargeable Days

3 Includes approximately 20% of time occupied with project administration.

4.2 Project Operational Plan

The Project Schedule and Project Activity/Manpower Allocation is given on Page 32. It has been developed to satisfy the Project Tasks and the Project Operational System. The Consultant will assign to this project people who are experienced analysts who possess strategic skills. The staffing function, the responsibility of the Consultant, will be sufficiently adaptable so as to ensure that the right skills are made available to the project at the right time. The resulting co-ordination and field project management requirements of the project will be undertaken by the Forest Industries Specialist. Indicative work activities of the Short Term Specialists are given below. The final Terms of Reference for the Short Term Specialists will be prepared, in consultation with the National Forest Service, during the Case Study Definition stage of the project. The Consultant's Project Coordinator will mount two monitoring missions to Papua New Guinea.

4.2.1 Forest Industries Specialist

The Forest Industries Specialist will take the major analytical responsibility for the survey and evaluation of the current forest industry economic performance, and will also be responsible for the formulation of the overall sector case studies at the pre-feasibility level. Thus, he will supervise the Short Term Consultant case studies, and incorporate the findings into the main output from the project.

Specifically, the Forest Industries specialist will:

- complete the necessary data gathering and analysis to formulate a comprehensive report on the economic performance of the current forest processing sector in PNG;

- assist the GoPNG to design and schedule inputs from the Short Term Specialists in: forest industrial policy; markets and marketing (domestic and international), and; selected case studies;

- Co-ordinate inputs from private sector industry organizations, and organize workshops to discuss findings and formulate recommendations on the sector. This task will be especially relevant as support for the activities of the Forest Industries Policy Specialist, who must be given access to private sector and GoPNG decision-makers in a forum allowing exchange of views;

- Co-ordinate GoPNG surveys and data compilations in support of market analyses;

- in close co-operation with GoPNG, design a framework for, and participate in the implementation of, selected strategic case studies;

- integrate the analytical outputs from the project into a major, policy oriented report on the Forest Industries Sector of PNG. Issues papers and recommendations will be circulated widely amongst interested parties in PNG so that the eventual presentation of views to the GoPNG reflects the range of opinion concerning the realities of implementation of any recommended change in approach.

4.2.2 Forest Industries Policy Specialist

The Forest Industries Policy Specialist will investigate current policies of GoPNG which are likely to have significant impact on the achievement of stated objectives in forest industry development. These will include forest tenures/contracts; forest renewal policies and field forestry controls; coastal shipping and other infrastructure; human resource development; special industry incentives; tariffs; communications/liaison with PNG and foreign industry interests. He will also assist the Forest Finance and Taxation Specialist in his review of stumpage and taxation systems.

The Forest Industries Policy Specialist will take the lead in quantifying likely socio-economic impacts (volume, value-added, employment, community stability) with respect to new policy developments or scenarios (e.g. log export ban vs. gradual phase-down). The specialist will lead the sector analysis, and integrate key information from other specialists.

The Forest Industries Policy Specialist will play a key role in discussion of developed case-studies and resultant recommendations with GoPNG and designated industry representatives, before final report preparation. He will assist in preparation of final report and recommendations.

4.2.3 Forest Finance and Taxation

The Finance and Taxation Specialist will conduct a strategic study of existing stumpage, taxation and transfer payment systems in or closely related to the forest sector, with respect to their likely impact on the stated industry development objectives. Tax regulations on industries, wage-earners (domestic and foreign) will be included. He will assist the Forest Industries Policy Specialist in quantifying the net economic and revenue effects of defined sector development strategies.

The specialist will also assist the Forest Industry and other Specialists in defining specific case studies in financial and economic terms, including GoPNG revenue effects.

4.2.4 Wood-Based Panels Specialist

The Wood-Based Panels Specialist will investigate the pre-feasibility of establishing veneer, plywood, Medium Density Fibreboard, Oriented Strand Board and chip board production capacity in PNG, both as an integrated adjunct to an existing primary manufacturing facility and as a "green-field" operation. "Minimum economic scale of operation" will be indicated. The study will identify the segment of the raw material supply spectrum upon which such developments would be based. The study will identify operating limiting parameters and suggest possible general area locations of establishment. Typical equipment and manpower lists, capital and operating costs and profitability will be given. General market acceptability of product will be given along with target markets for PNG.

4.2.5 Processing and Manufacturing Specialist

The Processing and Manufacturing Specialist will investigate the pre-feasibility of establishing sawmilling (various levels of production) facilities, planing and moulding facilities, kiln drying facilities, fumigation and other treatment facilities, barking and chipping facilities in association with either primary manufacturing, panel board or chip export operations, and the secondary manufacture of furniture and other products as either component or final assembly. "Minimum economic scale of operation" will be indicated. The study will identify the segment of the raw material supply spectrum upon which such developments would be based. The study will identify operating limiting parameters and suggest possible general area locations of establishment. Typical equipment and manpower lists, capital and operating costs and profitability will be given. General market acceptability of product will be given along with target markets for PNG.

4.2.6 Maritime Logging and Transport

The Maritime Logging and Transport Specialist will investigate the anticipated harvesting cost from typical selection harvest locations, and hypothetical plantation locations, in PNG, and investigate the pre-feasibility of establishing a coastal marine domestic transport system for PNG that would include water-borne equipment systems for the transport of logs and processed products, the pier or

assembly infrastructure that would be required at selected levels of production, and the prospects of having such a system developed and supplied by the existing coastal shipping interests, or whether it would require a separate entity(s) to implement. "Minimum economic scale of operation" will be indicated. The study will identify operating limiting parameters and suggest possible general area locations of establishment. Typical equipment and manpower lists, capital and operating costs and profitability will be given.

4.2.7 Forest Products Marketing

The Marketing Specialist will conduct a general strategic review of market prospects for forest products in the region and the world, with reference to likely PNG products. The Specialist will also conduct more focused strategic reviews of strong prospects identified through defined development scenarios and cases. These will include sawnwood in various species and stages of manufacture in Australia, New Zealand, Malaysia, Indonesia, Korea, China, Japan, India and other identified regional prospects.

The specialist will assist the Wood Panels Specialist in his assessment of regional and other panel markets. He will investigate special product or manufactured product markets at the strategic level, as identified through analysis of scenarios and cases.

The specialist will review domestic PNG markets for sawnwood, panels, and other identified wood manufactures.

5.0 PROJECT BUDGET

The Inception Report Budget (see page 37), totalling US$ 578,340, is based on the Project Schedule and Project Activity/ Manpower Allocation of page 32. Nine percent of the allocated manpower is devoted to mobilization and the preparation of the Inception report, 22% to the sectoral review, 14% to case study definition and the preparation of the Short Term Consultant terms of reference, 34% to the case studies, 12% to final analysis and report preparation, and 9% to the final report and project completion.

Manpower costs absorb 56% of the budget; airfare and ground travel costs absorb 16%; living and lodging expenses absorb 15%, and; the remaining 13% supports report preparation and publications, communications, equipment and materials, data collection and acquisition, workshops and training and miscellaneous and unforseen. Fees are not chargeable in respect of the input of the Consultant's Project Coordinator, however, the traveling expenses in respect of the monitoring missions to PNG will be charged to the project.

FOREST INDUSTRIES DEVELOPMENT STUDIES - PROJECT PD 108/90 - BUDGET - US$ (September 26, 1992)				
ITEM/ACTIVITY	PROJECT BUDGET (PART IV)	INCEPTION REPORT BUDGET	PAID BY ITTO	PAID BY GOPNG
1. Forest Industrial Specialist	180,000	178,350	178,350	
2. Forest Industries Policy Specialist	26,000	26,950	26,950	
3. Forest Products Marketing Specialist	26,000	20,425	20,425	
4. Short Term Consultants	71,000	67,525	67,525	
5. Project Travel (PNG & International)	90,000	126,950	124,750	2,200
6. Equipment and Materials	22,000	22,000	22,000	
7. Data Collection and Acquisition	20,000	5,000	5,000	
8. Workshops and Training	20,000	10,000	10,000	
9. Miscellaneous and Unforseen	5,000	5,000	5,000	
TOTAL UNDER ITTO/GoPNG AGREEMENT	460,000	462,200	460,000	2,200

GoPNG BUDGETARY SUPPORT	INCEPTION REPORT BUDGET
1. Balance B/F from ITTO/GOPNG	2,200
2. Communications (Fax Telephone Courier)	5,000
3. Mobilization of Long Term Specialist	14,200
4. Vehicle Hire	4,000
5. Report Preparation and Publication	10,000
6. Accommodation for Industries Specialist	50,000
7. Withholding Tax	32,940
Total GoPNG Budgetary Support	118,340
TOTAL PROJECT COST	578,340

6.0 EXPECTED SOCIO-ECONOMIC IMPACTS

6.1 Human Resources

The project will have some direct human resource development effects in the National Forest Service through the proposed workshop/project reviews, and through ongoing discussions throughout the project life.

The more important inputs should be secondary, through action on project recommendations to foster effective worker training, improved communication with labourers, participation in equity ventures by land-owner groups, and many other human resource development impacts of effective economic development of information in the forest sector.

6.2 Community Development

In each community where an effective forest industry is established, the local economy will develop in important ways, including wages, tax potentials, development of local infrastructure, expansion of local support facilities (i.e. mechanical) and a reversal of the migration trend. Each of

these inputs will feed into other local sectors such as agriculture and services.

Ultimately, community economic stability will be improved through the introduction of effective sustained harvest systems in forest management.

6.3 Forest Management

The major inputs of project activities in forest management will be indirect, but should be very important. They will include direct linkages of sustainable forest management systems and forest revenue and taxation systems.

Regional forest management should become accurately focused to provide for defined industry needs, within an integrated sector strategy.

6.4 National Institutions

The new Forest Authority and National Forest Service will be better focused to achieve national objectives for the forest sector, through project recommendations and discussions. Small steps will be defined, rather than giant leaps in industrial development, as contrasted with theoretical or proposed quick fixes, if the project achieves its objectives.

Direct institutional improvements will be targeted for Policy and Planning and Marketing/Forest Industries Development Divisions of the National Forest Service.

6.4 Forest Industrial Development

The principal target of the project is to assist PNG to get on a solid path of development in forest product processing. Employment and value added in the sector could easily double within five years of implementation of a workable strategy.

If the industrial develops in efficient forms, via efficient methods, high cost and/or financial losses can be avoided. Total GoPNG revenues from the sector should exceed current levels (including log export revenues) within a few years.

Local customers should find improved quality and prices in a range of forest products from domestic supplies.

Housing and construction should be strongest gainers from an efficient local forest industry.

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Commercial Climate of PNG - February 16, 1993

FOREST INDUSTRIES DEVELOPMENT STUDIES

2nd December, 1992

SECTORAL REVIEW[1]

Subject: Current Forest Industry Structure and Performance

Topic: FOREST MANAGEMENT

1.0 INTRODUCTION

There are three crucial aspects that must be considered in determining the performance of Forest Management systems in PNG, namely silvicultural success, cost and efficiency.

1.1 Situation

The dominant forest management system practised in PNG is that of natural forest management through the application of a selection cut system based on minimum diameter limits. This selection cut system is applied on the communally owned lands. Limited plantation forestry systems, some 50,000 ha, are practised on State owned land by the National Forest Service, and on lease-hold communal land by Jant Pty. Ltd. Jant Pty. Ltd. also practice clearfell and natural regeneration on non-lease-held communal lands. In addition, there is evidence of an increasing interest in the establishment of plantations of exotic high-value hardwoods on the communally owned land by the individual land owners.

Disturbance is a major factor in the stand structure formation over a significant area of PNG. Disturbance factors include:

- **land-slip** due to earthquake activity, of local and periodic occurrence;
- **volcanic ash-fall**, of sometimes more widespread, or regional, and periodic occurrence, and;
- **fire**, widespread throughout the country with no concern for the consequences being expressed by the

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[1] There are two major subjects of the FIDS Sectoral Reviews: economic prospects of the Forest Industrial Sector, and; current forest industry structure and performance. This paper addresses a fundamental topic under the later subject, that of Forest Management. Wide ranging response is requested to this, and subsequent, papers so that the FIDS project can adequately reflect the range of valuable experience that is available.

landowners or community at large.

Of the three disturbance agents, fire is the most important agent in stand structure formation. The fires are man-made and are possible to start whenever a dry period of about a month ensues. These fires, rarely conflagrations, are usually "creepers" where tree surface-roots are severely damaged, with subsequent tree death being due to physiological drought.

As the result of disturbance, much of the stand structure in PNG is of a pioneer successional stage. Thus one finds a surprisingly large proportion of the area of PNG consisting of relatively even-aged stands of limited species content. These stands are of individually varying extent. Consequently, the application of a diameter-based selection cut system in over-mature or mature stands of this nature has resulted in a *de facto* clear-cut of those stands.

Recovered volumes/ha from the even-aged, limited species, stands are much higher than that achieved under the application of the selection cut system to the climax successional stage of the forest where some $35m^3$/ha, or usually less, is recovered. Clearfelling of plantations or natural forest also recovers significantly higher volumes/ha than does the selection cut system.

2.0 SILVICULTURAL SUCCESS

Silvicultural success must be measured in terms of the forest management system demonstrably producing a repeatable harvest of the desired species, in predictable volume and size class distributions of no less than the original harvest, and in predictable and equal time periods. Any lesser criteria do not meet the test of "sustainability" from the industrial point of view.

2.1 Natural Forest Management

Tropical forests are notoriously difficult to manage successfully. The selection cut, and other innovative, systems have generally failed. The original selection cut system, devised by Brandis in 1857, has failed in Burma. After three cutting cycles and more, the minimum girth limits have decreased from 12 feet to 6 feet; the cutting cycle has decreased from 45 years to 15 years, and; the total annual volume harvested has decreased to about 50% of its post-war peak. Similarly in Belize, the mahogany minimum girth limits have decreased from 12 feet to 6 feet; the cutting cycle has declined from 45 years to 10 years, and exceptionally as low as 3 years, and; the total volume produced has declined to about a third of the post-war peak. The system used in Queensland, in not-too-dissimilar

forests to that found in PNG, has been abandoned as wanting. The selection cut system has succeeded in several small localized areas with peculiar stand silvics.

In PNG, in spite of the selection cut system being in use for a number of decades, there is no hard data available on the post-harvest developing stand structure to show that the original harvest was sustainable. In fact, it is probable that the selection cut system, as practised in PNG, really amounts to "high-grade" exploitation. While the original limited harvests commenced as long ago as the 1930's, it is not known where a second cutting cycle has taken place and, more importantly, where the subsequent stand produced a potential harvest equaling the original. There are reports of a few areas being logged a second time, but the indications are that it was to pick up species that were left behind in the first cutting cycle.

For this lack of data and history of repeatability, it would now be silviculturally irresponsible to assume and/or promote that the selection cut system as employed in PNG has been a success.

2.2 Clearfell and Natural Regeneration

Man-made clearfell and natural regeneration in PNG has only had a recent history of about 15 years. The stands in question, in the Gogol project, were already the result of disturbance from a major forest fire that occurred at the end of the last century. The species composition was still in a pioneer successional stage of development. The post-harvest data for the initial harvests in the Gogol project has shown that, while there were initially species shifts in stand composition, the under-represented or "missing" species were significantly re-entering the stand structure. The stand structure development has subsequently been terminated in some cases by subsequent harvests. No data is available for the stand structure development subsequent to these second harvests.

Another form of "clearfell" and natural regeneration has been the result of non-man-made disturbance. Recent earthquake induced land slides have been observed to quickly reforest. Little is known of the initial stand composition or the subsequent stand composition development in these cases.

Fire is considered to be the progenitor of the *Calophyllum spp.* pure stands of eastern Manus. No data is available concerning the regeneration of these areas following the "selection cut" clearfelling that is underway. The Kwila dominating stands of the Vanimo area are also attributed originally to fire.

The silvicultural success of the various clearfelling systems, both natural and man-made, can be regarded as a partial success in that vigorous stands of mainly a limited number of commercial species developed following the disturbance. However, the original stand structures, except in the case of Jant/Gogol, are not known. Thus the factors that affected the controllability and predictability of the subsequent stand structure development are not well understood at this time.

2.3 Plantation Development

PNG does have some experience in plantation establishment and management. A number of species trials have been conducted over the years and some species have been found to be suitable for establishment under site specific conditions. For example, the pines (*Pinus spp.*) generally are suitable for establishment in the highlands, though some out-perform the others.

Species that are considered to be suitable for plantation establishment, in that the basic silvics have been determined, and the m.a.i. that is considered to be generally achievable, is given in Table No. 1.

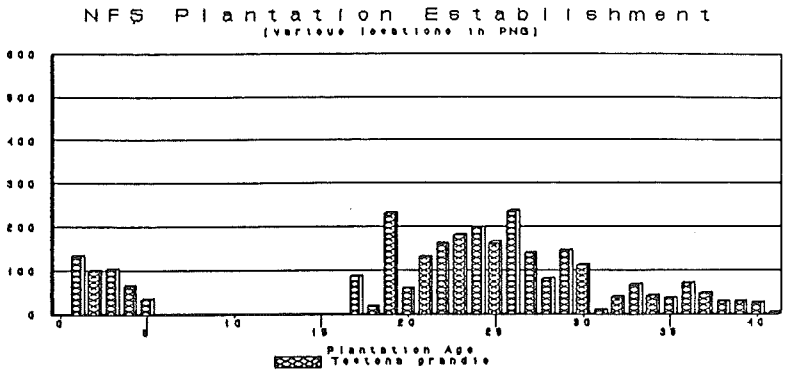
Table No. 1 Plantation Species in PNG

Name		Expected m.a.i. m^3/ha/yr
Common	Latin	
Brown Terminalia	*Terminalia brassii*	20
Eucalyptus	*Eucalyptus deglupta*	20
Acacia	*Acacia mangium*	20
Mahogany	*Sweetenia macrophylla*	15
Walnut	*Dracontomelon spp.*	15
Calophyllum	*Calophyllum spp.*	15
Black Bean	*Castanospermum australe*	12
Klinki Pine	*Araucaria hunsteinii*	12
Hoop Pine	*Araucaria cunninghamii*	12
Pine	*Pinus patula*	10
Teak	*Tectona grandis*	10

The plantation establishment records of the National Forest Service are wanting. The available, sufficiently complete, data is depicted in Graphs 1 to 7.

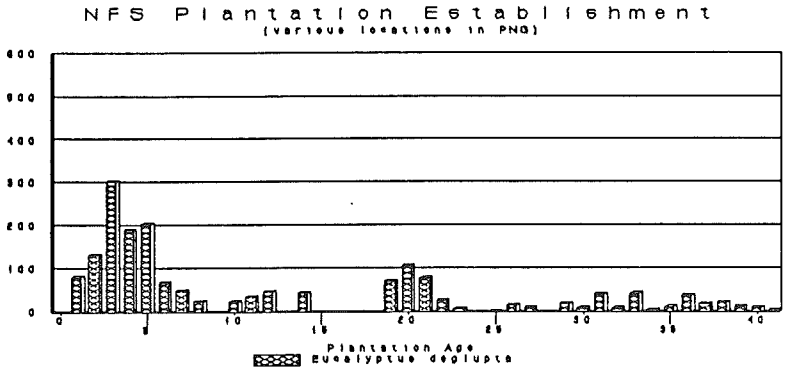
The teak should produce about 25,000 m^3/year of round wood at rotation. Similarly, *Eucalyptus deglupta* should produce 35,000 m^3/year, *Terminalia brassii* 9,000 m^3/year, *Pinus patula* 43,000 m^3/year and *Acacia mangium* 2,000 m^3/year at rotation.

Graph 1



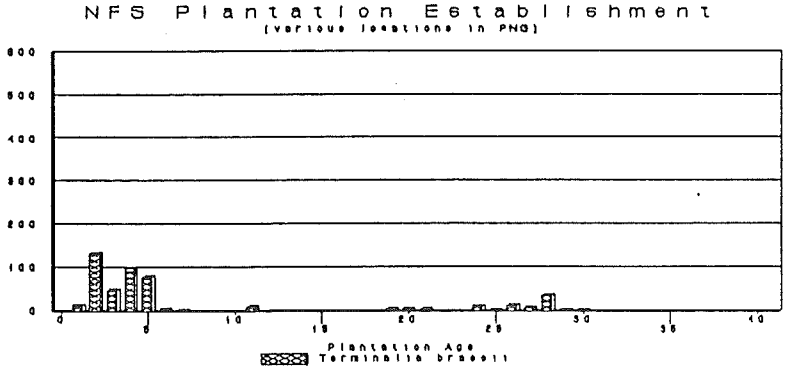
Tectona grandis (teak) totals some 2,842 ha, and the average plantation size is 39 ha.

Graph 2



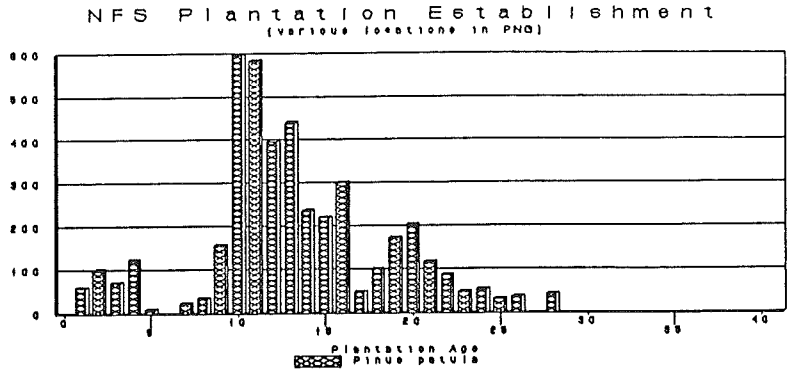
Eucalyptus deglupta totals some 1,787 ha, and the average plantation size is 18 ha.

Graph 3



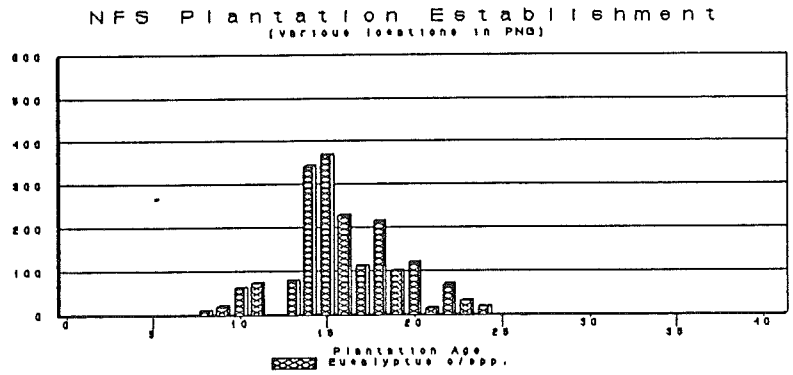
Terminalia brassii totals some 481 ha, and the average plantation size is 10 ha.

Graph 4



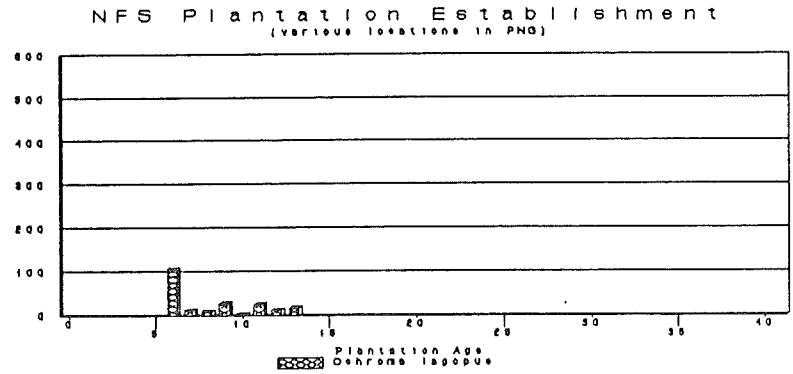
Pinus patula totals some 4,352 ha, and the average plantation size is 69 ha.

Graph 5



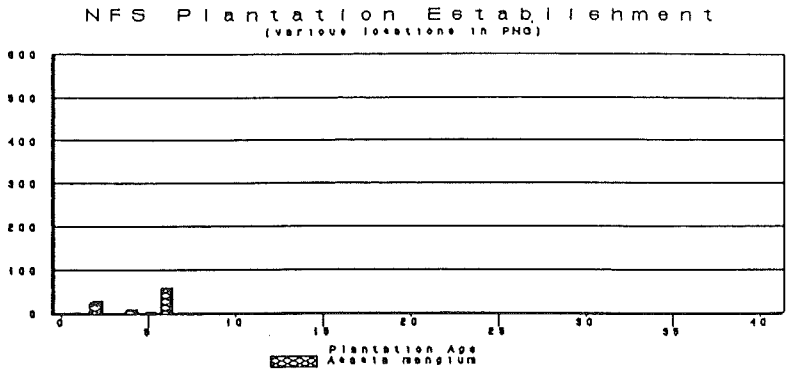
Eucalyptus grandis and *Eucalyptus robusta* totals some 1,892 ha, and the average plantation size is 22 ha.

Graph 6



Ochroma lagopus (balsa) totals some 224 ha, and the average plantation size is 25 ha.

Graph 7



Acacia mangium totals some 93 ha, and the average plantation size is 10 ha.

The erratic plantation establishment programme is evident from the graphed data. The individual plantation size also varies greatly. The species spatial distribution is also erratic. These unfortunate problems are related to timber land tenure problems, a fundamental problem underlying the failure to establish a viable forest industry in PNG. The base data also is wanting in that acceptable records available at the National Forest Service in Port Moresby account for about a quarter of the stated plantation established area. All the above problems are operations related problems. None-the-less, a level of information and experience has been established upon which a well designed and implemented plantation development programme could be based. **Species selection, in marketable terms, will be a crucial policy decision matter.**

The silvicultural success of the existing plantation programme in PNG can be regarded as positive in that some sawlog plantations that mature in about 30 or 40 years, and another group of plantations that mature in about 10 years, have been harvested and re-established.

3.0 COST

The cost parameters that should be measured to judge the suitability of a silvicultural system include not only the establishment costs of the regeneration, they must also include the associated harvesting costs.

3.1 Natural Forest Management

The regeneration costs of the natural forest management system are regarded as being nil in that no direct outlay is needed in order to achieve regeneration. However, there are indirect costs of interest that should

be chargeable on the normal delays experienced in obtaining regeneration of the desired species. No data is available upon which to quantify this hidden cost.

The Forest Revenue and Financial Study (FRFS) found that established operations that practised natural forest management through the selection cut system experienced direct logging costs[2] "to the mill gate" ranging from K 33.86/m^3 to K 60.53/m^3, with a production based weighted average of K 43.03/m^3. Operators that were just commencing operations were indicating direct logging cost of twice this amount. For the purposes of this analysis, we can take the indicated average cost of the selection cut system in PNG as K 43.03/m^3, excluding interest charges on regeneration delays, if any.

3.2 Clearfell and Natural Regeneration

Post harvesting studies on the Gogol (Jant) project indicated that virtually all of the natural regeneration was achieved within the first year following clearfell harvesting. Again, the cost of regeneration can be considered to be nil in that no direct outlay (scarification etc.) was expended in achieving regeneration. Regeneration delays were probably minimal, though undetermined.

The FRFS found that direct harvesting costs in Jant's operations were K 31.44/m^3, and this can be taken as the indicated cost of the clearfell and natural regeneration system in PNG.

3.3 Plantation Development

The National Forest Service has a plantation development programme underway to establish 4,000 ha of new plantations annually. The annual cost of this operation, including plantation tending, is budgeted at K 4,000,000. The annual cost per hectare established is K 1,000. Similar costs are reported for the plantation establishment programme of Open Bay Timber where plantations are established following a selection logging, clearfelling, spot burning treatment.

The reforestation costs should be expensed, in the year that establishment takes place, as a part of the cost of the plantation harvest that takes place in that same year. Sawlog plantations should produce between 285 m^3/ha and 350 m^3/ha at rotation. Based on 4,000 ha being harvested each year, and 4,000 ha being reforested each year, the reforestation costs add between K 2.50/m^3, if the

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[2] Excluding taxes, royalties, levies, and marketing costs.

plantation produces 350 m^3/ha, and K 3.50/m^3, if the plantation produces 285 m^3/ha, to the logging costs of the year.

Plantation clearfell harvesting costs are only available for the plantations associated with the PNG Forest Products operation at Bulolo. Contractor rates for skid-trail refurbishment, minimal road maintenance, clearfelling, skidding, loading and hauling (maximum of 5 km) range from K 14.00/m^3 and K 20.00/m^3. The harvest ranges from 250m^3/ha to 300m^3/ha.

If K 20.00/m^3 can be taken as representative of plantation harvesting costs in PNG, and K 3.50/m^3 is a realistic cost of reforestation, the plantation forest management system costs about 23.50/m^3.

4.0 EFFICIENCY

The efficiency of a forest management system should be measured in terms of growth rate (mean annual increment).

4.1 Natural Forest Management

The m.a.i. generated by the selection cut system in other parts of the world, when the selection cut system harvest levels are above sustainability, generally range from 0.20 m^3/ha/yr to 0.70 m^3/ha/yr. There is no real comparable PNG data in that no second cycle selection cuts have yet taken place on areas where the original selection cut was as presently practised. However, if the second cycle cut was 30m^3/ha on a 45 year cutting cycle, the generated m.a.i. wold be approximately 0.70 m^3/ha/yr. It is very likely that the sustainable m.a.i. of commercial species would be very much lower.

4.2 Clearfell and Natural Regeneration

The Gogol forests that were clearfelled were reported by the Department of Forests to contain about 100 m^3/ha, made up of 65 m^3/ha of pulpwood and 35 m^3/ha of sawlogs. It is speculated that these stands originated from a fire that swept through the area at the end of the last century. The indicated m.a.i. for sawlogs, based on 75 years of growth, is about 0.50 m^3/ha/year, and the pulpwood m.a.i. is about 0.90 m^3/ha/yr, for a total of 1.40 m^3/ha/year. A pulpwood subsequent rotation would undoubtedly improve the performance of the m.a.i. Unfortunately, no data is available upon which to base such an estimate.

4.3 Plantation Development

Plantations develop m.a.i.'s ranging up to 20 m^3/ha/yr or more (see Table No. 1). The m.a.i.'s indicated may be a bit conservative in that Open Bay Timbers is achieving a m.a.i. of between 30m^3/ha/yr and 35m^3/ha/yr for *Acacia mangium* and *Terminalia brassii*. Clearly, plantations are the most efficient method of timber production.

5.0 DISCUSSION

5.1 Forest Management Systems Comparison

The comparison of the silvicultural success, cost and efficiency of the three forest management systems employed in PNG is given in Table No. 2.

Table No. 2 Comparison of Forest Management Systems

Forest Managem't System	Silvic. Success	Cost (Kina)	Efficiency (m^3/ha/yr)
Nat. For. Mgmt.	very doubtful	+/- 43.03/m^3	+/- 0.70
Clearfell	partial	+/- 31.44/m^3	+/- 1.40?
Plantation Dev.	yes	+/- 23.50/m^3	+/- 20.00

From the above analysis, it is clear that the most successful, least cost and most efficient forest management system used in Papua New Guinea is the plantation system. It does deliver wood in reasonably predictable quantities by species. It costs about half that of natural forest management, and two thirds that of clearfell and natural regeneration. It is also about 30 times more efficient than the natural forest management system.

The importance of efficiency should not be overlooked in the context of competing demands on forest use. For the same level of production, for every hectare that is put into plantation production, 30 hectares can be put "into the bank" and reserved for other, or later, use. This is an important factor in providing recovery time for the current forest areas that have been subjected to the selection cut system.

5.2 Components of a Plantation Development System

It does not make good forest management sense to convert all production zoned forest areas to plantations.

Priority areas for plantation development will be related to favourable access and topography. "Green" fire breaks and the need to ensure proximity to natural forest in the interests of ecologically induced forest pest protection systems will further break up the pattern of a well planned plantation development scheme.

Size of development will depend on the overall industrial development strategy, where policy decisions regarding the formation of an open domestic log market *vrs* localized production facilities establishment becomes important. There is a minimum economic size of plantation development, and no plantation development scheme should be proposed for areas that do not meet this minimum. There is also a minimum economic size of individual plantation establishment factor to be considered. Small sized, scattered location plantations defeat the cost advantages of plantation systems.

As mentioned above, the species selection, a major policy decision, for plantation development should be market driven. "Fast growing" species should be established only if the likely market conditions are promising. Thus, such plantations should be "tied" to domestic production facilities. It would seem to be unwise to try to compete in the global export market in this type of species. There is a growing glut of eucalyptus and pine on the world market. Brazil is a major *Eucalyptus spp.* producer and has developed the cloning technology to the point that sawlogs are produced on a three year rotation. It is also doubtful that PNG could compete against the major *Pinus spp.* production areas of Chile and New Zealand. In the export market, it would seem to be better to target a niche market area and, the characteristics of the most likely niche area will demand a steady supply of high value tropical hardwoods, an area that PNG should be able to compete in successfully. The range of species planted should be limited in the interests of standardizing production techniques and servicing markets.

A significant issue in plantation development is forest land tenure. Indeed, the tacit rationale for the implementation of the selection cut system is not based on silvicultural reasons as much as on land tenure reasons. It clearly is simpler to practise selection cut, and it may be the only system that can be practised, under the current timber land tenure arrangements with the communal land owners. All current plantation development schemes are based on "State Land" or 99 year lease (sometimes called "State Land") land. The new Forest Management Agreements must address this issue directly, in a binding way, and solve the underlying problems of revenue sharing among, and land dedication to forestry development by, the communal land owners.

5.3 Justification for the Continued use of the Selection Cut System

Where timber resources still remain in quantity, the selection cut system should be allowed to continue for this current cutting cycle, but **only provided**, the capital generated from the selection cut system is sufficient to fund, after reasonable profit to the operator, revenue to the land owner and funding to the National Forest Service, a well planned plantation development programme. Under such a plantation development scheme, the areas designated for conversion to plantations should have all, regardless of size, merchantable timbers harvested. All other uses of the selection cut system really amount to a policy of "cut out and get out".

If the selection cut system averages $30m^3$/ha of timber recovery, and a forest to plantation conversion charge of K $3.50/m^3$ were assessed for plantation development, some K 105.00/ha harvested would be generated for plantation development purposes. This would be sufficient to convert 10% of the forest area into plantations. Current timber allocations amount to some 4.5 million hectares. There is possibly 3 million hectares remaining for harvesting under these current timber allocations. The area that could be reforested (plantation development) as given above would be about 300,000 ha. At a m.a.i. of $15m^3$/ha/yr, the plantation development scheme would produce about 4.5 million m^3/year at rotation, roughly equivalent to twice the current annual harvest. This would be preferable to exhausting merchantable timber reserves in some five to 15 years time under solely the selection cut system, with no ongoing prospects for a viable continuing industry likely.

The role of the Policy and Planning Division in affirming the basic premise contained in the above cannot be underestimated. This Division must have a major input into the designing of sustainable harvesting systems for Papua New Guinea.

FOREST INDUSTRIES DEVELOPMENT STUDIES

3rd December, 1992

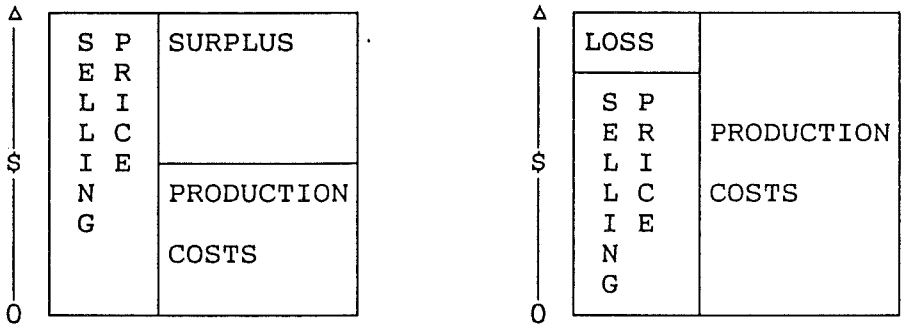
SECTORAL REVIEW[1]

Subject: Current Forest Industry Structure and Performance

Topic: REVENUE, COSTS AND SURPLUS DISTRIBUTION

1.0 THE BASIC PRINCIPLE

All commercial enterprise decisions are based on the difference between selling price and production costs. Where the production costs are less than selling price, as shown below, there is a Surplus from the operation, and where the production costs exceed the selling price, there is a loss on the operation. This should be used as the basis of determining forest revenue. The FR&FS agrees with this principle.



1.1 Selling Price

It becomes absolutely necessary to be able to determine Selling Price with confidence as any Surplus (Loss) is very sensitive to this value (FR&FS). The SPO and its operation should be able to provide Selling Price values for export logs, in the face of price transfer

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[1] There are two major subjects of the FIDS Sectoral Reviews: economic prospects of the Forest Industrial Sector, and; current forest industry structure and performance. This paper addresses a fundamental topic under the later subject, that of stumpage. Wide ranging response is requested to this, and subsequent, papers so that the FIDS project can adequately reflect the range of valuable experience that is available.

activities and market fluctuations, with a degree of confidence. The proposed SMA[2], if functioning as a forest processed products promotion and marketing agency, should be able to determine the true market place selling price for lumber, moldings, panel board etc. through its own sales records and through monitoring the product price publications that are available in most countries. As such an instrument, SPO/SMA input becomes an essential part of the forest revenue determination process, more so in the case of log export, but perhaps less so in the case of export of manufactured products. The potential for transfer pricing in uncontrolled log export is very high, usually because of a tied pattern of business dealings. The export of manufactured products is of a more open nature, with a supplier commonly servicing a number of buyers and the price trends being monitored by the Governments of other countries and price trends being periodically published in trade journals etc. However, there are other compelling reasons for the SMA to become involved in the export of manufactured products which are not apropos the subject.

1.2 Production Costs

Given reliable estimates of Selling Price, the determination of Surplus is dependent on the determination of Production Costs. The FR&FS has tried to develop "global" production costs based on reported company account data. It eliminated data from one low cost operation (clear fell operation), 3 high cost operations (start-up phase) and some companies where the accounts were judged to be unreliable. The resulting Surplus was then divided into Stumpage charges and Export Levy revenue. While this process can be considered expedient as the proposed "interim" situation, the use of company cost reports cannot be relied upon to reflect reasonable costs and the development of a global Stumpage charge is inequitable.

While the company supplied account data, that was used by the study, was assumed to reflect actual costs, no effort was made by the FR&FS to assess just how efficient the individual operations were. In a hypothetical situation where the Surplus is sufficiently great to permit inefficient and more costly actions to be tolerated by the management of a company, that additional cost burden is, in effect, direct theft from the Surplus, and the possibility should be recognized and guarded against.

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[2] The subject of another Sectoral Review Topic.

The FR&FS did recognize that pertinent physical factors of resource and terrain etc. affect cost, and proposed empirical (?) allowances to be applied to the proposed Stumpage charge. This is more equitable than not applying these allowances, but there is no assurance that they are reasonable and provide the Surplus with its just due.

1.3 Surplus

The FR&FS argues for a Surplus to exclude consideration of Profit on the operation and to be composed of two items, Stumpage charges on all logs and Export levy on exported logs. This is in keeping with the traditional way that revenue has been considered in Papua New Guinea.

Given that the FR&FS proposed annual stumpage review revises both selling price and production costs, the determination of profit at 15% on cash flow, including depreciation, but before determination of Surplus, in the FR&FS model, implies that the recipients of the Surplus take all the risk in the event of market prices tumbling to a level of operator direct cost plus profit and risk allowance. This occurs simply because the operator's profit and risk portion remains in proportion to direct costs while the Surplus is "squeezed" between the rising costs, including operator profit and risk allocation, and falling prices. This situation can hardly be fair to the land owners and could be prejudicial to the financial funding of the NFS. It also negates any imposition of the Export Tax as a punitive or corrective factor in encouraging a shift from log export to domestic processing.

The FR&FS regards the Export Levy as being the portion of Surplus that is to be used to fund the activities of the NFS and some proposed trust funds. This is inconsistent with the intent of the current Export Tax to be a punitive corrective charge in encouraging domestic processing and the intent of the Government to shift from log export to domestic processing. To institutionalize the Export levy as the funding source is to base the future of the NFS on an ephemeral source of funding, which is not a practical consideration.

Since the entire question of revenue and financing is under review at this time, and the issue critically affects the prospects for the desired development of domestic forest industrial processing, the basis of a modified revenue system is presented in the following sections. Where appropriate, options are explored and the implications discussed.

2.0 STUMPAGE APPRAISAL

The basis of common Stumpage Appraisal systems is:

- the provision of reliable market selling price data (the SMA should be carefully structured and motivated to fulfil this function); and,

- the costs of each individual logging and milling, i.e. site specific, operation are "appraised" to reflect the costs that a reasonably or acceptably efficient operation would expect to incur.

These **appraised costs are not actual company costs**, but are cost allowances that are calculated in the manner of a feasibility study, and awarded to each and every phase of production (see following schematic diagram). Such a process is easily computerized for ease of application. The phases include such items as felling, bucking, skidding, loading, hauling, unloading, road construction, road maintenance etc. The phase costs include wages, consumables, depreciation, allocated overheads and mechanical shop cost etc. The "feasibility study" designs a realistic logging or other production system that accomplishes the production goals in a reasonably efficient manner. The princple of "**least cost**" should be the basis of the appraisal. The accumulated sum of the costs are used in determination of the Surplus which is demanded from the operator. The system places every operator on an equal footing in that the cost allowances reflect the individuality of each operation. Since the costs are based on reasonable efficiency, the inefficient operators will, in practice, experience higher costs than allowed for and the resultant financial pressure will either force them to become more efficient or to drop out of the industry. The operators who are more efficient than planned for will reap extra benefit in higher profits, and all profits are taxable thereby providing benefit to the central Government. The recipients of the Surplus will obtain an equitable portion of the proceeds of the operation.

The cost appraisal is applicable to each and every logging coup (Harvesting Authorization). It reflects the severity of the various cost burdens that a logging or milling operation experiences by dint of timber quality, terrain, location, climate, infrastructure etc. Thus, it is the fairest process possible in that those operations that can reasonably be expected to incur high costs will be expected to return lower Surpluses in the form of Stumpage, and those that have advantages of, say, good large sized timber which is easily logged can afford to, and will, pay larger Stumpage charges. It will also minimize the desire to "mine" the forest in that single or "global" stumpage rates in PNG have resulted in high-grading operations where the closest, biggest and best is taken first, and the less valuable timber is harvested later, until cost exceeds

revenue (i.e. "cut out and get out" logging).

LOG EXPORT OPERATION

SELLING PRICE	SURPLUS	Stumpage
		Allowance for Profit and Risk (10%?)
	PRODUCTION COST	Marketing
		Reforestation
		Logging
		Forestry
		Engineering
		Road Maint.
		Road Const.

PROCESSING OPERATION

SELLING PRICE	SURPLUS	Greater Stumpage
		Allowance for Profit and Greater Risk (20%?)
	PRODUCTION COST	Marketing
		Waste Disposal
		Planing
		Seasoning
		Milling
		Log Yard Ops.
	HARVSTING COST	Reforestation
		Logging
		Forestry
		Engineering
		Road Maint.
		Road Const.

In the above schematic example, for the hypothetical log export operation, the Production Cost is made up of cost allowances for road construction, road maintenance, logging engineering, forestry, logging (felling, bucking, skidding, loading, hauling, unloading), plantation establishment and marketing. The Surplus, actual market selling price minus appraised production cost, is the residual value, sometimes called "**conversion return**", that is available to split between the various parties who are involved in the project.

In the hypothetical schematic example for the Processing Operation, the Production Cost is made up of Harvesting Cost and Processing Cost. The Harvesting Cost is very similar to the Production Cost of the Log Export Operation, with the exception that there is no marketing cost allowance for exporting logs. The Processing Cost is made up of cost allowances for log yard operations, milling, seasoning, planing, waste disposal and product marketing costs.

2.1 Apportionment of Surplus Between Claimants

It is common for the grower to demand 60% to 80% of the Surplus, or 20% of the selling price, as Stumpage, which ever is the greater. The proportion depends on the distribution of costs that are agreed to. For example, if the operator is to carry costs that are non-essential to the production process, the grower's proportion is reduced. In the Papua New Guinea context, it is probably justified to award the Stumpage recipients 60% of the Surplus, and the operator 40% of the Surplus to cover his Profit and Risk, provided a "Minimum Stumpage" (see 2.4 below) is always payable.

The advantage of a proportional distribution of Surplus is that it encourages the operator to seek higher market prices for the end product in the knowledge that he will share in the benefits that accrue. Proportional distribution acts as a "partnership" factor in that if one benefits, both benefit, and if one loses, both lose, thereby encouraging harmony and cooperation between the project participants.

If it is decided to follow the FR&FS model of allowing an operator an allowance for Profit and Risk, but not as a part of "costs", it is probably justified to award a logging export operation, that has virtually no or a low level of risk, 10% of the appraised Production Cost as its share of the Surplus, providing that the Indicated Stumpage does not drop below a minimum level that is to be demanded by the Stumpage recipients.

In general, one expects the benefit of the sales price to be much higher for a processing operation rather than a

log export operation. However, the investor does have greater risk to his investment, and his proportion of the larger Surplus, under the FR&FS model, should be increased to above that of a log exporter, say to 15% or even 20%. The level that this allowance is set at can also be manipulated as an incentive factor. For example, it is possible to encourage an investor by setting this allowance at 30% and then reducing this by 1% per annum for a 10 year period until the allowance reaches 20%, always that the Indicated Stumpage does not fall below the Minimum Stumpage, in which case, the Minimum Stumpage applies.

It is important to note that there is no Export Tax shown in this schematic diagram. The introduction of an Export Tax simply reduces that portion of the Surplus that is available for distribution between the Stumpage recipients and the operator, until the Minimum Stumpage is reached. This means that the operator would run into a loss making situation at a higher selling price than shown. If it were desired to impose a punitive Stumpage in order to encourage a switch from log export to domestic processing, it is only necessary, under the proportional sharing model, to increase the proportion that is awarded to Stumpage, or, under the FR&FS model, to reduce the allowance for profit and risk. An Export Tax is not recommended under the outlined Stumpage Appraisal system as it simply siphons off part, or perhaps most, of the Surplus for the benefit of Consolidated Revenue, and deprives the recipients of the Surplus of that amount. An "Export Levy" is also not needed, if it is accepted that the funding for the NFS should not come from an ephemeral source of funding, as the Minimum Stumpage demanded (see below) is designed to ensure that funding is available.

2.3 Cost/Asset Ramifications

It should be noted that, since items such as road construction and reforestation are included in the cost portion of the Stumpage Appraisal, these costs result in a direct lowering of the Surplus. Thus, even though the operator actually physically spends the funds on these items, the resulting asset is the property of the Surplus recipients. Under the proportional sharing model, it is usual to accept that the proportion allowed to the Stumpage recipients has been deliberately reduced from an ideal split so that the resultant assets belong to the Stumpage recipients. Under the FR&FS model, it is more clear. In effect, the Stumpage recipients have sub-contracted these items to the operator. An alternative under the FR&FS model, not often successful and therefore not recommended, is that the Stumpage recipients undertake to fulfil the responsibilities of items such as road construction and plantation establishment directly, thereby reducing the production costs of the operator, but transferring those

costs as a charge against Stumpage.

Any plantation establishment undertaken in conjunction with the harvesting operation, under a Stumpage appraisal system, properly belong to the landowners. Any main line roads, similarly established and amortised in the Stumpage Appraisal (see 3.1), properly belong to the (National Forest Service) Government, who is the custodian of the national communications network system. Shared use of these roads by other operators will require shared maintenance costs.

Each model has different benefits, it is a policy decision as to which model to use, or to even combine the best features of each model.

2.4 Minimum Stumpage

The Minimum Stumpage must cover the fixed costs, claims, or minimum aspiration costs of the Forest Service, other claimants and the land owners.

In all fairness to the land owners and the operator, the fixed costs of the NFS must be seen to be under control, be reasonable and not to include costs for frivolous and non-essential activities or activities not in the national interest. However, the NFS is a corporate body and should be allowed to fund, directly from Stumpage, depreciation and to operate a sinking fund from which the Board may authorize expenditures for desired investment or extraordinary purposes.

It may be that, legally, the Provincial Governments also have a claim against the Stumpage collected. The implications of this requirement is subject to debate and possibly further negotiation.

The land owners must also receive a minimum amount as needful for their sustenance, with the remainder of the Surplus also being used to finance developmental or similar activities on a local basis. This issue is complex and subject to further debate and negotiation.

Care must be taken in setting the Minimum Stumpage that it does not impose an impossible burden on the timber industry as a whole. Arbitrary allowances allocated to various recipients can quickly unbalance the financial basis of the industry. The Minimum Stumpage must be limited by what the industry can reasonably be expected to produce under normal to tough economic times. The setting of the Minimum Stumpage should therefore be the subject of

a separate study. As an interim measure, and as suggested by the FR&FS itself, the proposed Stumpage level as contained in the FR&FS report should initially be set as the Minimum Stumpage pending the full implementation of the Stumpage Appraisal system, with the proviso that the Export Tax be rescinded and that amount be included in the Minimum Stumpage charge on log exporting operations only. However, any price increases in the export value of logs from the time of the determination of the FR&FS proposed Stumpage should be captured as part of the Stumpage charges, i.e., if the log price goes up by $5, the Stumpage goes up by $5.

The actual Stumpage charged the operator is the greater of the Indicated or Minimum Stumpage. Should the Selling Price drop below the Production Cost plus Minimum Stumpage, the logging company makes no profit at all, but the Stumpage recipients still get the Minimum Stumpage. In such a case, the forest industry, in the hope of a market turnaround, historically has continued to operate - at a loss - as to shut down its operations would be even more costly as there would be no cash flow generated to cover its fixed and financial costs. This willingness to operate at a loss is less true of an operation that is confined to logging only, as the fixed and financial costs are usually minimal in that the staff can be laid off and the equipment has been fully depreciated, possibly even before being delivered to the logging site.

3.0 SPECIAL CONSIDERATIONS

3.1 Amortization

Certain costs, notably main-line road construction (not spur road), should be amortised and written off over the volume of timber that the road construction developed. This will avoid placing a punitive burden on the Surplus in the year in which the road construction occurred, and will allow the operator to recover the full value, under the Minimum Stumpage rule, of his expenditure on road construction. Similarly, defined project "development" costs should be amortised as an incentive to entering into the industrial development.

3.2 Depreciation

While the development of the cost allocations under the appraisal must include an allowance for depreciation, the depreciation must be "real" if it is to be allowed as a legitimate cost. Therefore, operators using equipment that has been fully depreciated under the terms of the appraisal should have their cost allowances reduced by the

allowance for depreciation, i.e., if an operator's bulldozer is 10 years old and the appraisal calculated depreciation over a 5 year period, the operator will not receive an allowance for depreciation in the appraisal. Under the "least cost" principle, allowances should not be made for extra down time and maintenance needed for a 10 year old piece of equipment, otherwise the Stumpage recipients will be penalized due to the operator's own inefficiency.

3.3 State Marketing Agency

Since the SMA operates as a "commission agent", the recurrent costs of the SMA should not be a charge against Stumpage as these are already allowed for in the cost allocation for marketing in the Stumpage Appraisal and it is assumed that the commission demanded is sufficient to cover the selling and promotion activities undertaken. However, the SMA can reasonably be expected to require capital for the development of regional shipping pier facilities and, since there is no immediate source of funding, these should be funded either directly by the Government as its part in the promotion of the timber trade, or through government guaranteed financing. When processing becomes more prevalent, the SMA will have a need for sorting, remanufacturing, seasoning and grading facilities to be associated with its timber collection and shipping points. It may be more desirable to operate some of these last mentioned activities at "arms length" from the SMA, or even as a separate entity, either governmental or private sector. Since commission agent timber sales organizations have historically only operated successfully as either governmentally owned and operated or producer association owned and operated, and certainly not privately owned and operated, the SMA should probably start out as government owned, but with the provision that, in the future when the success of the operation is proven, the mechanism is available for a producers association to acquire the financial interests of the SMA.

3.4 Research Institute

Research benefits the forest sector as a whole. Therefore, the sector as a whole should pay for the research that is carried out. However, the contributions to the research should be considered to be of an "investment" nature. That is, the operator's contribution should come from its allowance for profit and risk, the land owner's contribution should come from Minimum Stumpage, and the Government's contribution from Consolidated Revenue. The level of the individual contribution is subject to further study and negotiation.

4.0 IMPLEMENTATION

While the concepts of a Stumpage Appraisal system are relatively simple, the application of the system can be demanding. While the calculation of costs can become quite mechanical, and thereby suited to computerization, agreement must be reached on just what costs are to be allowed (i.e. fire protection?) and in what manner. The appraisal allowances for profit and risk or Surplus sharing need to be determined. The distribution of the Stumpage portion of the Surplus and the Minimum Stumpage has to be determined. If the principle of moving to a Stumpage Appraisal system as being a fair and equitable method of determining Profit and Loss and Stumpage is accepted, then a project is required to design the system for Papua New Guinea. Most certainly, high-grading must be guarded against through post harvest inspections and inventories, with either Stumpage or punitive Stumpage being charged on low-value trees left standing.

4.1 Base Data

To make a Stumpage Appraisal system feasible to implement, a great deal more data and information is required than currently collected by or available to the Department of Forests. Detailed planning based on forest inventory and mapping is required. Asset inventories are required. Information interflow must be precise and quick. And much more. However, the new Act and supporting policy are demanding that the operators provide this information as a condition of being granted harvesting rights. **Providing control is strictly enforced** within the concepts of the Act and National Forest Plan, the data can be made available for implementing a Stumpage Appraisal system.

4.2 Re-Appraisal

Production cost components (i.e.labour, fuel, power etc.) move relatively slowly over time, or are influenced by major financial events (i.e. Government's budget). Thus the Re-Appraisal of Stumpage in the face of these factors should be undertaken annually, and preferably following the tabling of the national budget. Selling price is a different matter. This can move quite rapidly over time. Re-Appraisal incorporating this factor should be done quite frequently, say every quarter based on the last six months volume weighted selling price, or even more often.

4.3 Volume Weighted Stumpage *vrs* Individual Species Stumpage Rates

Volume weighted stumpage should be applied against each individual Harvesting Authorization in the interests of streamlining the stumpage collection system. The individual species cruise volumes (+/- 10% S.E.) are multiplied by the species lumber recovery factor to arrive at total lumber (or other product) production. The species selling price is then multiplied by the species production to arrive at the total sales price for that species. Total sales price for each species is added together to get all species total sales price. This figure is then divided by the total volume, all species, to be harvested from the Harvesting Authorization, to give the all species, volume weighted average, log unit ($/m^3$) sales price. Production costs are deducted from this unit sales price to arrive at the unit Surplus. The Surplus is then divided into Stumpage, and what is due to the operator. Thus, all logs, **regardless of species**, will be charged the same volume weighted Stumpage price from any given Harvesting Authorization. This procedure can lead to the encouragement of high-grade logging, which must be guarded against. However, the advantages of a single Stumpage rate for all species on a Harvesting Authorization outweighs the disadvantages. For example, it makes the implementation of weight scaling more facile, a system that eases disruptions to logging operations and reduces revenue collection costs.

It is possible to calculate a Stumpage rate for each individual species to be harvested on a Harvesting Authorization. The implementation os such a scheme imposes a larger burden on the scaling and billing activities. It does not eliminate the risk of high-grade logging. While it is a system more in keeping with historical PNG thought, it should be abandoned in the interests of efficiency and streamlining the revenue collection system and logging operations.

4.4 Revenue Collection

The operator should be required to pre-pay a Stumpage deposit into a NFS designated account. Scaled billings should be then deducted from the deposit. Scaling activities should only be conducted when the Stumpage account is in credit.

Scaling should be conducted by an operator employed Licensed (under the Forest Act) Scaler. The Licensed Scaler's work must be randomly spot checked by an authorized member of the National Forest Service. The operator must post a bond against the Licensed Scaler's fidelity. Any mal-practice detected must result in the cancellation of the Scaler's license, the forfeiture of the bond and the cessation of scaling activities until another Licensed Scaler is employed and operator bond posted.

FOREST INDUSTRIES DEVELOPMENT STUDIES

4th December, 1992

SECTORAL REVIEW[1]

Subject: Current Forest Industry Structure and Performance

Topic: TIMBER ACQUISITION, ALLOCATION AND EXPLOITATION

A newly implemented Forest Act and re-formed National Forest Service gives rise to the question of the new procedures that should be followed in acquiring, allocating and exploiting timber in PNG. From an industrial development point of view, the following sequence of events and key policy elements is given that should, if uniformly implemented, lead to the development of meaningful processing facilities being installed in PNG.

1.0 TIMBER ACQUISITION

1.1 National Forest Plan

Land is classified (zoned) by permitted use taking into account DEC[2] and NFS general policies and procedures.

Only Land that is classified for production forest use is considered for the following action.

The project area must be sufficiently large to give reasonable assurance of sufficient timber availability to support a minimum economic sized processing facility.

1.2 Initial Landowner Awareness Programme

From an industrial development perspective the objective of the landowner awareness programme is to ensure landowners in the project area are absolutely aware of:

- possible consequences of forest industrial development;

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1 There are two major subjects of the FIDS Sectoral Reviews: economic prospects of the Forest Industrial Sector, and; current forest industry structure and performance. This paper addresses a fundamental topic under the later subject, that of the sequence of events leading to timber acquisition, allocation and exploitation. Wide ranging response is requested to this, and subsequent, papers so that the FIDS project can adequately reflect the range of valuable experience that is available.

2 DEC has a major intervention at this stage.

- the responsible and acceptable behavior patterns that will be expected by any source of investment funds, and;

- the requirement for long term commitment of the land to forest industrial development, and the related aspects of "evergreen" extension of that commitment.

If the land owners cannot accept the principle of forest industrial development, and the implications of that development on their life style etc., and the need for socially and contractually acceptable behaviour, negotiations should be terminated amicably. A FMA negotiated that will not attract financing is certain to become inoperable and cause future trouble.

1.3 Development Options Study

For industrial development purposes, the objective is to gain sufficient information to ascertain whether or not there is a potential for such development in the area.

Forest inventory is at the reconnaissance level (S.E. +/- 40%). A preliminary Sustained Yield Capacity is calculated which sets the preliminary annual allowable cut.

Obvious environmental and social impacts are listed.

A preliminary concept of forest industrial development is suggested that considers:

- timber supply, species suitability and spectrum of the available inventory to be utilized;

- production systems, minimum economic size, and expected general level of investment and operating cost;

- markets and market price, and;

- regeneration systems.

The outline of a corporate system to act as the vehicle for implementation is proposed.

1.4 Formation of Land Groups

The land owners are formed into legal corporate status Land Groups. This becomes the entity for distribution of stumpage etc. It also is the unit building blocks upon which the Forest Management Agreement and any joint venture corporate structure is based.

1.5 Issue of Project Guidelines

In light of the recommendations made in the development options study the PFMC, in consultation with landowners and the Provincial Government, prepares draft project guidelines which are reviewed by the National Forest Board and final guidelines issued.

The Guidelines will become an annexure to the Forest Management Agreement and will thus have to incorporate landowner concerns. The Guidelines will also comprise the basic document which is used to advertise the call for application from interested developers.

1.6 Execution of Forest Management Agreement

This completes the timber acquisition phase. The FMA is standard throughout PNG. It sets the term of the agreement. It sets the pattern of revenue distribution. It sets the principles of revenue sharing and sharing of regeneration benefits. It passes the responsibility for approving and controlling the management of the forest to the Forest Authority. It sets that the revenues due to the landowners will be based on a stumpage appraisal system, with a reserve, or minimum, stumpage being set, all determined by the NFS.

If the land owners cannot accept the FMA conditions which will be necessary to attract financing, negotiations should be terminated amicably. A FMA negotiated that will not attract financing is certain to become inoperable and cause future trouble.

2.0 TIMBER ALLOCATION

2.1 Call for Project Proposal

The Project Guidelines are published for a response from developers who provide a project proposal that contains a development concept (see outline in Appendix No. 1) that gives:

- physical parameters of the enterprise;
- schedule of development;
- proposed operating financial parameters (debt/equity ratio etc.);
- land owner physical and financial involvement;
- the proposer's history of implementing/operating similar enterprises;

- the proposer's financial capability, and;

- a feasibility study plan (see outline in Appendix No. 2) including cost parameters by forestry, engineering, marketing and financial viability.

2.2 Selection of Preferred Developer

The preferred developer is selected based on an evaluation of the project proposals. The conceptual development may suggest a variation to the Project Guidelines in which case the consent of landowners to the variation will need to be obtained. The activities, content and cost of the proposed feasibility study are reviewed and renegotiated where found deficient.

A Letter of Intent is signed between the Authority and the developer that provides the developer with the exclusive right to conduct a full feasibility study, at his cost, of the accepted forest industrial development concept. The Authority may withdraw from the agreement in the Letter of Intent upon reimbursing 100% of the developers actual costs up to the feasibility study agreed-to cost limit. In this event, the feasibility study contents, calculations etc. remain the property of the developer.

2.3 Feasibility Study

2.3.1 Forest Inventory

The developer then conducts a management level forest inventory based on:

- photo-interpretation of forest cover types based on stand structure (not ecological units);

- an appropriate stratification of the forest cover types, and;

- a field sampling system designed to return a S.E. of +/- 20% of volume weighted net merchantable volume of all species 20 cm dbh+.

The inventory report will present area summary tables as appropriate. Stand and Stock tables will be presented for all species in terms of gross, merchantable and net merchantable volume, by strata and all-strata. An all-strata log array will be presented.

The Sustained Yield Capacity of the area to be harvested will be presented for several silvicultural regimes.

The developer must present copies of all the field data, mapping and calculations to the Forest Authority as a condition of presenting his feasibility study as the basis of the Project Agreement. The National Forest Service must check cruise the inventory.

In the unlikely event that the forest inventory demonstrates that the volumes available for development are insufficient upon which to base the proposed or re-designed alternate development concept, the developer may be permitted to withdraw from the agreement and be reimbursed 50% of his agreed to forest inventory costs by the Forest Authority upon presentation of the field data, mapping and calculations. In such event, another preferred developer is approached who may re-present his development concept based on the forest inventory results upon payment of the 50% inventory cost paid by the Forest Authority.

2.3.2 Industrial Study

The developer then completes his feasibility study and demonstrates financial viability to the satisfaction of the Minister. The feasibility study must include a silvicultural plan that is acceptable to the Forest Authority and the land owners. A **forest development plan**, including **policies** and **procedures**, must form part of the feasibility study. The forest development plan must **outline** the main road network, harvesting system(s), regeneration methods and pollution control measures to be employed in the implementation of the enterprise. The forest development plan must be acceptable to DEC[3] and the Forest Authority.

The developer submits his feasibility study to the Board in the format of a draft Project Agreement.

2.4 Corporate Formation

The developer takes the legal steps to form the corporation that will implement the enterprise. It is important that the developer be part of, or the sole owner of, the corporation. It is inconceivable that major investment will be secured if the developer is merely a sub-contractor to a Land Owner Company.

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[3] DEC have an opportunity at this point to provide the general inputs of policies and procedures that will be acceptable to them.

2.5 Project Agreement

A final Project Agreement will then be executed by the Authority and the corporation formed under step 2.4 above.

2.6 Timber Permit

The Minister issues a Timber Permit to the corporate identity that entered into the Project Agreement. The Project Agreement becomes attached to, and part of, the TP. This completes the timber allocation phase.

3.0 TIMBER EXPLOITATION

3.1 Rolling Five Year Working Plan and Annual Logging Plan

The TP holder presents a five year working plan, supported by maps as appropriate, to the Forest Authority. The first year of the five year plan will be in detail. Harvesting areas will be identified.

The five year working plan and annual logging plan must be prepared under the direction and supervision of a licensed (under the Forest Act) professional forester under the employ of the TP holder. The TP holder must post a bond against the licensed professional forester's fidelity to the National Forest Service. Should any mal-practice be detected, the professional forester's license must be cancelled, the TP holders bond be forfeited and a new licensed professional forester be hired and bonded.

An operational cruise is required for proposed harvesting areas. The operational cruise will be to a S.E. +\- 10% and contain log array data by species. The operational cruise data will be used in appraising the stumpage payable upon granting of harvesting rights to an individual proposed harvesting area. It will also be used for cut control *vis a vis* the licensed harvest levels, and for a check on out-turn scale. The operational cruise will also identify site specific environmental concerns and propose mitigation or control measures.

Where appropriate, a regeneration plan will be designed.

An annual logging plan, supported by a map, will be prepared covering each of the harvesting areas in which logging is proposed during the relevant year. The logging plan will detail such items as landing location, skid trail location, culvert/bridge

requirements etc.

3.2 Harvest Authorization

Upon the Forest Authority approval of the TP holder's submitted five year development plan and annual logging plan, the TP holder submits an application for a Harvesting Authorization for each area to be harvested in that year. The Forest Authority will issue a site specific Harvest Authorization[4] which will authorize the harvesting of the timber in accordance with the term and conditions contained in the HA document.

The HA will detail the timber mark, the stumpage rate, the utilization standards, scaling point, regeneration requirements, fire protection requirements, stream-side protection, etc. applicable to the harvest area.

The HA will be used as the principal instrument of record keeping and control of the enterprise's harvesting activities.

3.3 Operations Control

The licensed professional forester will be required to ensure that the TP holders logging operations are in conformance with the conditions of the HA. Authorized National Forest Service staff will need to spot check the work of the licensed professional forester and his staff. Any corrective actions required, and the time frame in which to perform, will be directed to the TP holder through the licensed professional forester. A written record will be made of each and every spot check carried out by the NFS, which shall include maps depicting logging progress and observations on performance in relationship to the HA conditions. Copies, duly signed by both the NFS inspector and licensed professional forester will be lodged at the NFS headquarters. Suspension of operations should only be authorized from the responsible senior staff member of the NFS in Port Moresby:

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[4] The provisions of the Water Resources Act and the Environmental Planning Act will be incorporated into the HA. DEC will be encouraged to audit the HA provisions that concern them, both at issuance, and on the ground. However, it must remain the responsibility of the NFS to monitor and control the conditions of the HA as it will be disruptive to NFS/operator relations to have more than one authority responsible on any one area at any one time.

PROJECT PROPOSAL CONTENTS Appendix No. 1

A. an executive summary (name of project, name of proponent, forest industry participant registration number, description of proposal and a concise statement of how the proposal is expected to realize the objectives set out in the Project Guidelines)

B. comments on and suggested variations to project guidelines

C. proposed sources of project finance and proposed financial operating parameters (debt/equity ratio etc)

D. proposed annual harvest, export and processing volumes

E. proposed stumpage premium and supporting financial analysis

F. physical parameters of the project (plant type, size, features, etc.)

G. anticipated schedule of development

H. a feasibility study plan including cost parameters by forestry, engineering, marketing and financial viability

FEASIBILITY STUDY MINIMUM CONTENTS Appendix No. 2

A. forest inventory (+/- 20%)

B. a forest development plan covering -
   a. Sustained Yield Capacity calculations and required annual licensed harvest to meet industrial plant design capacity
   b. strategic forest development system design
   c. plan for preparation of 5 year rolling working plan and HA application
   d. plan for complying with HA conditions
   e. forest management and regeneration system
   f. road construction system, construction schedule and design standards
   g. road maintenance plan
   h. harvesting system design
   i. scaling system
   j. equipment maintenance system and plan
   k. fire protection system and plan
   l. environmental monitoring and control
   m. operational infrastructure location, design and specifications
   n. woodlands organization chart, management policy, including supervision, and recruitment plan
   o. manning/salary charts and job descriptions
   p. workman safety policies, plans and measures
   q. initial equipment list and specifications
   r. capital cost estimate +/- 10%
   s. harvesting phase unit costs and total delivered-to-mill wood unit cost

C. an industrial development plan covering -
   a. plant type, size, configuration, process flow, water requirements, power requirements, chemical requirements, etc.
   b. volume of plant raw material input and manufactured product output by expected grade/specification
   c. infrastructure design and preliminary specifications
   d. equipment/machinery design and preliminary specifications
   e. capital cost estimate +/- 20%
   f. infrastructure/equipment/machinery maintenance plan and fire protection measures
   g. plant organization chart, management policy, including supervision, and recruitment plan
   h. manning/salary charts and job descriptions
   i. pollution control policies and measures
   j. workman safety policies, plans and measures
   k. marketing strategy and expected sales price and price projections
   l. manufacturing phase unit costs and finished

product total unit cost

m. cost estimate of final detailed engineering

D. implementation strategies on the following -
   a. training and localization
   b. local business development
   c. ongoing consultation with landowners

E. an implementation schedule including -
   a. final design engineering and detailed specifications
   b. equipment bid/purchase/delivery
   c. site development
   d. infrastructure construction
   e. equipment installation
   f. component testing
   g. woodlands road construction
   h. production start-up and time to full production

F. projections of profitability, a financial plan and disbursements schedule, including projections of revenues to be paid to the landowners

G. details of proposed corporate structure/relationships/ responsibilities, including shareholding

H. details of reporting procedures and scheduled reports to be given to the National Forest Service

I. pro-forma of Project Agreement legal clauses

FOREST INDUSTRIES DEVELOPMENT STUDIES

26th January, 1993

SECTORAL REVIEW[1]

Subject: Economic Prospects of the Forest Industrial Sector

Topic: THE MARKETING PROCESS

All successful production is market oriented. However, the mere existence of a market for that production does not guarantee success or best returns to the producer. How the production is marketed also plays an important role in the financial health of the enterprise. This subject is of long-standing, as well as current, debate in the National Forest Service. An industrial development viewpoint is given below.

1.0 THE CURRENT SITUATION

1.1 Export Logs

Current log production is primarily marketed by the log producer. The Government arranges the marketing of about 2% to 3% of the annual production under its "State Purchase Option" (SPO). Under the SPO, the producer is obliged to offer a minimum of 25% of its production to the State for marketing purposes, ensuring that the offer is representative of the general log production of the timber harvest area, and stating the price that it can obtain for that production. If the State believes that it can better that price, it acts as an agent/broker, and arranges the sale of that offer directly between the producer and purchaser, for which it charges an agency commission of 2% of f.o.b. value. If the State believes that the price the producer can obtain is representative of market conditions, the State declines the offer and the producer is permitted to arrange the sale himself at the stated price. Thus, the State uses the SPO for market intelligence, rather than revenue, reasons. However, there is a "competitive" effect in that the imposition of the SPO has raised the general f.o.b. prices that were reported by the log producers.

The 1991 direct destination log export market was dominated by Japan (57%), followed by Korea (35%), with other countries receiving 8% of PNG log exports. The

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[1] There are two major subjects of the FIDS Sectoral Reviews: economic prospects of the Forest Industrial Sector, and; current forest industry structure and performance. This paper addresses a crucial topic under the first subject, that of the marketing process. Wide ranging response is requested to this, and subsequent, papers so that the FIDS project can adequately reflect the range of valuable experience that is available.

current log export market structure is complex, generally involving the producer, an initial purchaser/shipper, an importer and a wholesaler. The final destination of the logs is not well known or understood[2].

There has been claim, and denial, of transfer pricing being carried out under the marketing structure.

The bulk, about 60% of production, of log exports is controlled by a single commercial entity.

1.2 Domestic Log Market

There has been no real development of a formal domestic log market. The only known current instance is the sale of sawlogs by Jant to Taway Timbers[3]. This circumstance probably reflects the Jant primary interest in the export of chips, and of Jant having no log import interests in Japan or elsewhere.

1.3 Lumber

Lumber production is a requirement of most Timber Permits (TP), the amount of required sawn production varying widely from TP to TP over time. The permission to export logs is conditional upon the lumber production requirement. Most, if not all, TP holders have not reached their agreed-to sawn production commitments.

Sawn production, never very large, has ceased in the Highlands Region. Lumber producers, who have road access to the major population centers, generally service those centers, usually cutting to order, rather than to stock for best recovery. Dealings are generally direct between the lumber producer and the wholesaler/retailer or even the end user. Sawmill furnish for the sawmills associated with the log-exporting companies is from logs that have been rejected for export. PNG Forest Products, Taway Timbers, Forest Management Services and a few very small enterprises servicing local markets, are the only sawmills that are not being subsidized through log exports.

The requirement to produce lumber as a condition of a TP has led to a number of commercial anomalies in the industry. For example, a major log exporter faithfully produces the required lumber, carefully dries the lumber,

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2 The FIDS as well as another ITTO funded project are addressing this aspect in 1993.

3 Taway Timbers has no timber holdings and is therefore entirely dependent on market logs. There are two sawmills in Lae, with no real or secure timber holdings, buying direct from landowners on an irregular basis. One of these mills has bought logs from Madang Timbers.

and then carefully moves the dried lumber off to the water side and stacks it to rot, all to satisfy the conditions of the TP.

Lumber exports peaked in 1979 (62,600m^3), the year that log export was liberalized, and declined rapidly to 3,380m^3 in 1991 when Australia took 47% of this minuscule export, and New Zealand 20%.

Lumber production in PNG, with virtually only one exception, is all rough sawn, unseasoned, timber. Planing is a special order, with a price add-on. The production from most mills is poorly manufactured. Log costs to the mill vary, but are about K 45.00 to K 50.00 per m^3. Rough sawn lumber f.o.b. mill price varies from about K 300.00 to K 400.00 per m^3.

In PNG, there is a 50% import tariff on processed timber. — actually, 30%

1.4 Plywood

Plywood is only produced at the PNG Forest Products mill in Bololo. The mill has a production capacity of 16,000 m^3. The 1992 production was 10,505 m^3, sales were 8,913 m^3 for a total sales revenue of K 6,562,549 at an average selling price of K 736.28/m^3. The plywood is now totally absorbed into the domestic market. Dealings are direct between the producer and the wholesaler/retailer.

The product features a transverse grain clear face sheet.

In PNG, there is a 200% import tariff on plywood.

2.0 DISCUSSION

2.1 Log Export

"The present marketing structure (for log export) does not enable the product to realize its maximum returns to PNG. Revenues remain constrained by an industry structure which , not only places logging companies in a favorable position to the monitoring and enforcing agencies, but which also reduces the potential market value of the product. ....it is suggested that proper returns to Papua New Guinea and effective management of the resource can only be achieved through fundamental changes in this marketing structure. These changes require that ownership of a much greater share of the resource not pass to foreign companies and end users until a much later point in the marketing chain. Achieving this change would require the introduction of a much increased role for a competitive, centralized marketing agency." (Webber 1988).

If log export is to continue, and the public concerns over monopolization and irregularities of the log export trade are to be allayed, the above and following comments by Webber should be heeded. "There are sufficient end users or intermediate buyers who do not have links with logging companies who would be prepared to purchase from this (centralized marketing agency) source provided prices were competitive with the existing companies. Moreover, the agency would have sufficient market size to exploit the potential for market gains through the measures ..... such as greater consistency of species and grades in each shipment."

In response to Webber and others, the new Forest Act has created the existence of a "State Marketing Agency", primarily to exercise the SPO, but also to undertake a broader role in marketing if deemed necessary or desirable.

2.2 Domestic Log Market and Log Trading

The timber supply has been recently dominated by log exporters. The domestic log market has never developed inspite of reported domestic offers to log exporters, at export prices, for the purchase of logs. The log exporters simply refused to direct any of their production to the local sawmills which were short of log furnish. This may have had a direct bearing on the decline of the lumber production industry. It would be in PNG's interest to specify that domestic log market requirements be satisfied before any log exports are permitted. Such an action could be carried out in conjunction with the SPO. The domestic mills should have first call on species and grade selection. Only the logs rejected for the domestic market should be allowed to be exported. The log price initially should be set at the export price less export duty.

The forest industry has never reached the level of sophistication where sawmills were specialized in terms of either input size requirements or market serving species requirements. There has never been log trading, or cross selling between sawmills, developed as a result.

2.3 Lumber Production

There is a ready, trade preferential, market demand for PNG lumber production of about 300,000 m^3 of rough sawn, ungraded mill run, undried and untreated lumber in Australia. Inspite of this demand, the market is not being seriously addressed (some 1,590 m^3 in 1991) simply because of high costs associated with initial production and coastal shipping, the irregular volume supply, the irregular species supply, random length shipping, the long delivery time from placing order, the small volumes offered by the individual producers in relationship to economic

shipping and the relatively low prices being offered for this poorly manufactured production. International "liner" shipping demands containerized shipments, rather than strapped bundle shipments.

There is no cooperative marketing process in place to overcome some of these cost adding constraints inspite of the obvious potential advantages. The probable reason for the lack of cooperative marketing is the independent nature of the sawmill industry and the dominance of the industry by log exporters who have little or no experience in lumber production. The log exporters have little or no interest in lumber production other than to satisfy TP conditions as a prerequisite to continuing log exporting. The obvious vehicle to develop cooperative marketing is the Forest Industries Association (FIA), a producer owned lobbying group. The FIA is dominated by the log exporting element of the industry and shows little or no interest in taking up the challenge.

While a sector of the Australian demand for PNG lumber is relatively unsophisticated, there is a very large sophisticated, high priced, market in Australia for precision manufactured tropical woods. Japanese markets, and the high value markets of the USA and Europe are also sophisticated markets demanding steady, reliable, quantity supplies of precision manufactured lumber and secondary manufactured products. PNG is in no position to address these markets[4] at this time except for trial or small special consignments.

3.0 CENTRALIZED MARKETING

There is a good case for considering the development of a centralized forest product marketing structure for PNG. It would contain the ownership of export log production within PNG further into the marketing chain. It would be able to seek realistic and lower internal transport costs, assemble, grade/re-grade, up-grade, sort, package, etc. lumber and moldings etc. for developed markets. Small producers could find an outlet for production to other than the domestic local market traditionally serviced. All of this is dependent on the economics of any planned such operation[5]. Considerable investment will be required if centralized marketing is to become possible.

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4 One mill, in Lae, has tapped into the Australian high price market. The mill has no timber position and is only able to supply small quantities of timber to this market after servicing its domestic requirements.

5 The FIDS is addressing the financial/economic aspects of centralized marketing as part of the project.

Centralized cooperative marketing traditionally has been most successful when it has been producer association owned and operated. It is unrealistic at this time to expect the existing forest industry structure to spearhead such a development because of the investment required and the basic lack of interest in cooperative marketing.

Under the Forest Act, provision is made for a "State Marketing Agency" (SMA). While the original intent was to use this SMA to exercise the SPO for export log market intelligence purposes, it can be argued that its role could be beneficially expanded to include a wider ranging brief of:

- to develop base markets for PNG wood based forest products, and to promote those PNG forest products both domestically and internationally;
- to provide an export sales outlet for all producers of all wood based forest product types;
- to service the domestic wholesale system where appropriate;
- to act as the vehicle for investment, Government or other, into developing the infrastructure (dock and strarage facilities, barging systems, etc.) needed to develop the marketing system;
- to the benefit of the producers, to service the export and domestic markets through:
    - the development of a domestic log market where appropriate;
    - the assembly of the production of the individual milling facilities into marketable material;
    - the arrangement of the up-grading of forest products that are in the marketing chain where appropriate;
- to provide market intelligence in respect of price and product trends as input into production and financial decision making within the industry, and;
- to obtain the best prices possible for PNG forest products.

3.1 Development of a State Marketing Agency

There appears no alternative at this time to State intervention in forest products marketing if the PNG forest

industry is to develop its full potential. Conceptually, the creation of any such entity should be designed in such a way that a producers association, which does not have strong financial ties to the overseas markets, can eventually obtain financial control and direction of the entity. The only feasible option, that provides a modicum of success, is the initial creation of the entity under the Companies Act, as a wholly owned subsidiary of the Forest Authority. Any governmental investment in the required infrastructure to develop the entity should be designated as share capital. The entity should have its own Board, composed of a limited number of purely commercial experts appointed as Directors, who receive Director's Fees for their endeavors. Such a Board should be totally de-politicized. While the entity should be operated at "arm's length" from the National Forest Service, there must be strong, permanent, information passing linkages between the two organizations.

The term "State Marketing Agency" has a negative connotation and thus should be changed. The name given to such an entity should project a recognizable, favorable, marketable image that is easily captioned in a simple and easily recognizable Logo form. This decision is a major one, worthy of careful consideration, with far reaching consequences for an inappropriate selection.

The financial operation of such an agency should be on a commission basis. The agency must have the producers deal fairly with it in that a producer must agree to market all his production through the agency in return for the agency undertaking to accept and market the not-in-demand or lower grade part of the production spectrum.

3.2 Interim Situation

The existing system for exercising the low level of SPO is adequate. Even if the domestic log market was to be serviced first, the existing system could be up-graded to accommodate the additional requirements. The full move to a "State Marketing Agency" should occur only if the role is to be greatly expanded and investment funding is available.

FOREST INDUSTRIES DEVELOPMENT STUDIES

16th February, 1993

SECTORAL REVIEW[1]

Subject: Economic Prospects of the Forest Industrial Sector

Topic: THE COMMERCIAL CLIMATE OF PAPUA NEW GUINEA

1.0 Demographics

Population	:	3,529,538 (1990 census) (growing at an average of 2.03%/year over last 10 years)
		- Males = 1,835,079
		- Females = 1,694,459
Urban Population	:	536,860 (79 centers) (growing at an average of 3.7%/year over last 10 years)
		- Vanimo = 9.5%/yr
		- Kimbe = 5.7%/yr
		- Port Moresby = 4.5%/yr
		- Wabag = 4.3%/yr
		- Mendi = 4.1%/yr
		- Alotau = 4.0%/yr
Rural Population	:	2,992,678 (1990 census) (growing at an average of 1.75%/year)
Literacy	:	40% (1990 estimated)
School leavers/year	:	Gr. 12 = 189, Gr. 10 = 14,100 Gr. 6 = 42,200 (1992 figures)

2.0 Geographic

Area	:	46,284,000 ha
Capital City	:	Port Moresby (193,242 pop.)
Other Urban Centers	:	Lae (78,265 pop.)
		Madang (27,057 pop.)
		Wewak (23,224 pop.)
		Goroka (18,360 pop.)
		Mt. Hagen (17,392 pop.)
		Rabaul (16,883 pop.)
Average Temperature	:	+/- 28 °C

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[1] There are two major subjects of the FIDS Sectoral Reviews: economic prospects of the Forest Industrial Sector, and; current forest industry structure and performance. This paper addresses a crucial topic under the first subject, that of listing the commercial climate of Papua New Guinea. Wide ranging response is requested to this, and subsequent, papers so that the FIDS project can adequately reflect the range of valuable experience that is available.

3.0 Socio-Political

Political Stability	:	Democratic Government, multi-party system. Political parties (some 12 parties) are populist. Institutions are functioning normally. Stalemated war of secession continuing in Bougainville. Federal Government currently planning to make radical changes to the Provincial Government system and meeting mixed support and opposition.
Social Stability	:	Social unit is the clan with which clanal members intensely identify. There are some 700 languages spoken. Clanal rivalry and disputes has led to a subdued general state of civil anarchy. The situation is exacerbated by the low level of literacy, education and modern experience coupled to the demand for retribution and compensation.
Commercial Policy	:	Private sector development of the economy. Privatization of Government activities where possible.

4.0 Economic and Financial

Economy	:	Export commodity dependent (gold, petroleum, copper, copra oil, palm oil, cocoa, coffee, rubber, copra, tea, logs, wood chips, prawns).
Currency	:	Kina
Exchange Rate	:	Floating Rate US$ 1.00 = K 0.99 (as at 25/01/93)(relatively stable)
GDP (current prices)	:	K 3,058.7 million (1990)
GDP per capita	:	K 825 (1990)
Real Growth rate	:	9% (1992 estimate)
Real Growth rate	:	1.5% (Average 1984 - 1990)
Exports	:	K 1,174.2 million (1990)
Imports	:	K 844.5 million (1990)
Public Foreign Debt	:	K 1,010.8 million (1992)
Inflation Rate	:	9.6 % (Average 1987 - 1992) 8.0 % (first 3/4 of 1992) 13.1 % (1991)
Cost of Living	:	High

5.0 Labour

Employment	:	143,231 (1987) (estimated to be 152,000 in 1992)(4% of pop.)			
Males	:	124,591 (1987)			
Females	:	20,740 (1987)			
Informal employment	:	80% of population rely on subsistence agriculture			
Forest Sector					
No.of Ops.	:	42 (1987)			
All Employees	:	2,509 (1987)			
Male Employees	:	2,434 (1987)			
Female Emp.	:	75 (1987)			
Unemployment	:	n/a, but considered to be a problem			
Work Stoppages[2]	:	1992 - 10 official, with 1,488 workers involved, loosing 6,688 man days. Two were in the forest industry. Seven wildcat strikes.			
Private Sector Wages:					
Minimum Wage[3,4]	:	K 22.96/week	=	US$[5]	4.59/day
Youth under 22	=	K 17.22/week	=	US$	3.44/day
Married Youth 2	=	K 53.02/week	=	US$	10.60/day
Married Youth 1	=	K 62.83/week	=	US$	12.57/day
General Labour2	=	K 53.02/week	=	US$	10.60/day
General Labour1	=	K 62.83/week	=	US$	12.57/day
Class 1 Level 2	=	K 57.00/week	=	US$	11.40/day
Class 1 Level 1	=	K 66.68/week	=	US$	13.34/day
Class 2 Level 2	=	K 61.51/week	=	US$	12.30/day
Class 2 Level 1	=	K 71.04/week	=	US$	14.21/day
Class 3 Level 2	=	K 67.18/week	=	US$	13.44/day
Class 3 Level 1	=	K 76.63/week	=	US$	15.33/day
Class 4	=	K 83.34/week	=	US$	16.67/day
Class 5[6]	=	K 90.05/week	=	US$	18.01/day
Class 6[7]	=	K 96.79/week	=	US$	19.36/day

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2 Innumerable work stoppages also occurred regularly due to landowner disputes. The Government has little or no control over preventing or stopping this type of work stoppage.

3 Urban (Level 1) wage rates apply to Alotau, Arawa, Goroka, Kavieng, Kieta, Lae, Madang, Mt. Hagen, Popondetta, Port Moresby, Rabaul and Wewak townships. Rural, (Level 2) wage rates apply to Bololo, Bwagaoia, Daru, Kainantu, Kerema, Lorengau, Samarai, Vanimo, Wau, Mendi, Kimbe and Kundiawa townships. Wages for Class 4, 5 and 6 employment apply throughout the country. The wages for Single Youth under 22 years of age through to Class 3 in areas not listed or in "bush" situations strictly are to be negotiated between employee and employer, however the Labour Department unofficially expects the Level 2 wage scales to be applied in such cases. The current wage levels have been reduced by about 50% from wage levels in force prior to 15th September, 1992, however the current rates apply to new entrants into the labour market with the previous entrants maintaining their earlier, higher, wage levels.

4 There is no formal job description for Class 1 through 4 workers. Pay level is individually determined by the Labour Department based on education and skill level of the worker.

5 @ K 1.00 = US$ 1.00, 5 day week basis.

6 Tradesmen B1 & B2.

7 Tradesmen A1 & A2.

Work hours/week[8]	:	42 (8/day + 2 hours on Saturday + Double Time Over Time)
Labour Supply	:	Low level labour in plentiful supply. Ticketed Tradesmen (Class 5 and 6) in short supply[9]
Fringe Benefits	:	Employer contributes 7% of base wage level of permanent employees to the National Provident Fund[10].
Normal Median Salary:		US$ 15,000/year
Normal Max. Salary	:	US$ 25,000/year, plus benefits that may include housing and vehicle allowances.
Labour Productivity	:	Adequate
Management Skills	:	Scarce, but trainable.
Training Incentives	:	
Indirect	-	A new programme under the National Training Council (a policy making Statutory Body attached to the Department of Labour) is now in place that levies a 2% Training Tax on the total payroll, including benifit package of vehicle, housing, etc. allowances, of Companies whose payroll exceeds K 100,00/year. The purpose of the Tax is to further both skills acquisition and/or localization for PNG citizens[11].
Direct	-	The Department of Labour acts as a clearing house for placing employees in foreign training establishments on international Donor funded programmes[12].

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8 Work hours/week as given apply to the private sector. Government hours are 73.5/fortnight.

9 There have been about 200,000 Tradesmen certified, by the Labour Department, through the Apprenticeship Programme, over the last 20 year period.

10 Government run, but applicable to Private Sector. Permanent employees are those who have worked more than 60 days in a 3 month period. The employee also contributes 5% of his wages to the National Provident Fund. The employee receives, from the National Provident Fund, a lump sum of all contributions on release from employment, regardless of cause.

11 Under application to the Labour Department, any training programme that a company may undertake is treated as a Tax off-set. The allowable costs must be direct costs and include the salary an employee is paid while in a formal training establishment, a company's in-house Training Department costs, public and private seminar costs, etc.

12 The company pays the employee's salary, while the Labour Department sees to it that all other direct costs are met. The Labour Department gives approval for the company to recruit an expatriate, for relief purposes only, to fill the position vacated by the employee going on training. The salary of the employee is Tax deductible under the National Training Council scheme, but the costs of the expatriate are not.

Training Support :

Apprenticeship - A normal apprenticeship programme is in place where the company pays salary costs, but the Labour Department pays all other direct costs attributable to the apprenticeship.

Time Urgency of Workforce : Limited

Labour Laws :

- Industrial Organizations Act, Chap. 173 (Regulates Trade Union and Employer organizations)
- Industrial Relations Act, Chap. 174 (Gives the procedures for negotiating terms and conditions of employment)
- Employment Act, Chap. 373 (Sets the minimum terms and conditions of employment for PNG citizens)
- Employment of Non-Citizens Act, Chap. 374 (Sets the minimum terms and conditions for employment of expatriates)
- Industrial Safety, Health and Welfare Act, Chap. 175 (Sets minimum requirements)
- Workers Compensation Act, Chap, 179 (Sets compensation rates in the event of claim. Employers may insure against claim privately)

Labour Unions : It is not mandatory for employees to belong to a Labour Union, and companies need not be unionized. There are "national" unions and "amalgamated, cross-industry" unions. All unions must be affiliated with the PNG Trade Union Congress. Labour agreements are "policed" by the Labour Department who give "rulings" to obtain satisfaction. If the ruling is not accepted by the parties, Labour Arbitrator (Court) gives the final ruling.

Employer Association: There is an "Employers Federation". Membership by companies is voluntary.

6.0 Taxes

Corporate Tax Rate : non-mining sector = 25% (Pioneer, first-of-a-kind, industry gets a 5 year exemption)

Personal Income Tax :

	Income (K)	Tax Rate
Residents -	0 - 3,000	= Nil
	3,000 - 5,000	= 15%
	5,000 - 10,000	= 20%
	10,000 and over	= 28%
Non Residents -	0 - 2,000	= 15%
	2,000 - 7,000	= 20%
	7,000 and over	= 28%

Sales Tax : Varies by Province, but ranges from 1.5% to 6.0%

Capital Gains Tax : Legislated, but deferred for the present.

Withholding Tax Rate: Dividend tax = 17%

: Foreign Contractors, 25% of the gross contract price is deemed to be taxable income @ 48% tax rate. (i.e. 12% of gross)

: Foreign Management/Consulting Fees = 17%

7.0 Banks

Operating Banks : 5 Commercial Banks with full facilities

Bank selling rate : US$ 1.00 = K 0.9951 @ 12/02/93

Bank buying rate : US$ 1.00 = K 0.9547 @ 12/02/93

Banking Regulations :

- Banks and Financial Institutions Act, Chap. 137 (provides for the licensing of banks and financial institutions, and their inspection and control)
- Central Banking Act, Chap. 138 (creates the Bank of Papua New Guinea, defines the services of the Central Bank, controls the financial parameters, defines the relations with other banks and financial institutions and sets the currency. The Act is supported with Central Banking (Foreign Exchange and Gold)

Regulation and Central Bank (Prescribed Liabilities) Regulation.)

Bank loans (1990) : K 871.1 million
Finance Availability: Limited

8.0 Trade Arrangements

Member of :

- South Pacific Regional Trade and Economic Co-operation Agreement - (SPRTECA) (Australia, New Zealand and the South Seas Islands)

Trade Treaties[13] with :

Australia

- Agreement Between The Government of The Independent State of Papua New Guinea and the Government of Australia for the Promotion and Protection of Investments.
- Agreement on Trade and Commercial Relations between the Government of Australia and the Government of Papua New Guinea (PATCRA II)
- Agreement between Australia and the Independent State of Papua New Guinea for the Avoidance of Double Taxation and the Prevention of Fiscal Evasion with respect to Taxes on Income.
- Australia - Taxation Laws Amendment (International Agreements) Bill, 1990.
- Treaty on Development Co-operation between the Government of Australia and the Government of Papua New Guinea and Exchange of Letters.
- Memorandum of Understanding between the Government of the Independent State of Papua New Guinea and the Government of Australia

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13 A "Look North" policy is proclaimed for closer cooperartion with Asian countries.

concerning Consultation on Quarantine Matters.

- Memorandum of Understanding between the Government of Australia and the Government of Papua New Guinea - Maritime Consultations.

New Zealand
- SPRTECA

USA
- Joint Commercial Commission

United Kingdom
- Commonwealth

Europe (EEC)
- Lomé Convention

9.0 Infrastructure

Supply Lines : Long

Airports :

International (ICAO 4E)
- Jacksons (Port Moresby)

Major (ICAO 3C)
- Nadzab (Lae)
- Momote (Manus)

Major (ICAO 3B)
- Goroko
- Hoskins
- Kavieng
- Kieta
- Madang
- Mt Hagen
- Rabaul
- Vanimo
- Wewak

Others = There are a further 426 licensed National Government and Commercial Aerodromes in PNG.

Air carriers :

International
- Air Niuguini
- Quantas

Domestic Scheduled
- Air Niuguini
- Talair
- Airlink
- Island Aviation
- Milne Bay Airways

Charter Companies = There are a further 32 licensed operators in PNG with capability ranging from light aircraft to Islanders/ Twin Otters and helicopters ranging up to heavy lift.

Couriers : - DHL
- Fastpak (Federal Express)
- T.N.T.
- P.T.C. (Express Mail)

Ports : The Harbours Board is responsible for 17 Gazetted "dedicated ports"[14], which include extensive foreshore, as well as 10 metres adjacent land, rights, most of which is currently not developed. Charges are K 3.16/m^3, in addition to wharfage charges, for lumber to cross Harbours Board facilities. The 17 dedicated ports are Vanimo[15], Lorengau, Aitope, Wewak, Madang, Daru, Port Moresby, Alotau, Kavieng, Rabaul, Kimbe[16], Bialla[17], Buka, Kieta, Lae, Oro Bay and Samarai.

Coastal Shipping :

Capacity -

Vessel Type	Capacity Tonne-Kms ('000,000)
Landing/Motor Barge	821
General Cargo	1,248
Cargo/Passengers	538
Container General	131
Dumb Barge	40
All Above Vessels	2,779

Utilization -

Vessel Type	Utilization %
Landing/Motor Barge	19
General Cargo	48
Cargo/Passengers	37
Container General	38
Dumb Barge	57
All Above Vessels	35

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14 Port facilities may be freely constructed privately outside the Harbours Board jurisdiction. Harbours Board is prepared to consider extending its jurisdiction upon request.

15 There is a dedicated timber wharf at Vanimo.

16 The Stettin Bay Lumber Company port facilities come under the Kimbe jurisdiction.

17 Bialla is a Government funded installation in support of the oil palm industry. This is the only port that does not have specific Harbours Board charges by commodity. Instead, the Harbours Board charges an annual rental. The facility construction costs were K 4.5 million funded under loan from the ADB, and the rental charges are set to cover the repayment of that loan at 7%. The port facility is operated by the oil palm interests.

Water-borne freight :

- C.B. Marine & Engineering (South East Asia - every 2 weeks, Australia - weekly)
- Consort Express Lines (PNG Coastal - weekly)
- Thong Soon Lines (Far East/ Solomon Islands - weekly)
- Sofrana Unilines (New Zealand/South Pacific - every 2 weeks)
- The Bank Line - London (Europe/South Pacific - monthly, Asia/South Pacific -every 3 weeks)
- Laurabada Shipping Services (PNG Coastal)
- Mitsui OSK/Nippon Yusen Kaisha Line (Korea/Japan - monthly)
- Lushipp (PNG North Coast - weekly)
- Barbican Line (Brazil/South Pacific - monthly)
- Chief Container Service (Australia/Solomon Islands - every 2 weeks)
- New Guinea Pacific Line/Bank Line/P.O. Containers Ltd. (Asia/South Pacific - every 3 weeks with connections to Europe)
- Pacific Forum Line (New Zealand/Fiji/Solomon Islands /Australia - every 3 weeks)

Roads : Total 23,845 km (1990), of which 2,128 km paved and 21,717 km unpaved. No national road grid has been developed. A local road grid links and services Madang, Morobe, Eastern Highlands, Western Highlands and Southern Highlands Provinces.

10.0 Exporting and Importing

Export Procedures	:	Normal procedures
Import Procedures	:	
	-	Normal procedures
	-	10% duty on all industrial equipment except "pioneer industries".
	-	Duty free access of personal effects of non-nationals entering the country for the purpose of carrying on an approved enterprise.
Customs Brokers	:	Available
Freight Costs	:	
International	-	Sea Container - Australia = K 1,500 - North America = K 3,000 - Europe = K 2,800 Sea Container Wharfage = K 6.64/m^3 Sea Break Bulk - Australia = K 140/m^3 - North America = K 230/m^3 - Europe = K 230/m^3 - Japan[18] = K 170/m^3 Sea Break Bulk Wharfage= K 9.84/m^3
Domestic	-	Sea Break Bulk = +/- K 40/m^3 to K 80/m^3 plus +/- K 7.50/m^3 for stevedoring charges. Contract truck hauling = +/- K 0.225/m^3/km

11.0 Utilities

Electrical	:	94% of ELCOM's (the Papua New Guinea public utility) 1990 electrical power demand was hydro generated. Thermal (gas turbine and diesel) provided the remainder. There is no national transmission grid. There are three distribution systems: - Port Moresby/Kwikila based on the Rouna hydro scheme with thermal add-on; - Highlands/Morobe/Madang provinces based on the Ramu hydro scheme with thermal add-on, and

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18 Rate also applies to containers.

- Rabaul/East New Britain based on the Warangoi and Kerevat hydro schemes.

The line voltage systems are:

- 50 cycles
- Three phase : 415 volts
- Single phase: 240 volts

Electricity Rates (01/05/91)

Universal rates throughout PNG

Domestic
- First 100 kwh = K 0.121/kwh
- The balance = K 0.173/kwh

General Supply
- All energy = K 0.173/kwh

Industrial Supply[19]
- All energy = K 0.0923/kwh
- Demand Charge = K 11.56/KVA
- Minimum Charge= 200KVA or K 2,312.00

ELCOM 1992 installed generation capacity is 161.8 MW of hydro and 89.7 MW of thermal.

- Generation use/capacity is as follows:
  - Ramu = 50 MW in use of 75 MW of installed capacity, and with potential development of a further 140 MW;
  - Port Moresby thermal and hydro totals 100 MW installed capacity and is fully committed;
  - The undeveloped Divune hydro generation scheme has a potential 10 MW of generation capacity, and;
  - All local thermal generation is small and sized to current demand.

Costs of H.V. distribution (22 kv) line installation = K 60,000/km. Customer guaranteed purchase of power must ensure the recovery of ELCOM's distribution line development costs at 20% per annum, otherwise a capital advance is called for.

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19 Industrial supply charges available to large industrial and commercial consumers in the centers of Port Moresby, Goroka, Kainantu, Kundiawa, Lae, Madang, Mendi, Mt. Hagen, Yonki and Rabaul.

Private Electrical	:	The sugar, mining and oil industries are self sufficient in generation capacity. PNG Forest Products at Bololo has 5 MW of hydro generation of which 2 MW is surplus to need.
Water Supply	:	The Waterboard services Wewak, Madang, Mt. Hagen, Kundiawa, Daru, Lae, Popondetta, Kimbe, Rabaul and Alotau Waterboard Districts. The commercial universal rate for water is K 0.60/Kl. Port Moresby water is supplied by the National Capital District Commission at slightly cheaper rates. Water supply is not unlimited. Projects outside the Waterboard Districts have either to install their own supply or pay for pipeline connection to Waterboard supply.
Fuel Costs	:	Port-universal price based on purchase price on the spot market. All other locations have a freight differential add-on. Retail fuel is subject to sales tax which varies from province to province. Port Moresby based refinery in planning stage with furnish to come from Kutubu domestic oil production. - bulk gasoline = K 0.421/l - bulk diesel = K 0.313/l - bunker C = K 205.00/metric T - pump gasoline = K 0.492/l - pump diesel = K 0.381/l
Maintenance Services:		All

12.0 Communications

Telephones	:	STD Domestic. Reduced night and Sunday rate. IDD Worldwide. No reduced rate.
Telefax	:	Worldwide
Telex	:	Available
Data Transmission	:	Satellite/digital microwave
Broadcasting	:	Thee is only Government owned broadcasting originating within PNG. Satellite reception for foreign TV.
TV	-	1 TV station centered in Port Moresby with re-broadcast

stations for the Provinces.

Radio Stations - There is one FM station confined to Port Moresby area. There is one AM broadcasting station originating from Port Moresby with repeater stations to give country coverage.

13.0 Investment Incentives

Tax holiday	:	
	-	Pioneer industries are exempt Corporate Tax for a 5 year period.
	-	There is a 10 year Corporate Tax holiday for enterprises locating in designated undeveloped rural areas.
Import Duty exempt.	:	None, except for shipping and aircraft.
Profit Repatriation	:	Freely, except for 17% withholding tax.
Double Taxation Relief	:	Tax treaties with Australia/ Canada/Singapore/U.K. prevent double taxation on income earned in PNG. Treaties awaiting ratification with Malaysia and Germany.
Investment Protection	:	Protection against arbitrary seizure and confiscation.
Residence/Work Permits	:	Required and issued by the Government.

14.0 Forest Sector Dependent Parameters

Timber Ownership	:	97% of PNG land is communally owned by a myriad of antagonistic clans. Timber rights are attached to recognized land ownership rights. From 1992, timber rights can be passed to the GoPNG through the execution of a "Forest Management Agreement" between the GoPNG and the Landowner Group. The timber

rights can then be further passed to an operator by the Forest Authority, either directly or through a subsidiary agreement with the Landowner Group.

Natural Forest Timber Supply[20] :

- Theoretical production forest zoned S.Y.C. (selection cut) = ? m^3/yr
- S.Y.C. of timberlands acquired = ? m^3/yr
- Timber Allocated = ? m^3
- Licensed cut = ? m^3/yr
- Years cut left at licensed cut level = ? yrs
- Volume on un-acquired timberlands = ? m^3

Plantations :

- Commercial area = +/- 35,000 ha
- S.Y.C. @ m.a.i. 20 m^3/ha/yr = 700,000 m^3/yr

Timber Tenure :

- Area, not volume, based
- Short duration (1 to 10 years)
- Renewal/extension at end of tenure period. Tenure not "evergreen".
- A timber tenure's licensed cut is not tied to the S.Y.C. of the tenured property.

Forest Sector Wage Earnings (1987): K 7,815,000

1990 Forest Product Imports :

	'000 Kina	Unit
- raw paper	= 9,362	12,420 T.
- finished paper	= 7,539	
- cardboard box	= 3,388	4,280 T.
- lumber	= 32	6,962 m^3
- plywood/veneer	= 389	677,667 m^2
- panel board	= 866	251,254 m^2
- all others	= 1,772	

20 Natural forest timber supply data not available at time of Sector Review preparation.

Tariff Protection :

-	Plywood	= 200%
-	Lumber	= 30%
-	Moldings	= 30%
-	Particle Board	= 50%
-	Fiberboard	= 50%
-	Veneer laminated panel board	= 200%
-	Reconstituted wood	= 50%
-	Crating and pallets	= 30%
-	Window frames	= 50%
-	Doors and frames	= 200%
-	Parquet, shuttering, shingles and shakes	= 50%
-	Office panelling	= 80%
-	Carvings, furniture	= 50%
-	Corrugating medium	= 30%
-	Carbon and copy paper	= 30%
-	Graphic and draughting paper	= 30%
-	Toilet paper	= 50%
-	All other specialty papers	= 30%
-	Corrugated boxing	= 30%
-	Books, ledgers, office supplies	= 30%
-	Newsprint and all other raw paper in roll or sheet form	= 10%

GWV CONSULTANTS INTERNATIONAL
AND
NAWITKA RESOURCE CONSULTANTS

FOREST SECTOR REVIEW (DRAFT REPORT)
APRIL 1993 - PORT MORESBY, PNG

FIRST DRAFT

FOREST SECTOR REVIEW

1993

FOREST INDUSTRY DEVELOPMENT STUDIES

ITTO PROJECT PD 108/90

presented to

NATIONAL FOREST SERVICE
OF
PAPUA NEW GUINEA

by

General Woods and Veneers
Consultants International Ltd.
and
Nawitka Resources Consultants

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1.0 BACKGROUND

The World Bank led a review of the Papua New Guinea forestry sector in early 1989 under the auspices of the Tropical Forestry Action Plan (TFAP). In February, 1990, it presented its final report to the Government of Papua New Guinea, where it outlined a number of proposed projects for external funding to assist GoPNG to properly manage the conservation and utilization of its forest resources. For Papua New Guinea, the programme is now known as the National Forestry and Conservation Action Programme (NFCAP).

The TFAP report for PNG refers to the need to study closely the economic feasibility of industries based on forest resources, prior to formulation of any major policy decisions on the sector, such as imposition of log export bans, introduction of special incentive packages, and so on.

Presently the natural resources of PNG are exploited mostly for the export of raw logs - there are currently about 10 sawmills of varying sizes condition and production capability, one plywood mill and 1 chipmill in PNG as compared to about 84 log exporters. Nearly 98% of the 1992 log exports were controlled by non-PNG interests, and about 86% of all log exports were controlled by just one affiliated commercial group.

There is suggestion that the PNG processing sector is not internationally competitive, with high internal costs, a volatile tenure system and the diverse nature of the forest resource being contributory factors. This situation requires a more systematic study as it may indeed be related to the decline of processing capability since 1979 when the forest policy was changed to encourage log exports.

In 1992, a new Government was elected into power in PNG. In response to the Barnett Commission of Enquiry into the Forestry Sector of the mid 1980's, a new Forest Act

came into force on 25th June, 1992. The Department of Forests was legally disbanded and a new National Forest Service is currently being formed under the watchful eye of a new National Forest Authority as constituted by a Board. The decentralized Provincial Forestry systems is again being centralized under the National Forest Service. The Council of Forest Industries was disbanded. The Forestry (Private Dealings) Act was revoked. In general, 1992 saw the start of fundamental changes being made in the forest sector in PNG.

The forest institutions are undergoing a major rebirth as a result of these happenings. A new Managing Director of the National Forest Service has been installed under the political guidance of a new Minister of Forests.

The re-staffing of the National Forest Service, and the development of this cadre into an efficient and effective force for the betterment of the forest sector is expected to be the focus of the fledgling institution for the best part of 1993.

Against this background, the Forest Industries Development Studies (FIDS) project was initiated. The project, designed to be completed over 18 months, commenced on 26th July, 1992. The project is funded in the main by the International Tropical Timber Organization (ITTO). The ITTO is a multilateral agency which is funded by its member countries, including PNG.

The basic objectives of the project are to formulate a coherent and well-supported series of recommendations on the question of whether and how to pursue more intensive evaluation of specific forest product processing possibilities, and to present these findings to GoPNG after an extensive dialogue with government and industries agencies.

The first stage of the FIDS project is to present a sector review as input into the full development of the project basic objectives. This document fulfills that first stage intent.

2.0 FOREST RESOURCES OF PAPUA NEW GUINEA

2.1 Status and Trends

Closed forest cover dominates the landscape of PNG, blanketing over 70% of total land area, or about 32 million hectares. Ranging from sea level to over 4000 metres, and from dry savannah to moist tropical rainforest, these forests contain an immense wealth of species, ecosystems, and tropical habitats. Representing sets of both Malay and Gondwanaland flora and fauna they are among the most biodiverse national forests in the world. A sound general

description, and ample references are provided in Lamb 1990.

PNG flora alone comprise some 11,000 species; the principal commercial forest -lowland rainforest - contains more than 1,200 tree species. Many indigenous species of insects, birds animals and fish are also resident in PNG forests.

These forests form an integral part of the unique cultural and social heritage of PNG. Forest soils, plants, animals and birds still provide for or supplement the subsistence needs of rural people in all regions.

Major rivers traverse roughly 11,000 km. in PNG, with the largest watersheds being virtually 100% forested. (e.g. Fly River - 1200 km long, 6.9 million hectare watershed; Sepik River - 1,100 km long, 7.9 million hectare watershed.) The characteristics of many important wetlands and water resources are thus governed by upland forest cover.

Apart from the great river basins of the Southwest plain (Fly, Bamu Turama, etc.) and the Sepik basin, most rivers/watersheds rise fairly sharply from the coastal plains into foothills and the massive ridges of the central spine of the PNG mainland. Basins on the outer islands also tend to be relatively short and rise quickly from the coast towards a central ridge.

This terrain plus the great biodiversity of PNG forests have acted as a deterrent to commercial exploitation in the past. Known commercial species represented a relatively small proportion of total stand volume in the largest forest types. Difficult terrain compounded the difficulty of economic extraction of timber.

During the first thirty years after World War II, the more uniform (high proportion of Dipterocarp species) and extensive tropical forests of the Philippines, Indonesia, Malaysia and Thailand were preferred sources of hardwood timber in the large markets of the Pacific Rim.

Production from PNG forests was limited, and focussed on domestic and Australian markets. Annual harvest grew gradually from 100-150 thousand m3 in the 1960's to about 500,000 m3 by the early 1970's.

Thus by 1979, when forest policy of the new nation (PNG Independence in 1975) was revised to allow log exports, the forests of PNG had been only minimally impacted by forest industry activity, in relation to their totality. Resource inventory information was sporadic in coverage but adequate for planning purposes in larger areas newly proposed for Timber Rights Purchase (TRP - see below).

Fourteen years later, in 1993, the situation is very different. Timber rights have been purchased from customary owners on about 4.2 million hectares. The permitted harvest on this area (not necessarily sustainable) is about 5.4 million m3/annum at present.

The principal economic mover in the steadily rising interest in PNG forest products has been a growing scarcity of tropical hardwoods in the world, and particularly, of logs for import into large processing centers in Japan, Korea, Taiwan and other nations of the region. Some of the largest of these centres had developed forest industries based on log imports from Indonesia, Malaysia and the Philippines. Most of these log exports are now banned (see below), and demand pressure has shifted towards PNG steadily since 1979.

Total harvest was over 2 million m3 in 1992, and may reach 3 million m3 or more in 1993. This level of actual harvest activity, and the current permits for over 5 million m3, impose much more stringent demands upon resource inventories, and forest management systems, if resource sustenance is to be assured.

Following the recommendations of the PNG National Forestry and Conservation Action Plan (NFCAP) of 1991 (World Bank 1991), and with the assistance of AIDAB, a Rapid Resource Assessment is being prepared by CSIRO of Australia, to provide basic data on the state of PNG forests at present (CSIRO-draft-1992).

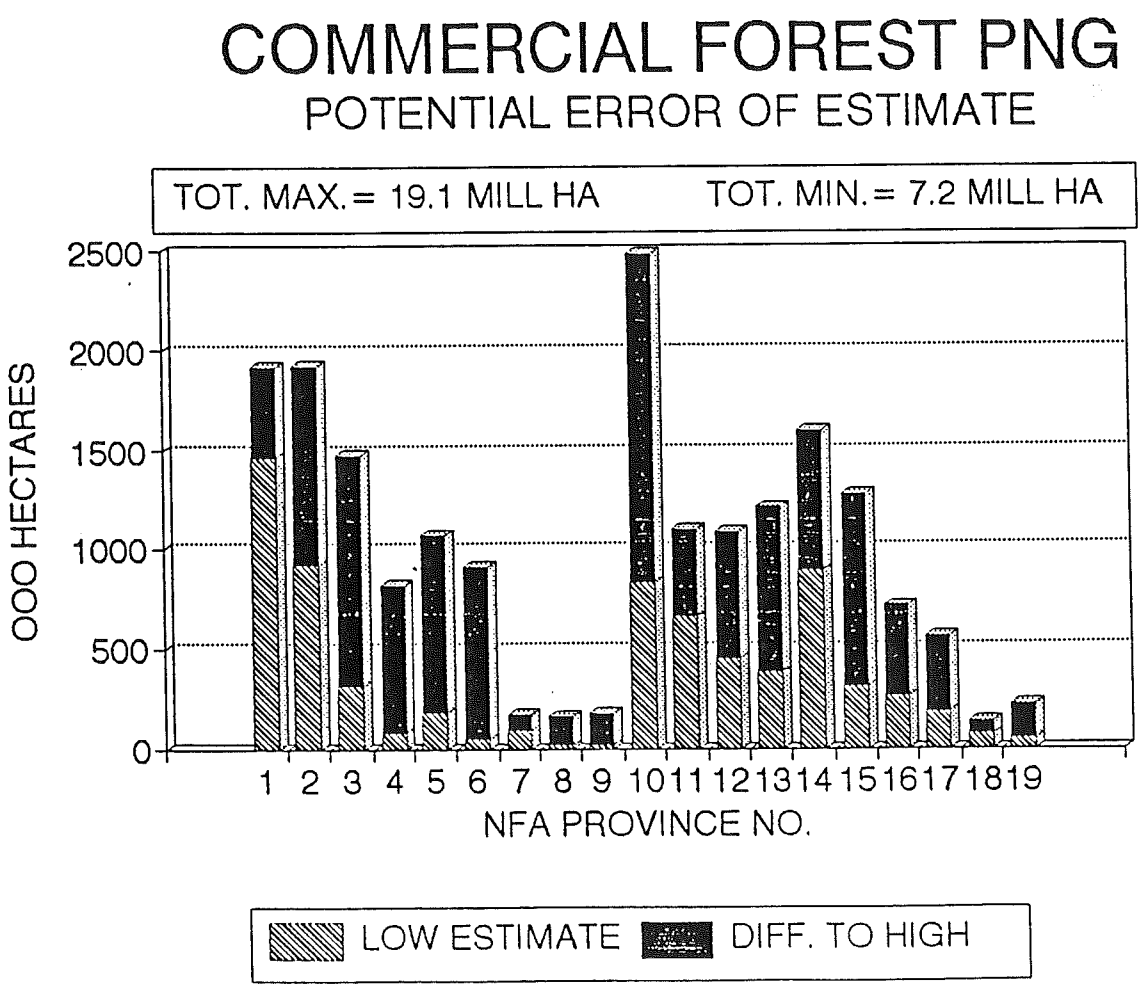
The draft conclusions of the Assessment reveal significant economic potential in the resource, but are sobering with respect to management and sustenance:

- the estimated accessible, commercial timber volume in PNG, on areas not previously harvested, is approximately 170 million m3 on a net productive forest area of 7.2 million ha;
- other area and volume estimates have placed the area as high as 19.1 million ha. and the volume as high 950 million m3 (see Figures 1. and 2. and Annex Table 1.);
- the physical basis of these estimates is conjectural - at best an "informed guess";
- economic accessibility estimates are weak, and are not assumed to be price sensitive;
- the least documented of the "guesses" are the rate and type of renewal and growth of natural forests, after varying degrees of selection cut under current regulations;

- o virtually no information exists methods of sustenance of commercial natural species after selection harvest;
- o none of the current regulations have been monitored or enforced over the past decade;
- o present means of dedication of natural forest to a production forest estate are inadequate - and significant losses to agriculture are forecast over the next 20 years, and;
- o national/regional/watershed land use planning systems have been moribund for over a decade.

Figure 1. shows the rough range of commercial forest area estimates for PNG, from 7 to 19 million hectares. This level of accuracy is clearly inadequate for planning sustainable development based on PNG forest resources.

FIGURE 1.



The total closed forest area of 32 million hectares contains a further vast area of uncommercial rainforest, dry forests, mangroves, freshwater swamp and sago palm forests, mountain forests, and scrub (13-25 million hectares).

The largest block of deforested land in PNG is in the densely populated portions of the Highlands. In this region burning and shifting cultivation has expanded to a stage which creates the expansive hillsides of kunia (imperata) grasses familiar elsewhere in Asia. Most other regions of PNG are greater than 90% forested.

LIST OF PROVINCES BY NUMBER

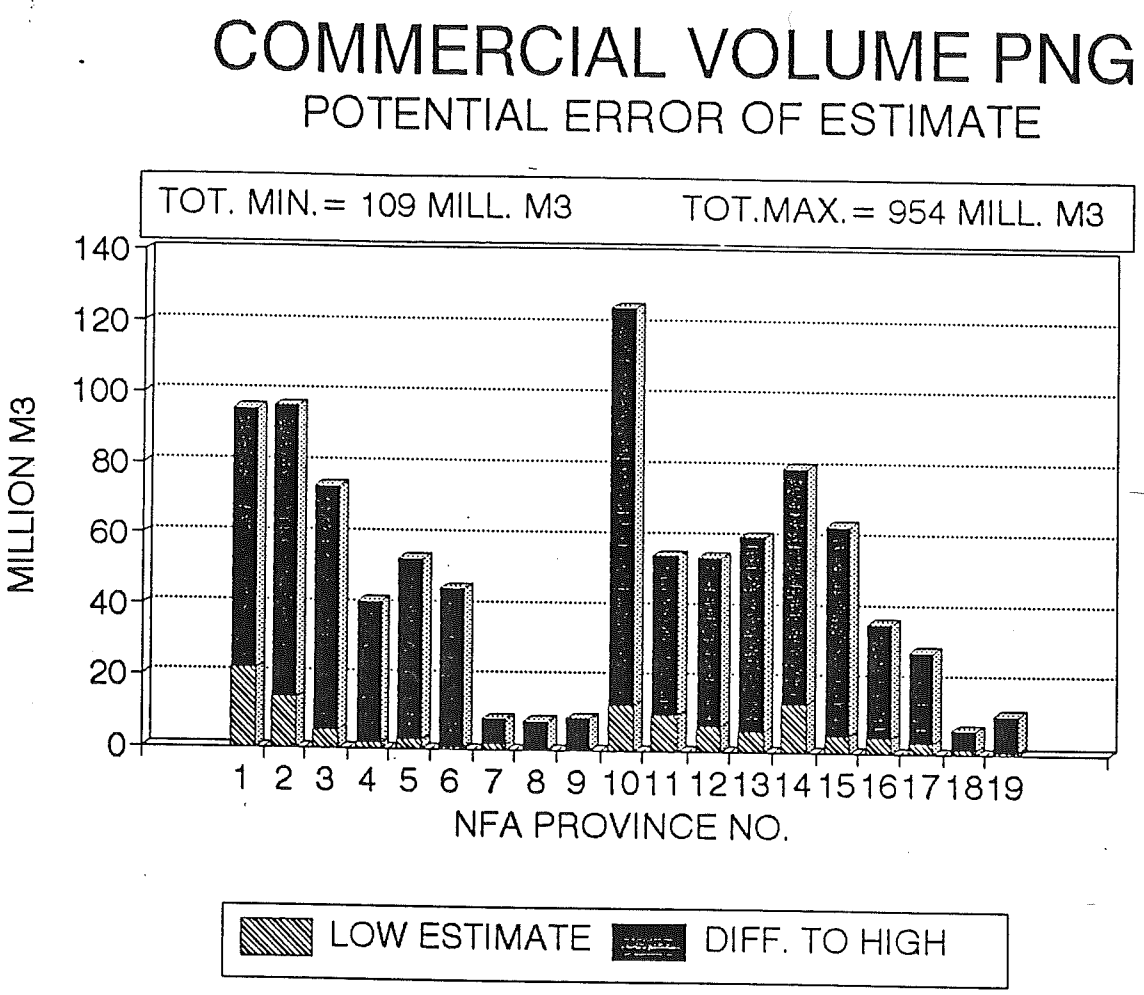
PROVINCES OF PAPUA NEW GUINEA

1. Western
2. Gulf
3. Central
4. Milne Bay
5. Oro
6. Southern Highlands
7. Eastern highlands
8. Enga
9. Western Highlands
10. Sandaun (West Sepik)
11. East Sepik
12. Madang
13. Morobe
14. West New Britain
15. East new Britain
16. New Ireland
17. North Solomons (Bougainville)
18. Manus
19. Chimbu
20. National Capital District (NCD)

Figure 2. shows the rough range of commercial volume estimates for PNG forests. The problems of area definition are compounded by inadequate field sampling, and weak

definitions of "commercial species". The latter problem is especially acute in terms of forward projection of market conditions for tropical hardwoods.

FIGURE 2.



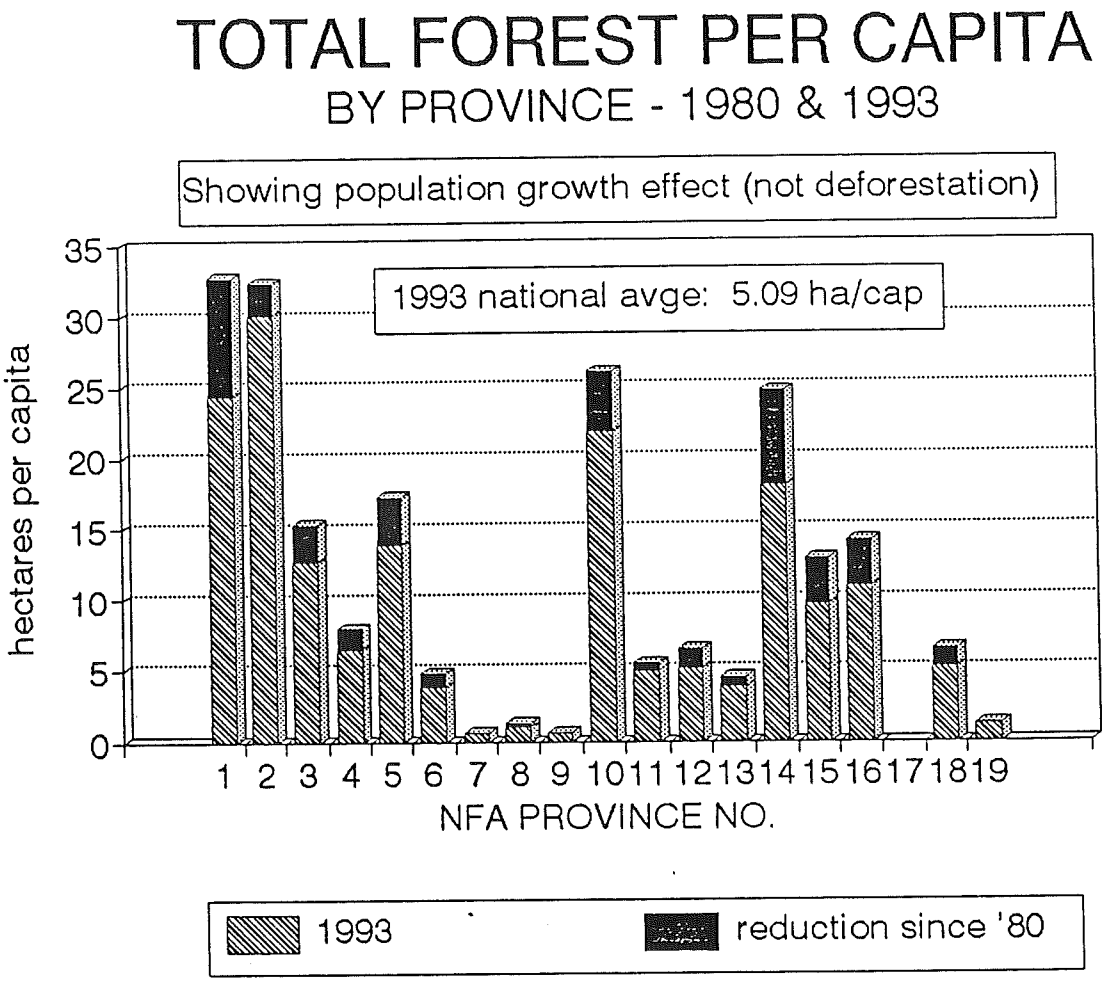
The CSIRO draft report urges the acceptance of a "minimum reliable estimate" in the short run, as a conservative approach to commercial volume. However it is easy to see both the risks of unsustainable operations and of missed opportunities, with such weak resource information.

Both the protection of forest biodiversity in PNG, and the realization of the sustainable economic potential of the forest sector will require significant improvements in the resource information base.

The different resource endowments by Province are accentuated on a per capita basis. The more densely

populated highland provinces have little residual commercial forest, and average less than one hectare per capita. Most of this forest is under pressure, and is already in a degraded condition. Well endowed provinces in the west of the mainland have 20-30 hectares per capita, while the outer islands contain some of the best commercial forests, at 10-20 hectares per capita (see Figure 3).

FIGURE 3.



In spite of the evident scale of PNG forest resources at present, there is little grounds for complacency regarding their sustenance in the long term. Figure 3. shows the reduction in forest per capita over the last thirteen years, through population growth only. There are no provincial or national estimates of deforestation to agriculture or other land uses since 1980.

3.0 THE CURRENT FOREST SECTOR - STRUCTURE AND PERFORMANCE

3.1 The Public Sector

3.1.1 The Forest Tenure System

Land and Timber - The Public Trust

Lands and forests in PNG are owned by landowners under customary law and traditional collective tenures (see below - private sector).

Governments of PNG (colonial/protectorate and national) have always assumed management duties in trust to assist landowner groups in their dealings with outside commercial interests. Objectives have included controlled economic development, forest conservation, and equitable distribution of revenues derived from timber sales.

From independence in 1975 until 1992, responsibility for implementing government policy in the forest sector was vested with the national Department of Forests. Provincial Forest Officers, responsible to their respective provincial governments, were mandated to carry out field supervision of activities on forestry Project Areas.

Timber Acquisition by the Public Sector

Roughly, these Project Areas were areas where rights to harvest timber had been purchased from groups of Landowners by the Forest Department (Timber Rights Purchase - TRP Areas), for the purpose of sustainable forest industry development. These TRP's were to be subject to harvest under specified conditions, under government supervision.

These purchases have always been the subject of protracted and sensitive negotiations with landowners. At least part of the problem is uncertain, overlapping and disputed claims to land or use of land by local clans/villages (see below).

The government's "Purchase" tenure has always been tenuous in the medium to long term. Landowners have often interfered with forest operations when they did not think their interest was being served. At least some of these concerns were justified.

Timber Allocation to the Private Industry Sector

After negotiations (and advertised bidding in some cases) agreements were signed between the Department of Forests and individual industry operators for each TRP, to

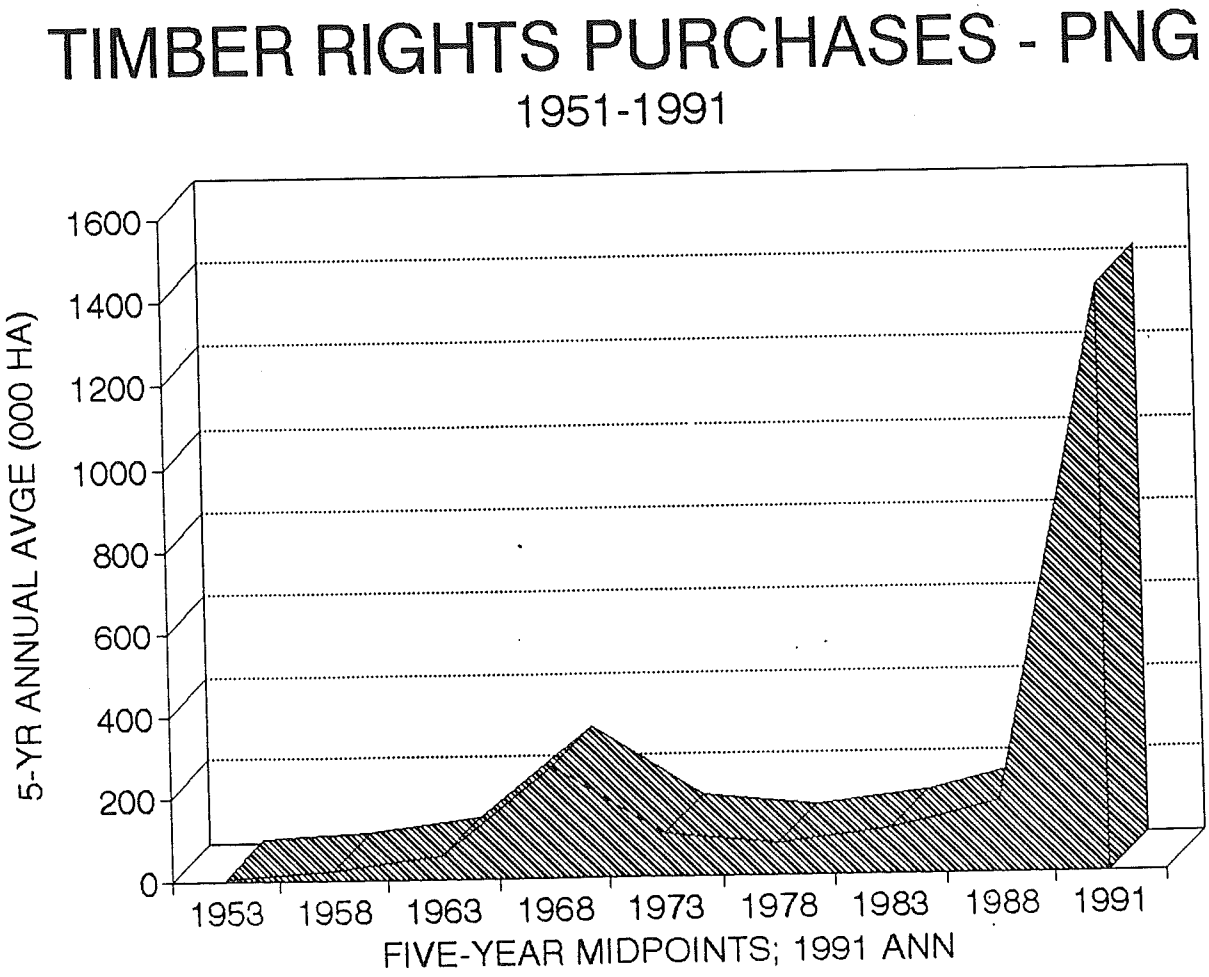
harvest the timber, make royalty/stumpage payments and construct agreed infrastructure for local landowner use. Timber Permits (TP) were issued for actual harvest within each TRP, containing more detailed conditions of harvest, including management plans.

Targets for development of local wood-based manufacturing industries within TRP's were vague, but generally set at about 30% of total harvest, by five years after project start-up. Log exports dominated industry activities after 1979.

The other main vehicle for transfer of harvest rights from landowners to timber companies was the Local Forest Authority (LFA). These agreements were made directly between landowners and industry companies, with direct payment of royalties/ stumpage to the landowners or representative group (under the Forestry (Private Dealings) Act).

Figure 4. shows the pattern of TRP acquisition and TP granting 1970-91.

FIGURE 4.



Supervision of Timber Operations and TRP's

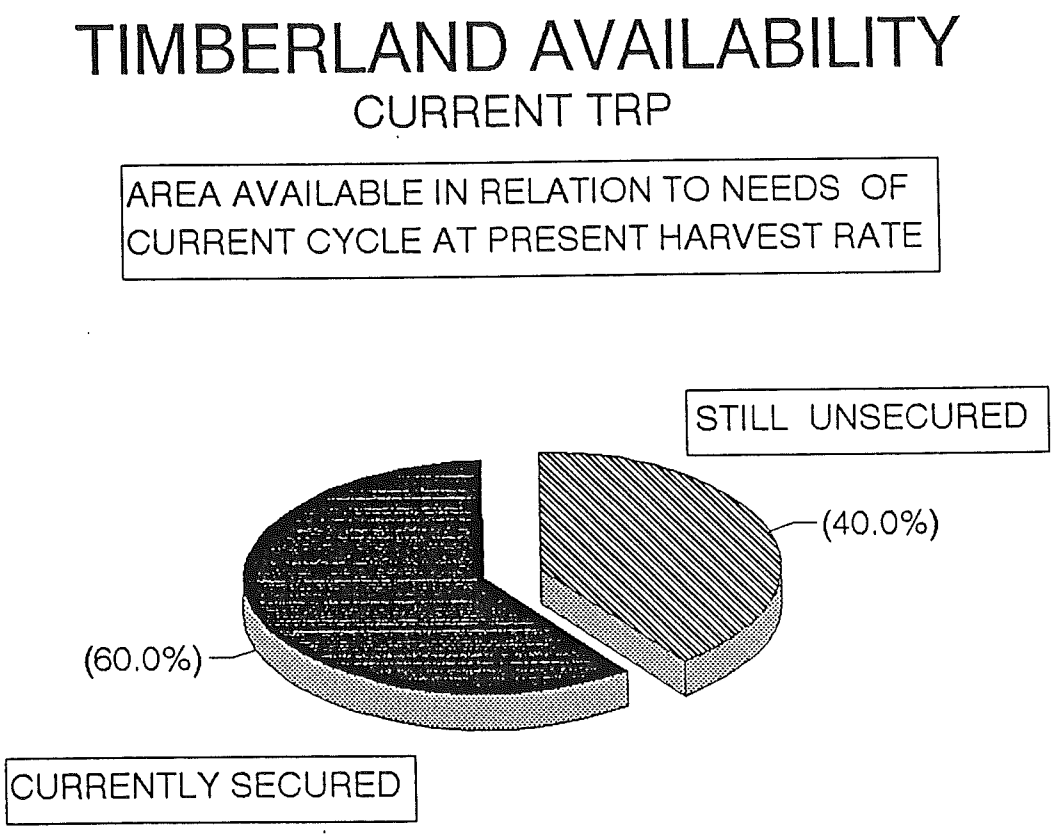
Inspection and supervision of the licensed private industry operations on TRP's and LFA's has been inadequate to assure protection of either landowner or public interests. Forest Agency budgets and staff have been inadequate for the task nationally and in each province.

Experience shows that the current licensed cut has depleted each TRP area in less than half the cutting cycle (40 years).

Both resource and harvest information systems are inadequate to identify the problem as lower commercial volume than originally estimated, less volume taken than agreed, or unrecorded harvests.

The present harvest rate nationally cannot be sustained with the current area under TRP agreements, and current harvest practices. Figure 5. shows a crude estimate of the additional area necessary to complete a forty year cutting cycle at the present harvest rate.

FIGURE 5.



The current recorded harvest rate is about half of the full licensed harvest rate. If operators were to harvest up to the maximum licensed rate, this situation would be exacerbated.

The conditions of each TRP agreement are different with respect to local infrastructure construction, and with respect to domestic manufacturing targets. These conditions have not been operationally inspected or supervised.

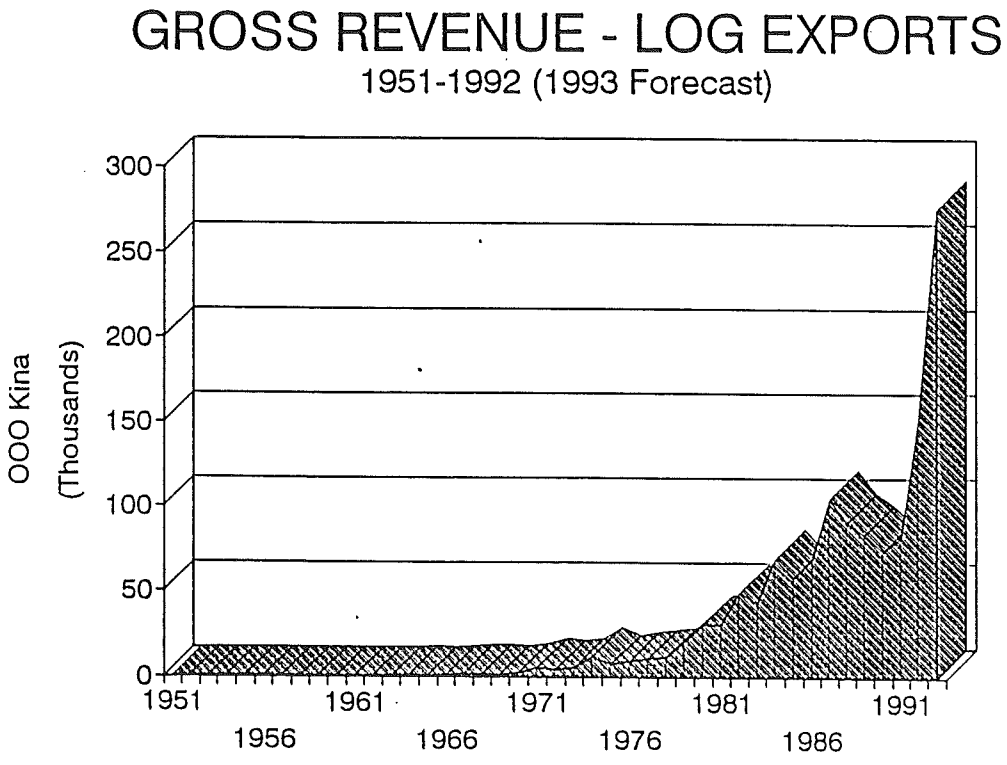
3.1.2 Forest Revenue Collection and Distribution

One of the most important objectives of public stewardship of landowners' forests was and is to obtain a fair price from industrial users for logs used, and distribute the proceeds equitably between public and landowner needs.

The rapid increase of log exports after 1979 dramatically raised unit prices of timber in PNG, and total revenue.

Sales revenue from log exports has increased dramatically during the 1980's, from about K 10 million to over K 100 million at the previous peak in 1987, and reaching record levels in 1992-93 (see Figure 6.)

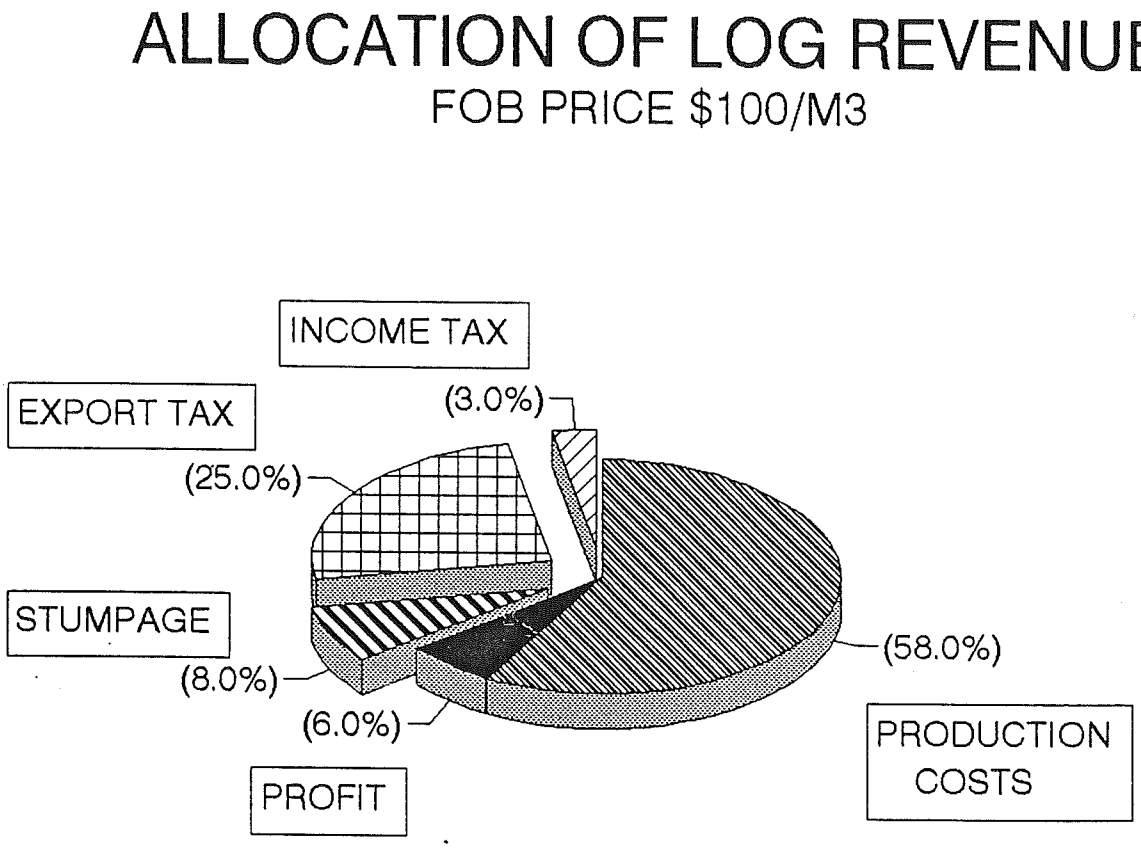
FIGURE 6.



Not surprisingly, both the scale and the distribution of those revenues has become an important issue to governments, landowners, and the industry (see AIDAB 1991). Figure 7. provides a summary of revenue distribution from export log sales in 1991.

The largest share of revenue not going to the operator (in costs or profit) goes to the national general revenue pool through the export tax. An inequitably low share goes to the landowners who commit timber assets to each venture.

FIGURE 7.



In the late 1980's the national government exercised its right to tax raw material exports, and as a result currently collects about three times what land/timber owners collect for each cubic metre of roundwood exported from a TRP or LFA area. A range of other, more minor taxes and transfers further complicate and confuse basic sector issues such as:

- reforestation and forest management (therefore sustainability of harvest), and;

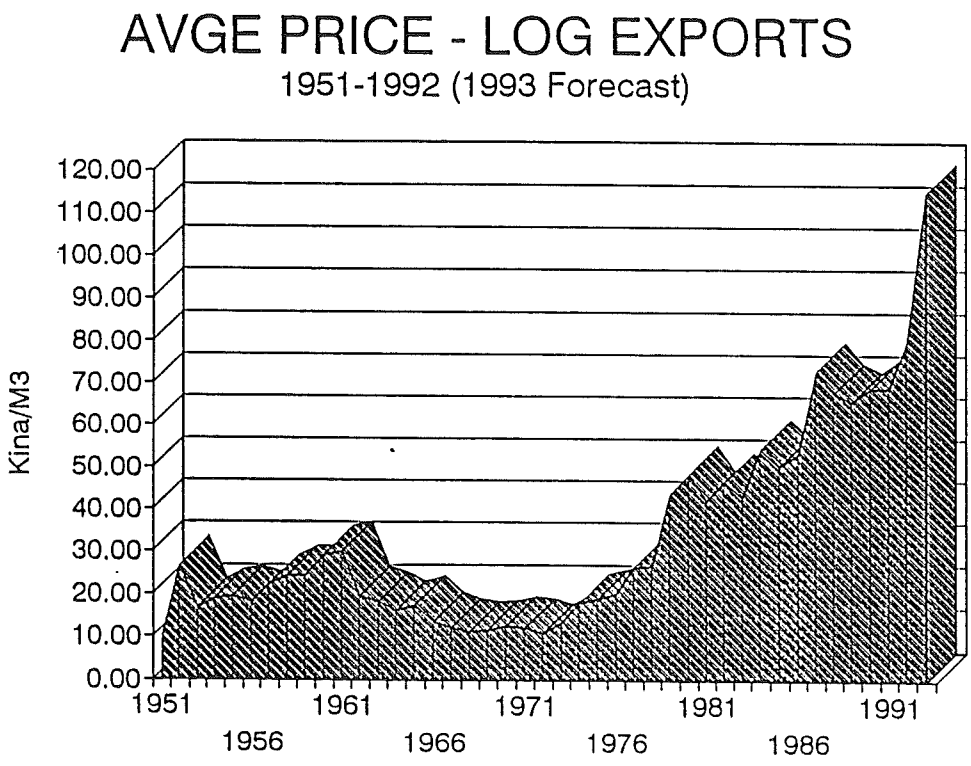
- profit for investment/reinvestment in infrastructure and equipment (therefore development of the sector).

One of the objectives of the government in imposing log export taxes was to collect additional revenue which had been "left on the table" for the operator to pick up, in original TRP agreements and forest revenue systems.

A key issue involves the selling price of these logs, which governs total revenue and therefore various residual (stumpage and surplus) calculations and tax rates. The effectiveness of current and past systems in tracking "market" log prices for shipments from PNG has been widely debated (see for example INA 1988 and 1990, as well as AIDAB 1991).

Figure 8. shows the trend of average sales price over forty years. Two evident peaks in the last two decades roughly coincide with pricing policy moves which could have been expected to raise the effective price (e.g local purchase option). However they also coincide with general market improvements during the same time periods, and unambiguous causal analysis is difficult.

FIGURE 8.



The scaling and export data on log species also is reported to contain significant weaknesses, which could have serious average log value and revenue implications.

An even more important problem involves the appropriate share of the land/timber owner. No single issue weighs more heavily on the ultimate sustainability of the forest sector as a viable economic presence in PNG. Forests which do not provide economic returns to their owners are unlikely to be sustained, as both land and capital are scarce and will seek returns in other uses.

The issue of sustainability is also governed by the related question of what the owner or his agent(s) do with payments for original forest resources. The owner of capital generated in the forest should at least have the (informed) option of reinvesting in productive forests and related processing industries. This is not the case at present.

The new National Forest Service, the NFCAP-TST advisors with related Transition Management Committee, and the Finance Department have not yet agreed on a single strategy/policy line in this field.

An integrated policy will be critical to achieve increased forest product manufacturing in the sector. Perfect revenue policies should not be the objective. They are near impossible to achieve in any event, and even harder to document. Rather policies should focus on the ultimate objectives of sector development:

- o establishment of efficient industries of appropriate types for PNG conditions over time, able to compete in international markets;
- o effective transfer of necessary technologies and achievement of necessary human resource development, and;
- o development of internal self-sustaining support systems for forests, dependent industries and the derived stream of socio-economic benefits.

It is in this regard that past policies have evidently not been successful. The question of whether this is simply an apt recognition of the economic realities of manufacturing in PNG, or a major forest sector policy failure, needs further attention.

3.1.3 Forest Management for Sustained Production

Tropical forests in PNG have been managed in the main through selection cutting, with the objective of leaving an integral stand after logging, capable of regenerating

itself. The principal system employed has been a polycyclic felling system in which the largest trees of commercial species (above 50 cm. dbh) are felled and removed. The system is meant to result in a series of small scattered gaps in the canopy, with ingrowth of smaller residual trees into the canopy. The stand is expected to return to an economically exploitable state in 40 years.

Other silvic systems have also been tried, across the widely variable regions of PNG. Unicyclic felling systems which create larger openings were tried in more uniform stands on the Gazelle Peninsula in New Britain. Here the expected wait for the gaps to fill with commercial species for the next harvest is longer - about 70 years.

Unfortunately, none of the commercial selection felling areas of PNG has ever been consistently measured/marked before harvest, supervised during harvest, or monitored after harvest. The current state of information on whether the systems are working according to objectives is simply inoperational.

Clear-fellings with planting of commercial species directly following the harvest has also been practiced in PNG - notably with softwoods around Bulolo (Auracaria and Pinus spp.), with short-fibre pulpwood in the Gogol Valley (Eucalyptus and Acacia spp.) and with quality hardwoods in scattered locations - e.g. Brown Valley near Port Moresby; Stettin Bay - N. Coast New Britain; near Rabaul on New Britain (Tectona, Swietenia, Calophyllum, Balsa, other spp.) Many of these plantation trials appear to have been successful in terms of establishment, growth and yield. Growth rates of 10-20 m3 per hectare are achieved with quality sawlogs/veneer logs, and 15-30 m3 per hectare with utility species and pulpwood.

The largest clear-felling trial has been in the Gogol Valley, where relatively small, low value native hardwood stands were clear-felled for the export of pulp chips from 1975 to the present (Jant Project - Honshu paper Co.). Plantation establishment after logging was successful, but slower than planned, due mainly to landowner reluctance to dedicate lands to pulpwood plantations.

This lag in plantations following clear-harvesting has had the unforeseen effect of creating a fairly large scale natural regeneration trial within large openings in a tropical forest. The project has also engendered the best post-harvest appraisal study in recent PNG history (Lamb 1990). In general, native pioneer species occupied the cleared lands (not used for agriculture) and a mixture of other native trees seems to be coming up successfully under the pioneers. No economic or biodiversity appraisal has been attempted.

Thus many silvic systems have already been tried in PNG, with results that appear encouraging, in several areas. However the dearth of operational stand profiles before or after selection harvest, the complete lack of growth and yield data, and most importantly the lack of a basic forest inventory preclude meaningful analysis of sustainability at present. They also limit the ability to select "best" silvic alternatives for the current harvest, while better data can be developed.

When coupled with the problems of timber tenure, this dearth of forest management information severely constrains the ability of the current study to specify sensible, sustainable forest industry investments in detail. However the resource situation, and industry scenarios, can be sketched in strategic terms with existing information.

Probably the most important limitation to sustainable forest management in PNG has been the absence of direct linkages between forest revenues and forest reinvestments. Neither the landowner nor the public agents of forest management have had access to the lion's share of forest-based revenues.

Fortunately improvements are underway in public forest sector institutions at present, and in systems or revenue collection and distribution (see Section 4.).

3.2 The Private Sector

3.2.1 Land and Timber Ownership

PNG Society is a complex evolving organism, emerging from the traditional structures towards more modern provincial/ regional/ national structures. Nowhere is the complexity more apparent than in the fields of land tenure and land usage rights.

The land tenure system has evolved within a complex "customary" system or mosaic of "land titles". The transfer of land between groups through gifts, intertribal/clanal conflicts and a host of other dealings was and is common.

Land is communally owned by lineage groups, called clans. The lineage group is commonly patriarchal, but some areas have matriarchal lineage groups. A very small proportion of Papua New Guinea practices individually, rather than communally, owned land. While the land tenure system may appear confusing to outsiders, it is simple to the participants in that the land owners, excepting boundary disputes, know the extent and location their land owner group holdings.

Nonetheless land tenure and disputes relating to land usage have, through their effects on forest-based industry development, emerged as a major problem facing Papua New Guinea.

In addition to land ownership rights, there is a pattern of usufructuary rights superimposed on this mosaic. This has led to serious problems in creating land agreements for developmental purposes.

The governmental organizations responsible for negotiating the land use agreements have at times confused usufructuary rights with land ownership rights, thereby creating further land disputes. Traditionally, the usufructuary rights, and attendant benefits, are controlled by the land owners. The guiding principle of Papua New Guinea land ownership rights is that the timber rights are attached to the land ownership rights.

Other complicating factors have included:

- the society is rapidly evolving from traditional values in the face of western values and materialism;

- while land ownership/use/deposition decisions made by consensus of the majority of a land ownership group that actually is occupying the site traditionally have been binding on subsequent generations, there is arising a new generation of Papua New Guineans who see past land use decisions as being either inequitable or non-beneficial to the interests of the present generation, and are not abiding by the past decisions;

- the Government, since independence, has pursued a policy of righting any grievances with pre-independence land ownership/use/deposition agreements through a land court system;

- the Government also has the policy that any such agreements made since independence, under the laws in force at the time, are legal and binding, but has found itself powerless to enforce these recent, but disputed, agreements, and;

- the land itself cannot be sold or alienated without the full consent of the affected members of the land owning group.

Legislation is in place that attempts to resolve some of the above problems. Land owners now can be incorporated into legal status Land Groups. The incorporated Land Group becomes the legal entity for the distribution of benefits

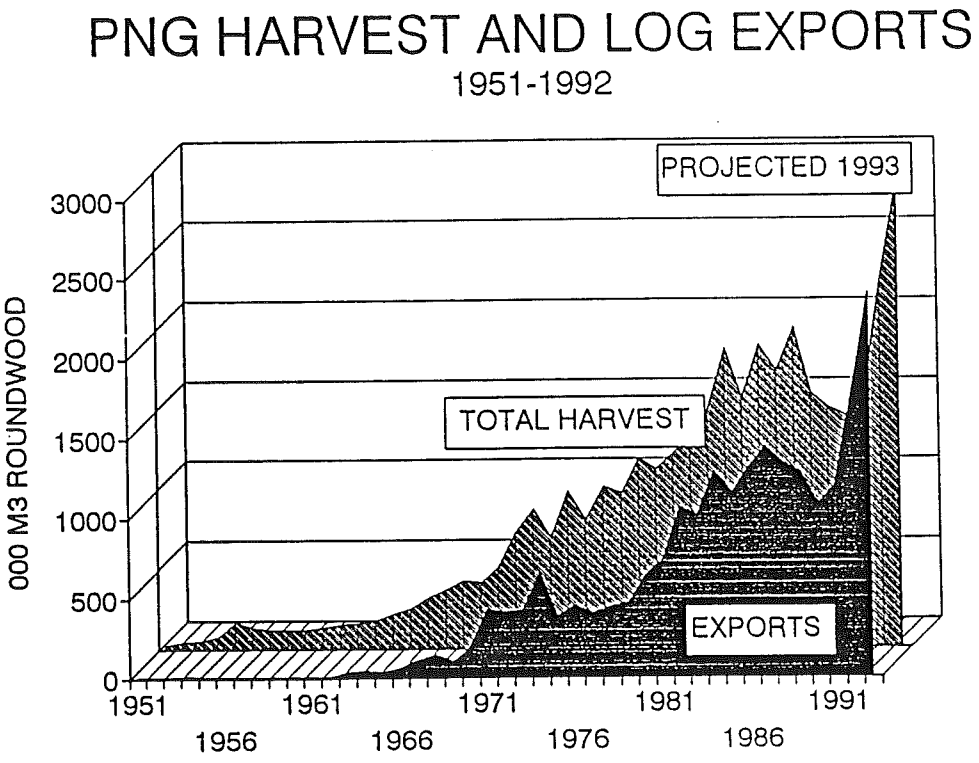
such as stumpage etc. The Land Group is also the unit building block upon which the still evolving Forest Management Agreement and any joint venture corporate structure can be based.

3.2.2 The Forest Industries - General

PNG forest diversity has been a strong conservative factor during the past century. World forest product markets and industries were simply not able to make major economic use of the PNG mix of species, under local development conditions.

However during the 1980's total harvest and exports have been increasing in the sector, principally through the export of roundwood (see Figure 9).

FIGURE 9.



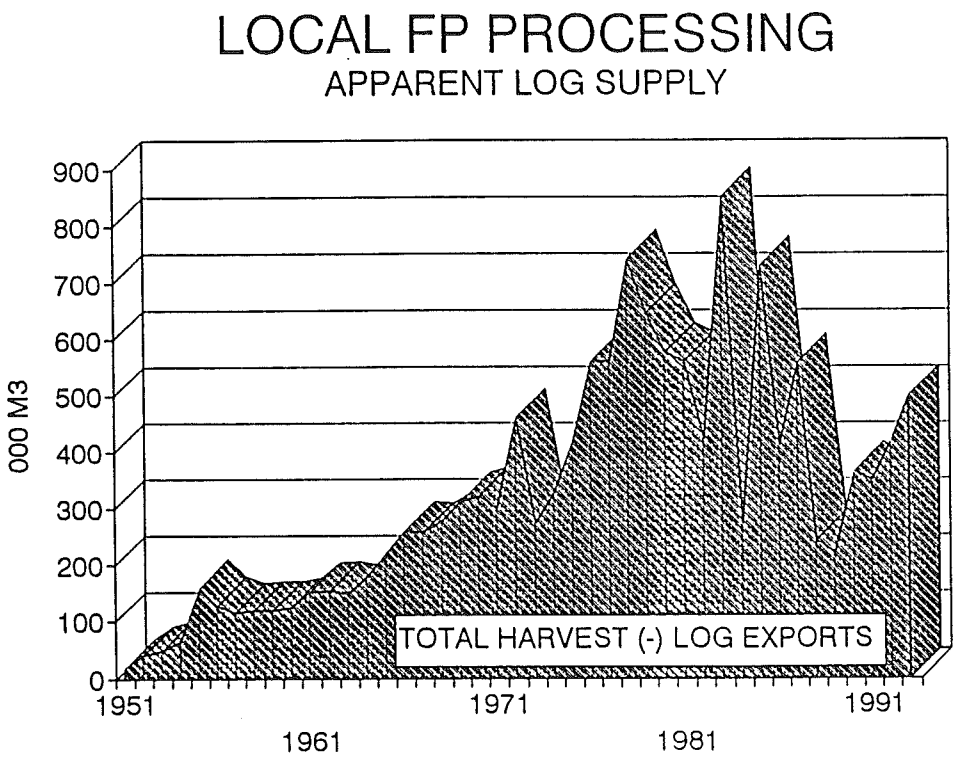
Some PNG species - in various mixtures - have found market niches elsewhere in Asia. This fact alone points to the need for a fresh appraisal of forest industry development in PNG in the 1990's.

Since the liberalization of log export authorities in 1979, most active TRP's have been involved in shipments of logs overseas. Some are still providing logs for domestic processing, some are not.

In early 1992, sixty five registered forest products operators were reported active in PNG. Thirty eight companies were engaged in log export operations, and sixteen of these also operated sawmills. Twenty seven companies were engaged solely in sawmilling, bringing the total registered sawmill operations to forty three. There are reportedly a larger number of small "walkabout" or mobile sawmills cutting timber for local use in various parts of the country (as many as 400?).

These mills in total have been supplying the domestic market with approximately 120,000 m3 of sawnwood in recent years, in the rapidly growing domestic economy (see Figure 10). shows an estimate of the domestic log supply (total log harvests less log exports). However, this estimate needs adjustment for chip export.

FIGURE 10.



An ad valorem import tax/tariff of 50% is applied to lumber imports, and to wood-based manufactures (furniture, house components etc.).

Only six domestic sawmills have log input capacity exceeding 20,000 m3 per annum (one expression of minimum economic size), and only about 3000 m3 of sawnwood was exported in 1991..

There is virtually no utilization of sawmill residues in PNG (likely current volume of 150,000 m3 is mixed in

species, scattered, and produced intermittently). Two major pulpwood chip operations have been established in PNG. Only one has operated commercially (near Madang), and the other has been moth-balled since its construction (East New Britain). Both operations have exported logs.

One fairly old plywood mill exists at Bulolo, operating at minimum level.

3.2.3 Forest Industries - Harvesting and Log Transport

Harvesting and transport of logs by the private sector is accomplished by conventional logging means utilizing the following general equipment configuration:

- o felling by chain saw;
- o skidding by track or rubber tired skidders to landings;
- o bucking to length and defect removal by chain saw;
- o scaling with scale tags applied at landing;
- o loading to trucks with front end loaders, cranes with grapples or hydraulic knuckle booms;
- o road transport to mill site or central log yards by six-wheel drive logging trucks c/w trailers;
- o unloading, sorting and stacking with front-end loaders;
- o export log loading to barges with tracked cranes c/w long booms and grapple. Alternatively, some load to scows with front-end loaders, and;
- o ship loading is accomplished with ship's rigging.

While the foregoing is accomplished with industry standard configuration, the reported productivity is substantially below competitive industry standards. For example, skidding is uniformly reported at 30 cubic meters per day per skidder while competitive topical hardwood operations indicate a minimum of 50 cubic meters per day per skidder. An important factor may be lower commercial volume per hectare in PNG, but the productivity still seems low, for a well organized operation.

Truck loading and hauling appear to approach tropical norms. road-side landings are often excessive in size, and road standards are highly variable from operation to

operation. Environmental impacts are generally maximum along roads (erosion, slips, stream risks).

Log Yards and Sorting

Logs are off-loaded from trucks to skids, where they are spread for grading and species identification. Export grade logs are sorted by species, size and grade ("High Grade" and "Standard Grade"), while export culls and non-exportable species are separated for domestic use.

Yards and equipment are generally to good weather standard, with difficulties likely in wet weather.

Marine Transport of Logs

Barge and ship loading approximates competitive operational areas, but payloads are considerably below international norms.

1) Export

Export logs are shipped by buyer specified log ship (complete with own log-loading rigging) in loads of up to 6,000 cubic meters. This shipment volume is substantially below that of many other global areas in which loads of up to 25,000 cubic meters are common. Ocean freight costs are usually negotiated by the log purchaser, and freight costs are to the buyer's account.

2) Domestic

Logs are shipped to domestic markets or to export ships markets by means of barges employed on navigable waterways. These barges will carry up to 2,000 cubic meters and are all propelled by tugs. There are constraints on the size of these barges, depending on the depth of inland waterways and tidal conditions. Since utilization of these barges for domestic use is at only 35%, the cost of barging appears to be excessive by world standards.

International Marketing of Logs

While some 85% of the volume of all logs produced in PNG are export marketed, little accurate control is currently exercised over grade confirmation, volume control and species identification.

An export marketing survey is currently underway to track and quantify export log export demand as well as final product markets.

Domestic Marketing of Logs

Domestic marketing of logs accounts for a very small fraction of the total volume harvested. In general it is limited to the sale of exotics such as Rosewood and Ebony to specialized domestic manufacturers, sales of "cull" logs to local sawmillers and the sales of logs in very limited volumes by private landowners to local mills.

3.2.4 Forest Industries - Manufacturing

Detailed and reliable information on the precise size, capacity, actual output and actual end markets for the manufacturing subsector is not currently available. Table 1. contains a listing of current major processing locations by province, company, location type and capacity (where known).

In addition to the 28 plants as listed in Table 1. there is an unknown number of smaller portable type mills and domestic furniture factories scattered at various locations about the country. However the total output of these lesser mills is believed to be insignificant.

Annex No. 1 contains a summary of log production (as recorded by the Department of Forests scale), exports (as recorded by the Department of Forests log export report) and the apparent domestic consumption of roundwood logs for local manufacture.

In fact, the apparent domestic consumption calculation of roundwood may be in error due to the fact that no stock or inventory figures are available to resolve short term (year end) aberrations between production and shipping of export logs. However, in the long term these inconsistencies may be ignored as eventually all logs produced are either exported or used for domestic conversion.

It is noteworthy that in 1977 some 63% of logs produced were converted to product within the country, while by 1991 (the last year for which statistics are available), this figure had fallen to less than 15% - and that 15% includes the 180,000 cubic meters of logs harvested by Jant P/L for production of wood chips only.

It is further apparent that in 1977 some 830,000 cubic meters were processed domestically while by 1991 this volume had fallen to only 237,000 cubic meters - including the volume processed by Jant for production of exportable wood chips.

TABLE 1. **DRAFT**

Partial Listing of PNG Wood Processors, 1992

PROVINCE/COMPANY	MILL TYPE	OUTPUT (M3/Ann.)
WESTERN PROVINCE		
Wawoi Guavi Timber Co.	Sawmill	11500
GULF PROVINCE		
Turama Forest Industries	Sawmill	4200
Baimuru Sawmilling Co.	Sawmill	Unknown
CENTRAL PROVINCE		
Sabusa Sawmills	Sawmill	5000
Hugo Sawmilling	Sawmill	12500
Landwell Resources P/L	Sawmill	8750
Santa (PNG) P/L	Sawmill	Unknown
Margarida Timbers P/L	Sawmill	Unknown
Golden Square	Sm/Ven/Furn.	3750
MILNE BAY PROVINCE		
Woodlark Island Dev. Corp.	Sawmill	Unknown
Ambogo Sawmill P/L	Sawmill	Unknown
WEST SEPIK PROVINCE		
Vanimo Forest Products	Sawmill	4200
MADANG PROVINCE		
Jant P/L	Wood Chips	180000
Madang Timbers P/L	Sawmill	Unknown
Taway Timbers	Sawmill	5000
MOROBE PROVINCE		
Lae Builders P/L	Sm/Furn.	7500
PNG Forest Products P/L	Sawmill	8750
	Plywood	12000
Timber Producers P/L	Sawmill	Unknown
P.I. Logging P/L	Sawmill	Unknown
Boinamo Enterprises	Sawmill	Unknown
WEST NEW BRITAIN PROVINCE		
Stettin Bay Lumber Company	Sawmill	7500
Catholic Mission Ulamona	Sawmill	7600
Nam Yang Timber Company	Sawmill	2500
	Wood Chips	(inoperative)
EAST NEW BRITAIN PROVINCE		
Teperoi Timbers P/L	Sawmill (balsa)	4500
Balsacraft P/L	Sawmill (balsa)	6000
G.S. Models P/L	Resaw (balsa)	300

3.2.3 Forest Industry Performance

Sawnwood

With very few exceptions, the sawmill sector may be characterized as obsolescent and poorly maintained in relation to other tropical hardwood timber processing areas. The exceptions are the more modern mills at Stettin Bay, Wawoi Guavi and Lae Builders.

All milling operations - including the more modern bandmilling plants - are operating at substantially below any real capacity. An approximation of utilized capacity for the entire industry would be between 20 and 30 percent.

It is further apparent that in addition to low production rates, the industry is characterized by extremely low recovery ratios, with published and verbal reports ranging from 20% to 45% of log input being recovered as sawnwood. This is in part due to the equipment configuration and mechanical condition (most mills are sawing with 7/16 inch kerfs and lack both positive positioning and positional stability in sawing), and partly due to poor operator training.

Some of the inefficiency of the domestic processing sector is likely attributable to the tariff protection from imports. However another major factor is the general uncertainty and constraints imposed on investment by the tenure/contract/ licensing systems over time. Investments in processing are hard to justify without a stable timber supply.

The background and causal agents of the current situation in manufacturing has been widely debated in PNG (see for eg INA 1990). However meaningful information on real cases seems to be scarce. It is premature to draw firm conclusions on immediate steps to achieve sustainable long run improvements.

Human Resources

Production plant labor has been observed to be relatively effective in performance of defined job activities and responsibilities. Further the availability of critical skills such as "saw doctors", mechanics and electricians does not appear to be a major constraint to operations. Many of the larger plants have developed their own apprenticeship/training programs.

Markets

The industry is presently sawing primarily for the domestic market. Although some minor quantities of exceptionally high valued species (e.g. Rosewood) are being exported on a sporadic basis, volumes are small. For

domestic sawnwood products non-exportable logs (including cull grades of prime species - e.g Kwilla) and non-exportable species from the 50 cm+ log harvest are used.

The problems of insectival attack on many of the species sawn for domestic structural applications have been overcome by use of both pressure treatment with Chromated Cuprous Arsenate (CCA) and diffusion treatment with other patented Boro-arsenate salts ("Koppers #7").

In addition to preservative treatments, a large portion of sawnwood for the domestic market is planed and/or profiled for use as dimensioned stock or as flooring/sidings. A major problem in these processes is the lack of dimensional control (most mills are rough over-sawing by up to 1.5 cm in order to prevent under-sized lumber production out of planers/shapers).

A further problem is lumber warpage due to "timber bind". Both of these problems greatly reduce both productivity and recovery, yet are readily preventable by use of reasonable equipment and sawing practices.

Wood Based Panels

At present there is only one wood-based panels plant in the country, namely, PNG Forest Products in Boroko. This plant is producing plywood - primarily cross grained pine - for the domestic market. The mill also produces some exotic faced (long grain) panels for the domestic and, in the past, export markets.

Lack of access to a reliable source of peelable hardwood logs has limited its ability to continue in the export market, and at present its sales activities are constrained to filling the bulk of the countries internal requirement for plywood. The company is currently installing a slicer for the production of high quality exportable plywood grades.

Some further volumes of specialty grades of plywood are still imported to the country.

Furniture and Other Wood Manufacture

At least two first quality furniture manufacturers - Golden Square and Lae Builders - are in operation, producing high quality designer furniture for both domestic and export markets utilizing a variety of exotic species including Rosewood, Teak and Ebony. In addition to these producers, there is undoubtably a number of lower quality producers meeting a portion of the local requirement for conventional grades of furniture and case goods products.

Pulp and Paper

Of the two pulp chip mills in PNG, only Jant is presently producing. Jant - part of the Honshu Paper Group - is still producing a mixture of eucalypt and native hardwood chips, from within the Gogol River drainage near Madang. At present they are selling a large potion of their production to the MDF industry in Japan rather than to the pulp industry.

Nam Yang (N. Coast New Britain) has never produced chips and their plant is non-operable in its present condition due to deterioration, fire and vandalism. At least $US 1.5 million would be required to activate it.

Short fibre pulp and chips are currently in over-supply globally for a variety of reasons, including:

- o installation of excess pulp and paper capacity in several developing regions;
- o increased re-cycling of paper products in developed regions, and;
- o reduction in use of linerboard/paper products in packaging.

4.0 ECONOMIC OPPORTUNITIES IN THE FOREST SECTOR OF PNG

4.1 Institutional Reform

By the late 1980's it was evident that the public forest trust to conserve PNG forest resources, and develop an economic forest sector, was not being fulfilled. The Barnett Commission of Enquiry (1987-90) and the World Bank-led sector review under TFAP both concluded that major structural, institutional, and policy reforms were essential. Forest "development" projects had mushroomed without development of an operational capability to control them.

A new National Forestry and Conservation Action Plan (NFCAP) was developed by the government, in cooperation with the World Bank, Asian Development Bank, international agencies (FAO; UNDP; ITTO) international NGO's (IIED; IUCN) and bilateral aid agencies (AIDAB; NZ; GTZ). In addition to the Department of Forests, the Department of Environment and Conservation (DEC) and Department of Finance were closely involved. A Forestry Transition Committee was formed to manage a Medium Term Development Strategy defined within the NFCAP.

As outlined in the Background section, a new and revised Forest Act has recently defined a new National Forest Agency with executive Forest Board to manage a new

independent agency - the National Forest Service (NFS) to manage the public forest trust in future.

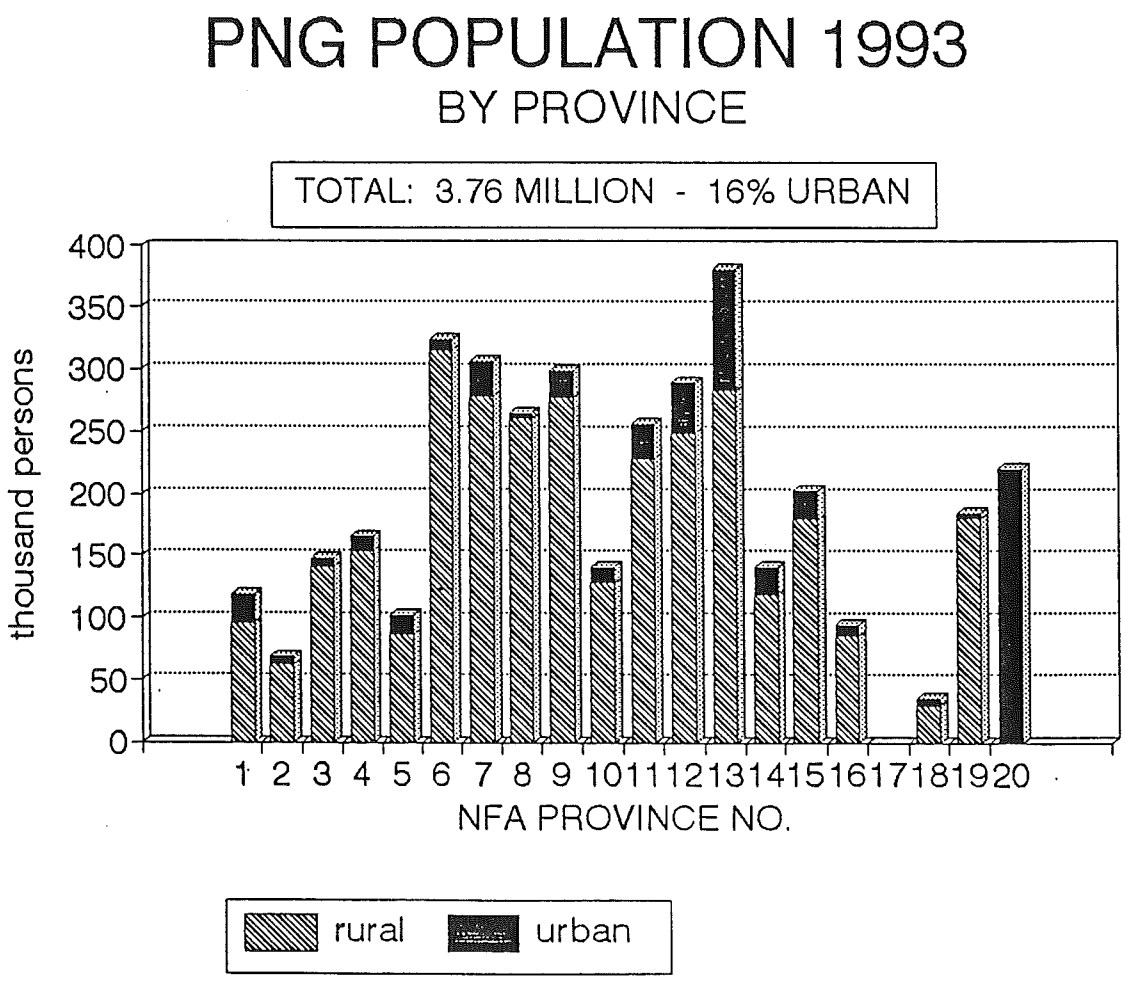
This is to be mainly accomplished through the definition of Forest Management Agreements (FMA) which will gradually replace all existing TRP's (after detailed review of the performance of each). The DEC will play an environmental monitoring role.

This sea-change in the public institutions of forest trust in PNG is just underway in April 1993. While still in formative stages, it must provide guidelines and principles for a new era in forest sector development in PNG.

4.2 Domestic Market Opportunities

The domestic market for forest products provides one of the cornerstones of sector development. Before examining specific products in more detail, a brief review of current economic prospects in general will be useful.

FIGURE 11.



4.2.1 The PNG Economy

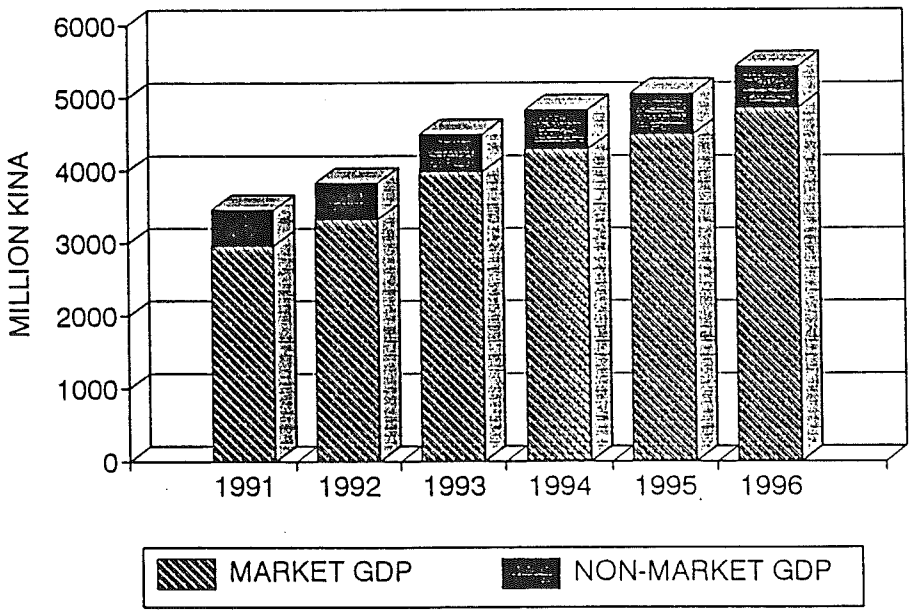
Papua New Guinea's population is approaching 4 million in 1993. Towns and cities are growing more rapidly than the population as a whole, as in-migration from rural areas continues. Figure 11. shows the population of PNG by Province in 1993.

Real GDP is rising rapidly, fuelled by resource developments, principally in the minerals and petroleum sector. Mining production, construction of major petroleum and gas projects and exploration activities are all accelerating; real growth in this sector was estimated at 46% for 1991, with real investment rising by 60%. Real growth in GDP was estimated at 9.3% for the same year (PNG National Statistics Office 1992).

Figure 12. illustrates the NSO projections of GDP for 1992-96, representing an average real growth rate of 4.9% over the period, with more rapid growth of 6-10% through 1993.

FIGURE 12.

GDP PROJECTION - PNG
1991-96 CURRENT PRICES



Developments by the private sector are expected to spur the economy, with Government performing regulatory and social services roles.

Annual Gross Investment averaged 683 million K during 1986-90, with net investment of 410 million K/annum. Net

borrowing from abroad to finance this investment averaged 240 million k/annum during the same period. Increases in net domestic savings will be needed in future to finance self-sufficient economic growth.

Mining and quarrying accounted for roughly 50% of all private capital expenditure from 1986-1990. In general, mining investments are heavily in imported capital goods, and forward production linkages to the rest of the economy are relatively weak. Revenue flows from these non-renewable resources are known to have a fixed life - the success of their re-investment holds the key to the economic future of PNG.

Plans are currently being drawn to reduce PNG dependence on foreign budget support, notably from Australia. However effective private industries are needed to generate economic jobs and income.

PNG is heavily dependent on imports, of both food and manufactured goods. Australia has been the traditional dominant supplier, but links are growing to Japan, the ASEAN Region, and New Zealand.

Total export revenue rose by about K 351 million in 1991 (32%) in spite of declining real prices and production for coffee, copra and palm oil. Supply problems in some parts of the Region (eg Philippines) may have improved the price performance for these commodities in 1992. New petroleum export revenues are forecast to earn a further k 500-600 million by 1993.

A key concern of the government is in employment, and development of linkages to domestic industries to efficiently support the expanding resource developments, replace imports, and eventually develop export markets for selected PNG manufactured products.

Employment in the private sector grew by 4 to 5% in 1991, or about 8,000 new jobs. Prices of some goods heated up in 1991, but overall inflation stabilized at about 6.5% in 1991 and is forecast to fall about a point in 1992. Non-mining GDP and non-mining private sector credit are each expected to grow by 9-10% in 1992-93.

Further strong growth is anticipated in the construction, transport and manufacturing sectors in support of the mining-petroleum boom. The economic prospects of the forest sector in the domestic market are therefore excellent, in general terms.

In view of extensive forest resources, and growing world market interest in PNG timbers (see below), the Government has strong hopes and ambitions for the forest sector to play a lead role in economic development, through rural development and industrialization.

5.0 CONSTRAINTS TO FOREST SECTOR DEVELOPMENT

Some general constraints to industrial development have been in effect since independence, indeed since colonial times:

- o widely distributed, diverse population with a few market centres;
- o rugged terrain, dense forest, long coastlines, transport problems;
- o cultural diversity (700 languages) and strong local loyalties;
- o scarcity of technical-industrial skills in workforce, and;
- o infrastructure still under development.

In addition, several constraints have more direct application within and upon the forestry sector, and forest industry manufacturing in particular.

5.1 Forestry Institutions

A recent major review of the PNG forestry sector was conducted under the auspices of the Tropical Forestry Action Plan (World Bank/ 1990). It concluded that "a completely new approach to forest administration in PNG" was necessary to limit environmental damage through logging, and to guide sector development into further manufacturing activities.

Critical sector issues/problems were identified:

- o forest environment problems due to present logging methods and patterns;
- o inadequate institutions and legislation to manage PNG forests on a sustainable basis;
- o insufficient involvement of local landowners or local governments in forest use decisions and management;
- o inefficiencies in domestic and export market processes;
- o inadequate consideration of forest sector development policy options;
- o insufficient forest resource data to support effective planning or management at local or national level, and;

- lack of coherent resource conservation policy.

5.2 Resource Information and Management Models

Within the institutional weakness which has characterized the PNG forest sector, one has particular implications for resource sustenance: resource information and forest management models.

One of the most serious constraints facing industry planners in PNG is the lack of forest inventory data, growth and yield data on natural forests, and management models for each significant production forest area.

This study must make it clear: talk of forest sustenance in the absence of these critical information systems is just that - talk. There is no way to sustain a forest industry without commercial forest available on harvestable ground. Nor can biodiversity be meaningfully protected in PNG in the absence of a national forest inventory.

There is also a techno-economic dimension to "commercial forest" and to "harvestable ground" which needs to be monitored over time. At current log export prices, there is practically no inaccessible forest land in PNG (for valuable species) with present technologies; new harvest technologies emerge each year.

New manufacturing and marketing technologies expand the range of species which can be used in each period.

In fact there is a tendency to "leave it to technology" rather than to explicitly manage for or reinvest in quality wood resources. This is a hazardous strategy for any significant wood industry - rather like wandering along a cliff edge in the dark.

The complexity and difficulty of the problem in tropical forests is no excuse - necessary monitoring and information systems must be developed.

5.3 Forest Tenure and Landowner Organization

One of the most important constraints to forest sector development in PNG has been the forest tenure or contract system - the means by which lands and forests are sold, leased, licensed etc. to the forest industry for economic use. Regardless of forest ownership, the conditions of these tenures/contracts (and their enforcement) provide the major impetus to forest revenues, sector development, and forest sustenance.

To abbreviate a long and complex history, two basic arrangements have dominated, in the transfer of harvest rights from local landowners to industrial users:

- o national timber rights purchase (TRP), and;
- o local forest authority (LFA).

Both have involved the use of an intermediary agent, representative or government between the landowner and the purchaser. One of the essential questions for forest industry investors has been that of which level of government acts as this intermediary. Many technical differences have been cited and some exist, but the essential question has remained - who is authorized to act for the local landowners. This question, and local issues related to it have played a critical and largely negative role in past sector developments.

In general, institutional and tenurial uncertainty or malfunction favors the minimum investment, high return operator. In the forest sector, this generally means the logger - his equipment can be loaded on a barge in hours and he is gone. Sunk costs in a mill cannot be so readily moved, and are generally larger. Unacceptable risk leads to no investment.

This issue will have to form a major element of forest sector development strategy in future.

5.4 The Commercial Climate of PNG

The commercial climate of PNG is outlined in Annex No 2. There are a number of constraints imposed on the development of the PNG forest sector, which include:

- o the literacy rate is about 40%, with few graduates from the Grade 12 school level;
- o wages and salaries are generally higher than in competitor countries;
- o skilled tradesmen are in short supply, though they are trainable;
- o The "Pioneer" industry corporate tax exemption is only for a "first-of-a-kind" development, and does not recognise the complexities of forest industrial manufacture, nor the difficulties of starting such enterprises in areas close to log supply;
- o there is a general shortage of loan capital within PNG;

- coastal shipping costs are well above world norms, inspite of the coastal vessel utilization rate being about 35%;
- road infrastructure is not well developed;
- imported production machinery is dutiable at 10%;
- there is no electric grid system for PNG thereby limiting industrial level power supplies to only two centers;
- the forest tenure system has not provided the stability of timber supply needed for a major forest industrial development, and;
- there is no reliable inventory of a forest asset, which may have a gross value of about K 25 billion, upon which to plan forest industrial development.

6.0 A FOREST SECTOR DEVELOPMENT STRATEGY FOR PNG

The detailed sector strategy which will be the final product of this study will be heavily dependent upon assessments of the domestic and export markets for forest products.

These assessments are just beginning in April 1993. At this stage a few opportunities have been tentatively identified, which it appears that PNG producers and landowners could economically supply.

6.1 Opportunities in Forest Management

It is expected that selection harvest of natural species will provide the principal commercial volumes used in PNG forest industries indefinitely. New information systems - forest inventory, growth studies, silvic models are needed. However operational information systems regarding natural forest volumes, areas and silviculture can only be developed over time.

In the meantime, a prudent economic plan for the sector would gradually build an efficient backup system for at least part of this volume of quality hardwoods.

PNG does have significant experience in plantation establishment and management. A number of species trials have been conducted over the years and some species have been found to be suitable for establishment under site specific conditions. For example, the pines (*Pinus spp.*) generally are suitable for establishment in the highlands, though some out-perform the others.

Species that are considered to be suitable for plantation establishment, in that the basic silvics have been determined, is given in Table No. 2, with the MAI that is considered achievable.

The silvicultural success of the existing plantation programme in PNG can be regarded as positive in that some sawlog plantations that mature in about 30 or 40 years, and another group of plantations that mature in about 10 years, have been harvested and re-established.

With a planting cost of approximately K1,000 per hectare, high and rising real prices for quality hardwoods, and harvest costs of about K20 per cubic metre, these plantations will be economic.

Table No. 2 Plantation Species in PNG

Name		Expected m.a.i. m^3/ha/yr
Common	Latin	
Brown Terminalia	*Terminalia brassii*	20
Eucalyptus	*Eucalyptus deglupta*	20
Acacia	*Acacia mangium*	20
Mahogany	*Sweetenia macrophylla*	15
Walnut	*Dracontomelon spp.*	15
Calophyllum	*Calophyllum spp.*	15
Black Bean	*Castanospermum australe*	12
Klinki Pine	*Araucaria hunsteinii*	12
Hoop Pine	*Araucaria cunninghamii*	12
Pine	*Pinus patula*	10
Teak	*Tectona grandis*	10

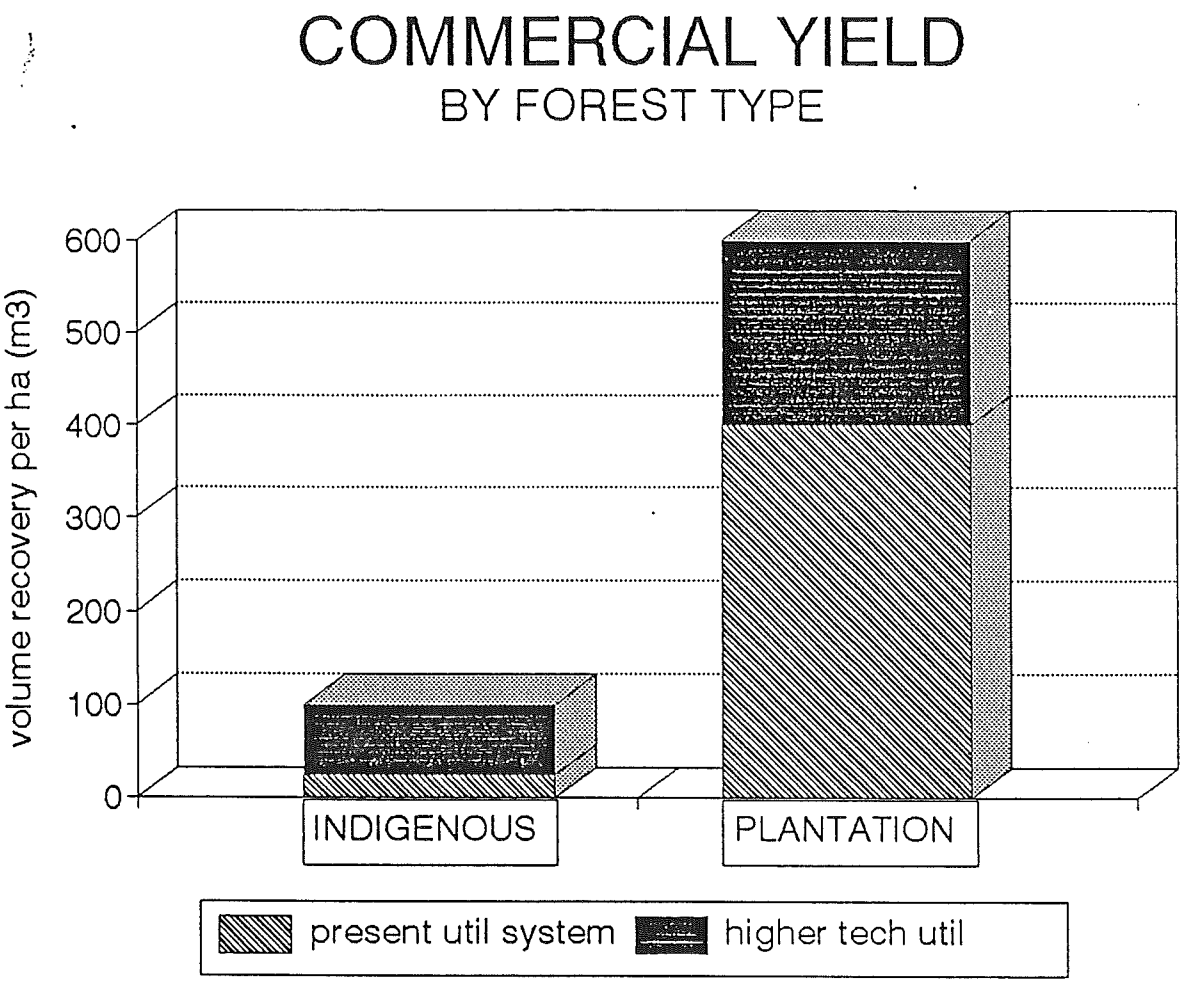
The question of scale, and of all-or-nothing plantation vs. natural forest has been widely debated in PNG (see for e.g. INA 1988). However a smaller scale, mixed strategy offers important advantages:

- relatively certain provision for high quality wood at the end of the current cutting cycle;
- protection of natural forest advantages/uses in each area;
- good average operation costs over more than one cutting cycle, and;
- sustainability of commercial harvest achieved with less total production forest area in the long run.

Figures 13., 14. and 15. provide a sketch of the impacts of such a strategy, under an annual harvest of

about 4 million m3, with annual plantation establishment of about 7500 ha.

FIGURE 13.



Size of each local plantation development will depend on both the local and overall industrial development strategies. Policy decisions become important regarding the formation of an open domestic log market *vs.* local feed to local production facilities only. A domestic log market with effective marine transport will provide a much wider spectrum of opportunities to each landowner group.

The minimum economic size of plantation development needs careful analysis in each case. Assumptions have often been too facile with regard to the need for massive plantations in one location.

The species selection, a major policy decision for plantation development should be market driven, by expected costs and returns. "Fast growing" has also been over-rated in plantation economics in many locations.

A significant issue in plantation development is forest land tenure. Indeed, the tacit rationale for the implementation of the selection cut system is not based on silvicultural reasons as much as on land tenure reasons. It clearly is simpler to practice selection cut, and it may be the only system that can be practiced, under the current timber land tenure arrangements with the communal land owners.

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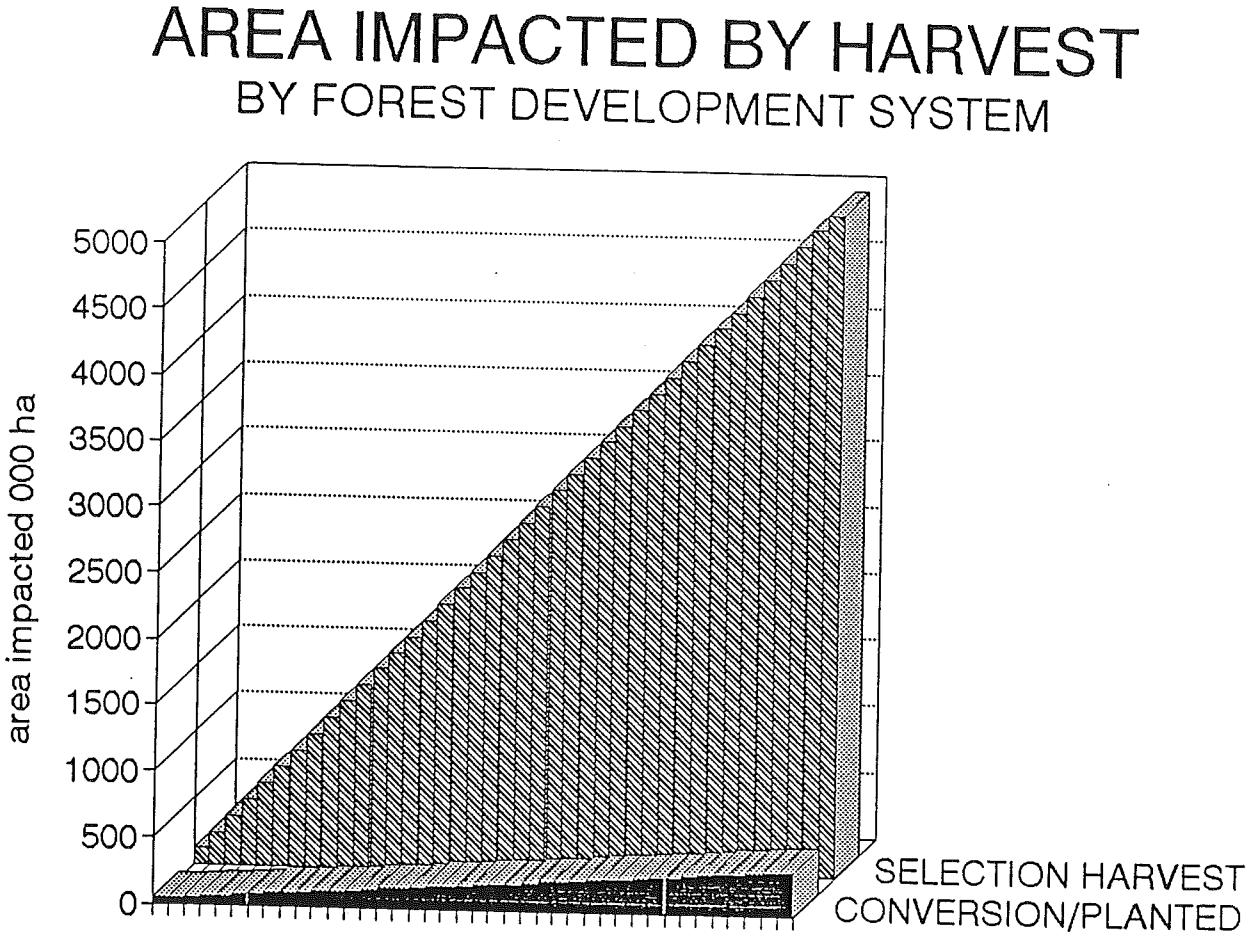
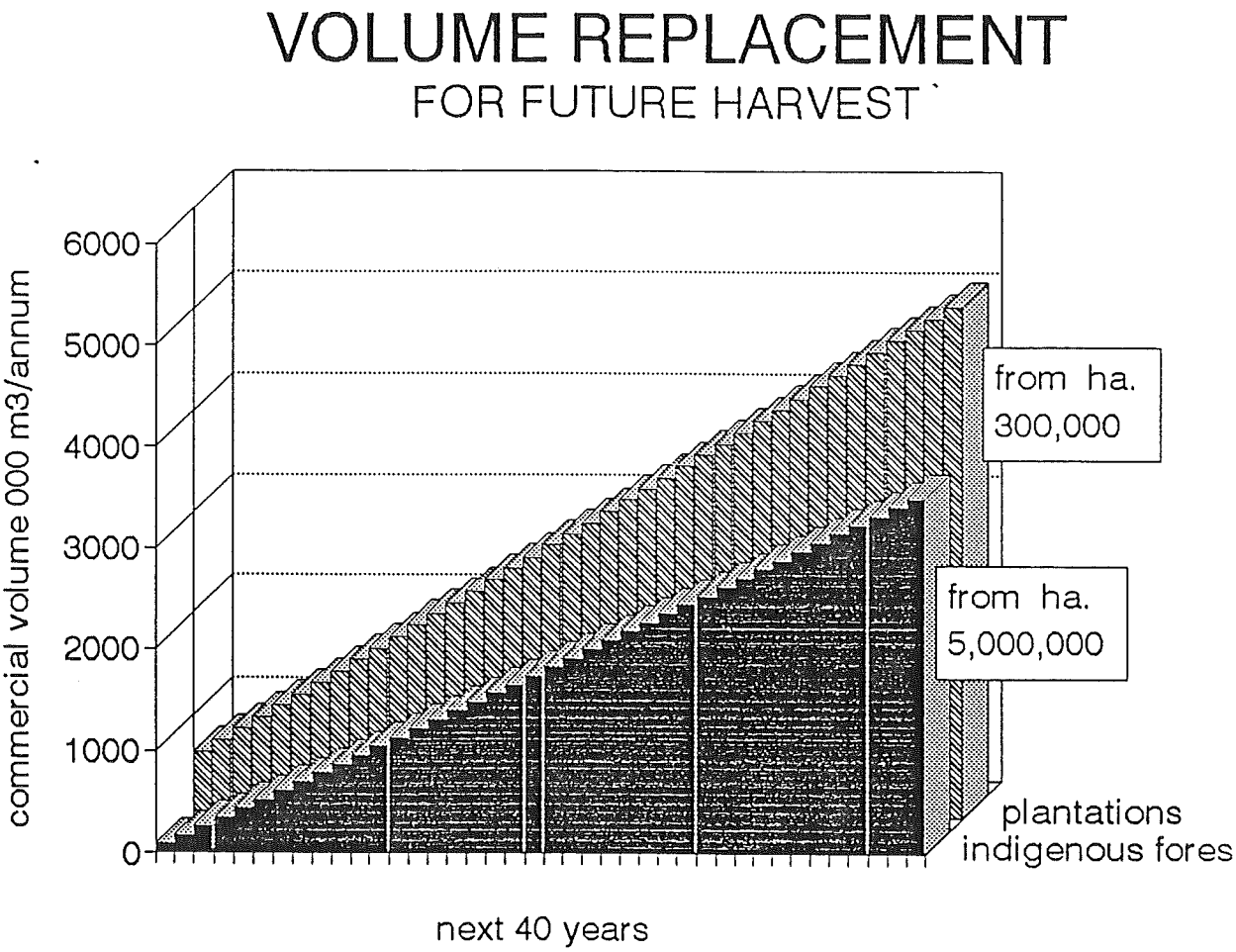
FIGURE 14.



All current plantation development schemes are based on "State Land" or 99-year lease (sometimes called "State Land") land. The new Forest Management Agreements must address this issue directly, in a binding way, and solve the underlying problems of revenue sharing among, and land dedication to forestry development for and by the communal land owners. Simple investment in and ownership of the plantations by the landowners seems the most likely option.

FIGURE 15.



6.2 Forest Based Revenues and Reinvestment

Existing PNG systems to assess, collect and distribute revenues from sales of raw timber are complex, inefficient, and inequitably distributed. They are therefore not conducive to economic or environmental sustenance of the forest sector, from which they are derived.

A new system of charges, and of revenue distribution is proposed which attempts to redress important limitations of the current system, particularly in terms of enhancing the climate for local, sustainable development of the socio-economic potential of the forest sector, as set out in the following objectives.

A new forest revenue system is needed which can:

- provide reasonable incentives and profits to genuine, efficient forest industry participants,

and increase domestic processing of wood products;

- o return resource rents primarily to the resource owner - generally, rent is the difference between selling prices and production costs (including fair profit);
- o be simple, easy to implement and monitor;
- o be stable in that the ground rules for change are clear and understood by all parties;
- o fund the Forest Authority to the extent that it provides cost effective services to the forest sector;
- o ensure sustained forest management, and;
- o ensure that resource rents returned to landowners is invested to effect a sustainable local economy with community-wide participation.

Such systems are currently under development within new national forest sector guidelines. The scale of the opportunity is very large, at current and forecast log prices. Table 3. provides an outline of this scale, and of a more equitable distribution of revenues. Figures 16. and 17. depict the typical distribution of revenue envisaged.

FIGURE 16.

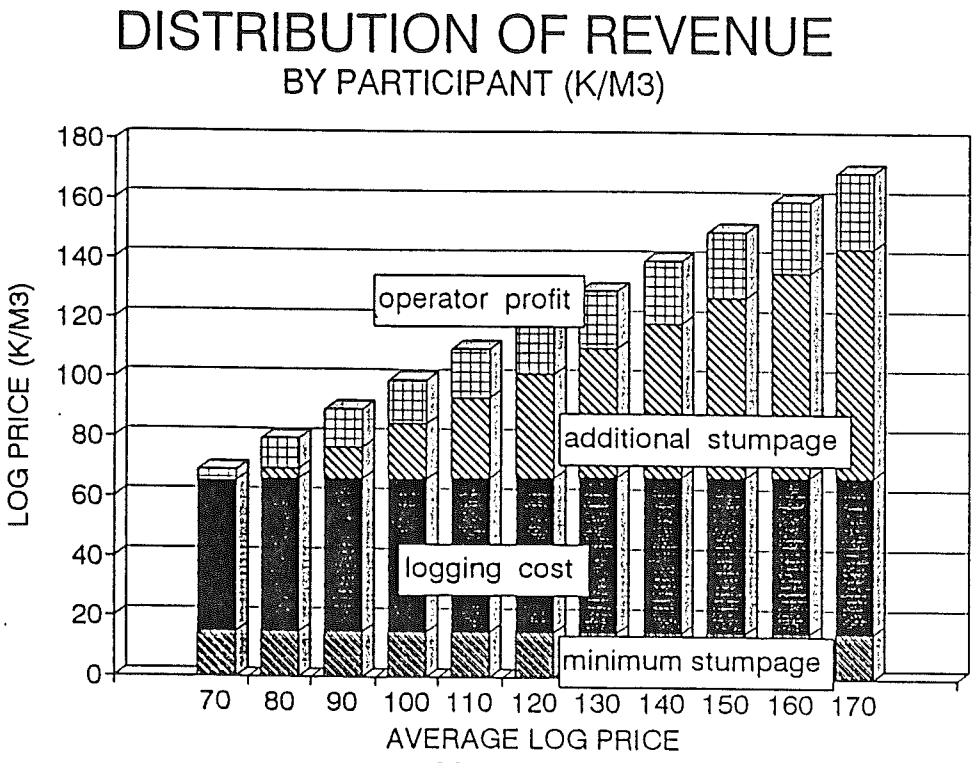


TABLE 3.

SAMPLE SCHEDULE FOR DIVISION OF SURPLUS
XX PROPORTION TO ADDITIONAL STUMPAGE CHARGE (ASC)

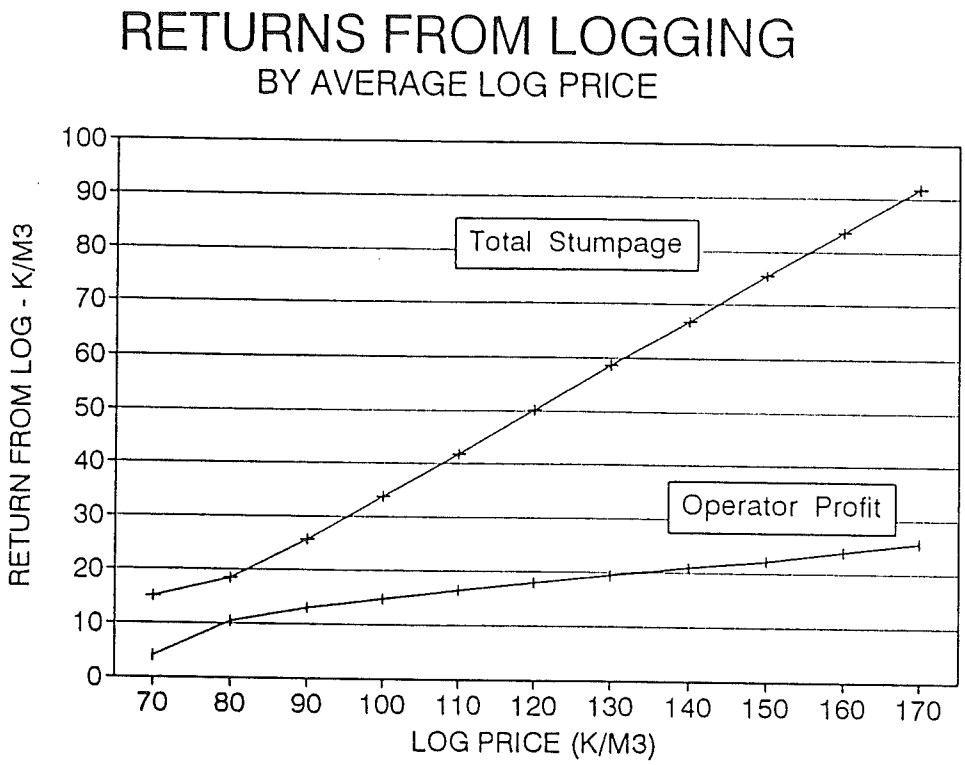
LOG PRICE	MIN STPGE (K/M3)	LOG COST*	SURPLUS	XX TO ASC % OF SURPLUS	OPERATOR PROFIT K/M3	OPERATOR PROFIT % COSTS
		50.00				
70	15.00	51.05	4	0.0%	3.95	7.7%
80	15.00	51.20	14	25.0%	10.35	20.2%
90	15.00	51.35	24	45.0%	13.01	25.3%
100	15.00	51.50	34	56.0%	14.74	28.6%
110	15.00	51.65	43	62.0%	16.47	31.9%
120	15.00	51.80	53	66.0%	18.09	34.9%
130	15.00	51.95	63	69.0%	19.55	37.6%
140	15.00	52.10	73	71.0%	21.14	40.6%
150	15.00	52.25	83	73.0%	22.34	42.8%
160	15.00	52.40	93	74.0%	24.08	45.9%
170	15.00	52.55	102	75.0%	25.61	48.7%

* includes prov grant export tax

RETURNS WHEN HARVEST VOLUME = 2400 (000M3)

LOG P	LOGS GROSS VAL	MIN STPGE	LOG COST	ADDIT STPGE	OPERATOR PROFIT
	MILLION K				
70	168.0	36.0	122.5	0.0	9.5
80	192.0	36.0	122.9	8.3	24.8
90	216.0	36.0	123.2	25.5	31.2
100	240.0	36.0	123.6	45.0	35.4
110	264.0	36.0	124.0	64.5	39.5
120	288.0	36.0	124.3	84.3	43.4
130	312.0	36.0	124.7	104.4	46.9
140	336.0	36.0	125.0	124.2	50.7
150	360.0	36.0	125.4	145.0	53.6
160	384.0	36.0	125.8	164.5	57.8
170	408.0	36.0	126.1	184.4	61.5

FIGURE 17.



Such a system could provide capital for investment in domestic processing at diverse locations, an improved marine transport system, and development of refined, integrated processing centres at central points (see below).

Most importantly, with adequate supervision of investments, it could provide for legitimate landowner participation in a modern forestry sector based in total on individual, regional and national resources - applied through modern market systems.

6.3 Sawnwood Manufacture

There is an apparent need for a re-vitalized sawmill industry, based on sound and proven process technology from other tropical hardwood processing regions to:

- improve sawnwood recovery;
- reduce export of unprocessed resources;
- create employment in the sector, and;
- provide on-grade products to both the domestic and export markets.

6.4 Wood-based Panels

There is an apparent opportunity to divert at least a portion of the peelable species of exported logs to at least one, and possibly two, moderately sized veneer/plywood plants for the production and sale of plywood to export markets, i.e. those markets currently being met through the offshore conversion of PNG produced and exported logs.

There is also an apparent opportunity for the installation of at least one moderately sized Medium Density Fibreboard (MDF) plant for the production of export quality MDF for sales to existing markets in Japan, Korea, Taiwan, Australia and the U.S.A. This process would utilize the currently unused (wasted) slabs, edgings, cores, planer shavings etc. from existing or proposed sawmilling/plywood operations.

6.5 Wood-based Manufactures

Due to the bulk and potential for damage in shipment of finished furniture, there is the opportunity for development of a highly labour-intense industry for production of furniture blank and component parts manufacture for export to industrialized export markets. This industry could process local species to standard component manufacture for final milling, assembly and finishing in end-user countries.

6.6 Pulp and Paper

Short and medium term prospects for further production of wood chips are not attractive, and in fact any further increase in chips production should be considered from mill residues and ear-marked for reconstituted wood panel manufacturing, i.e. MDF.

Pulp production in PNG is not considered to be an attractive option for the foreseeable future for a variety of reasons.

Firstly, there is no paper mill (for production of quality paper products) for utilization of the pulp grades producible with PNG wood species. Pulp would therefore have to be sold on a global market pulp basis and, as noted above, short fibre pulp is in over-supply.

Secondly, a major change in land tenure and/or establishment of a major pulpwood plantation program, would be required to provide reasonable cost roundwood to sustain a world scale economic pulp mill. There are likely higher priority/value uses for lands available for this purpose.

Thirdly, installation of a papermill to convert the pulp production of a world scale pulpmill would result in a capacity far beyond foreseeable domestic requirements, hence product would have to be sold on a global market basis - for which markets are already saturated and depressed.

Lastly, the potential for serious environmental problems (even from the latest technologies and closed-loop processes) may be in excess of the capability of absorption by the local river and marine ecosystems.

6.6 Wood-based Industry Locations

Two basic types of processing facilities are considered:

1) a "satellite" sawnwood plant, self contained with respect to power generation, and;

2) an integrated plant complex on power grid, consisting of sawnwood, kiln drying, full dressing and profiling capability, a plywood plant and a Medium Density Fibreboard (MDF) plant.

The first or "satellite" mill is intended for location fairly close to or contiguous with logging operations, preferably adjacent to a log exporting (coastal) log yard. Each "satellite" would be a self contained facility capable of producing 6,000 cubic meters of sawnwood from a mixture of both low grade (export cull logs and non-exportable species) and higher quality export grade logs for which there is a demonstrable export RST market available. The mill would produce RST for the immediate local market, RST for direct shipment to export markets and RST in both exportable and non-exportable species which it would ship to a centralized milling complex where its out-turn would be further processed to re-sawn, dried and/or planed/profiled product for ultimate sale to both export and domestic markets.

Satellite mills could be located in any number of locations, and it may be appropriate to consider areas on the south coast of New Britain (both East and West), West and East Sepik, Northern Province, Mine Bay Province, Central and Gulf Provinces as well as several potential locations in the inland Western Province, particularly in upper but barge accessible regions of the Fly drainage.

The Integrated mill complexes which would likely require grid electric power availability, and this would restrict their locations to the more heavily populated rural areas. This restriction should enhance to ability to attract a stable, reasonably trained and stable labour force.

Each complex would consist of a sawmill producing 60,000 cubic meters per year of accurately sawn RST which could be sold on export markets, domestic markets or utilized for further value-added processing to re-sawn, planed/profiled dried and/or preservative treated products. The complex would have kiln drying and planing profiling capacity for up to 90,000 cubic meters per annum, hence would be capable of processing to final product RST supplied to it by satellite operations.

Each complex may also contain at least a plywood plant of 30,000 cubic meters output capacity, producing high quality plywood for sale to export markets. One or more of the complexes may also contain an MDF plant, primarily designed to produce 30,000 cubic meters annually (expandable to 100,000 cubic meters per annum).

Log supply to the complex would be by 5,000 cubic meters capacity coastal barge. Logs would be collected from various coastal log supply points. The same barge would collect exportable RST from the satellite mills (for export from major port facilities) and RST destined for further processing at the central complex. Furnish for the MDF plant would be primarily from slabs, edgings, sawdust, planer shavings, waste veneer and cores of the sawmill and plywood plants.

Given the requirement for grid power and tidewater access, potential locations for the complexes are currently restricted to Madang and Lae. Other potential locations may be considered if the complexes are to be equipped with their own electrogeneration systems.

6.7 Processes of Marketing PNG Forest Products

6.7.1 Export Logs

Current export log marketing is being conducted by the present operators within the industry and is monitored by the Department of Forests.

Pending the findings of the current export market study, it is imperative that the monitoring activities of the Forestry Department continue in an aggressive manner in order to ensure the securing of equitable pricing for Papua New Guinea's export logs. This monitoring should include comparison to prices and price trends in other tropical hardwood log exporting areas.

6.7.2 Domestic Logs

In order to ensure log supply to proposed satellite,proposed centralized complexes and to existing independent milling operations, it may become necessary to

foster the establishment of a domestic log market. This may be accomplished through informal industry associations or agreements, or may require the establishment of a log marketing board.

The domestic log market should be so structured as to ensure that fair domestic market prices are established for domestic log consumption and should be on a grade comparable basis, i.e., similar prices should be in place for exportable log grades in order to provide an opportunity for profit from efficient log conversion, and a reasonable level of profit to the log producer.

6.7.3 Sawnwood

Pending the results of the current domestic market survey, no definite statement can be made. It is noteworthy that of the 14 mills visited to date, 12 reported that they could sell up to 50% more production locally - if they were able to produce it. The remaining two mills reported an inability to market their out-turn locally, but that this was more a problem of payment for product than lack of demand.

It is assumed that future increased domestic sales would follow the now established patterns of ex-mill sales, sales to distributors (stocking yards), contractors, light industry and governmental agencies.

Export sawnwood sales may require a more complex and initially more expensive sales effort. Pending the results of the export marketing study, recommendations may be developed for establishment of a co-operative sales agency for penetration of import purchasing systems and/or consolidation of agency representation to the importing companies in Japan, Korea, Taiwan, Singapore, North America, Europe and the Middle East.

7.0 EXPECTED SOCIO-ECONOMIC IMPACTS

7.1 Human Resources

The project will have some direct human resource development effects in the National Forest Service through the proposed workshop/project reviews, and through ongoing discussions throughout the project life.

The more important inputs should be secondary, through action on project recommendations to foster effective worker training, improved communication with labourers, participation in equity ventures by land-owner groups, and many other human resource development impacts of effective economic development of information in the forest sector.

7.2 Community Development

In each community where an effective forest industry is established, the local economy will develop in important ways, including wages, tax potentials, development of local infrastructure, expansion of local support facilities (i.e. mechanical) and a reversal of the migration trend. Each of these inputs will feed into other local sectors such as agriculture and services.

Ultimately, community economic stability will be improved through the introduction of effective sustained harvest systems in forest management.

One of the most important local impacts could be the development of local landowner organizations.

7.3 Forest Management

The major inputs of project activities in forest management will be indirect, but should be very important. They will include direct linkages of sustainable forest management systems and forest revenue and taxation systems.

Regional forest management should become accurately focused to provide for defined industry needs, within an integrated sector strategy.

7.4 National Institutions

The new Forest Authority and National Forest Service will be better focused to achieve national objectives for the forest sector, through project recommendations and discussions. Small steps will be defined, rather than giant leaps in industrial development, as contrasted with theoretical or proposed quick fixes, if the project achieves its objectives.

Direct institutional improvements will be targeted for Policy and Planning and Marketing/Forest Industries Development Divisions of the National Forest Service.

7.4 Forest Industrial Development

The principal target of the project is to assist PNG to get on a solid path of development in forest product processing. Employment and value added in the sector could easily double within five years of implementation of a workable strategy.

If the industrial develops in efficient forms, via efficient methods, high cost and/or financial losses can be avoided. Total GoPNG revenues from the sector should

exceed current levels (including log export revenues) within a few years.

Local customers should find improved quality and prices in a range of forest products from domestic supplies.

Housing and construction should be strongest gainers from an efficient local forest industry.

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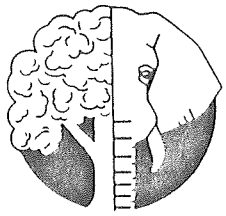

Société Internationale d'Experts-conseils
General Woods & Veneers
Consultants International Ltd

FOREST INDUSTRIES DEVELOPMENT STUDIES
International Tropical Timber Organization
Project PD 108/90 Rev. I (I)

Working Document no. 2
Industrial Processing Sector

Prepared for the

Papua New Guinea Forest Authority
National Forest Service

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EXECUTIVE SUMMARY

The existing wood processing industry of Papua New Guinea - with a few exceptions -is relatively obsolescent and inefficient in terms of both recovery from roundwood and in ability to meet international product standards. It basically produces for domestic market, with some very minor sales to specialty niche export markets in both sawnwood and furniture products. In 1992, less than 30% of the total log harvest was processed domestically, and the balance of the indigenous resource log harvest was exported in roundwood (log) form.

This study has examined the economic feasibility of establishing - through private sector investment - a re-vitalized forest products processing industry for the purposes of reducing log export, replacement marketing of semi-finished and finished forest products to both the domestic and export market and creation of employment opportunities in PNG.

A concept is proposed for the encouragement of a series of mills and complexes of mills based on:

1) Satellite sawmills of some 9,000 M3 per annum output to supply local requirements, a portion of direct sawnwood exports, and supply to centralized milling complexes for further value-added manufacturing.

2) Centralized sawmilling complexes of 60,000 M3/annum output and associated dry kiln/treatment plants of 90,000 M3/annum capacity as well as planing/moulding plants of 90,000 M3/annum capacity. These complexes would supply both rough sawn and finished goods components to both export and domestic markets.

3) Plywood plants of some 30,000 M3/annum output, primarily targeted at export markets but supplying a small portion of output to local requirements.

4) At least one Medium Density Fibreboard (MDF) plant targeted at economic utilization of residuals from the sawmill and plywood complexes with output product (30,000 M3/annum) aimed at export markets; with lesser volumes being utilized by domestic furniture manufacturers.

5) "Wokabout" or portable sawmills intended for special use applications in village settings for both creation of employment and supply for local use building materials.

Of the options examined, and based on April 1993 log and product market prices, the indicated return on investments (on cash flow) are -

	R.O.I.
Satellite sawmill	55.41%
Centralized sawmill	68.02%
Dry Kilns / Treating plant	56.87%
Planer / Moulding plant	201.23%
Plywood	41.62%
M.D.F.	24.30%
"Wokabout" sawmill	negative

It is apparent that all options, except for the "Wokabout" (portable) sawmill, offer most attractive investment opportunities. The "Wokabout" sawmill may have merit for local considerations, but not likely as a commercial enterprise.

In addition to encouragement of new investment in forest based companies, the Ministry of Forests should develop and enforce minimal standards of recovery and employment (working) conditions in the existing sawmill industry.

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1. INTRODUCTION

1.1 Background

The Forest Industries Development Studies Project (FIDS) has been conducted in PNG since July 1992, within the new National Forest Service of PNG (NFS), under the new National Forest Authority (NFA) and Forest Act. These new institutions, and plans for the FIDS Project were developed within the 1991 National Forestry and Conservation Action Plan (NFCAP) for PNG, led by the World Bank and a broad group of international donors.

Direct funding for the FIDS Project has been provided by the International Tropical Timber Organization (ITTO - Project PD 108/90 Rev. I (1) Yokahama) under the International Tropical Timber Agreement (ITTA). The Government of Papua New Guinea has also been a major contributor, through both direct project budget support and inputs from NFS staff.

Following an early situation report and detailed project plan, (Inception Report - September 1992), the project developed a detailed review of the status and trends of forest sector development in PNG (Sector Review - April 1993). This report included an outline strategy for the Government of PNG, together with the private sector timber owners and forest industry, to move towards government objectives of sustainable sector development, with enhanced domestic economic impact.

Since April 1992, more detailed case studies have been analyzed in forest revenue collection/distribution; domestic and international markets for PNG forest products; and potential small- to medium-scale, decentralized forest industry developments. These reconnaissance studies have provided background for more detailed forest sector policies and development strategies.

In May 1993, the new National Forest Authority drafted the National Forestry Development Guidelines, which have fundamentally re-oriented PNG forest policy. The FIDS team fully supports the new Guidelines.

The report presents the findings of the study team, and does not represent official policy of the Government of PNG, International Tropical Timber Organization, or other official national or international agency.

Background data and reasoning behind the conclusions and recommendations is provided in a series of Project Working Documents.

1.2 Objectives and Terms of Reference

The objectives and Terms of Reference for the Forest Industry Development Studies (FIDS) have undergone modifications since the original call for tenders. The resulting changes were necessary as new information became available in the form of sector working papers and the urgent timetable set by Government to establish a new Forest Authority and National Forestry Development Guidelines.

The Terms of Reference which covered this study can be found in the following documents:

- ITTO Call for tender documents - December 1991
- General Woods & Veneers/Nawitka Technical Proposal - January 1992
- Inception Report - September 26, 1992

1.3 Report Structure and Content

The overall study report is composed of:

i) the core report which crystallizes salient points of each of the FIDS sub-sector technical field reports. The information is intended for use by decision makers in drafting forest policy and national forestry development guidelines.

ii) Six separate working documents which provide technical details and analyses based on field studies which provide the detailed supporting information for the final report. They are:

Working Document no. 1	:	ITTO Terms of Reference FIDS Project Inception Report Sector Background Working Papers Forest Sector Review
Working Document no. 2	:	Industrial Processing Sector - Case Studies
Working Document no. 3	:	Harvesting and Transportation Review and Projection
Working Document no. 4	:	Financial and Economic Incentives in the Management of PNG's Forest Resources
Working Document no. 5[1]	:	Domestic Market Study
Working Document no. 6	:	International Market Study

This document is Working Document No. 2 - Industrial Processing Sector.

[1] It is to be noted that WD 5 is not a study conducted by GWV or Nawitka Resources. It was a separate contract with Mr. M.N. Amin, Marketing Branch, PNG. It is however included in the overall study as the domestic compenent of the marketing analyses.

2. CURRENT INDUSTRY OVERVIEW

2.1 Overview

Detailed and reliable information on the precise size, capacity, actual output and actual end markets for the manufacturing subsector is not currently available. Table 2.1 contains a listing of current major processing locations by province, company, type and capacity (where known).

Table 2.1

Partial Listing of PNG Wood Processors, 1993

PROVINCE/COMPANY	MILL TYPE (M3/Ann.)	OUTPUT
WESTERN PROVINCE		
Oriamo Sawmills P/L	Sawmill	Unknown
Wawoi Guavi Timber Co.	Sawmill	11500
Turama Forest Industries P/L	Sawmill	Unknown
GULF PROVINCE		
Turama Forest Industries	Sawmill	4200
Baimuru Sawmilling Co.	Sawmill	Unknown
CENTRAL PROVINCE		
Sabusa Sawmills	Sawmill	5000
Hugo Sawmilling	Sawmill	12500
Landwell Resources P/L	Sawmill	8750
Santa (PNG) P/L	Sawmill	Unknown
Magaridu Timbers P/L	Sawmill	Unknown
Golden Square	Sm/Ven/Furn.	3750
MILNE BAY PROVINCE		
Woodlark Island Dev. Corp.	Sawmill	Unknown
Ambogo Sawmill P/L	Sawmill	Unknown
WEST SEPIC PROVINCE		
Vanimo Forest Products	Sawmill	4200

MADANG PROVINCE		
Jant P/L	Wood Chips	180000
Madang Timbers P/L	Sawmill	Unknown
Kosmo Timbers	Sawmill	Unknown
Taway Timbers	Sawmill	5000
Lae Builders P/L	Sm/Furn.	7500
MOROBE PROVINCE		
PNG Forest Products P/L	Sawmill	8750
	Plywood	12000
Timber Producers P/L	Sawmill	Unknown
Timber producers P/L	Sawmill	Unknown
Phileo Joinery	Sawmill	Unknown
Bonamo Enterprises	Sawmill	Unknown
NATIONAL CAPITAL DISTRICT		
Golden Square P/L	Sm/Furn.	3000
Medaka Constructions P/L	Sm.(rubberwood)	5000
WEST NEW BRITAIN PROVINCE		
Stettin Bay Lumber Company	Sawmill	7500
Catholic Mission Ulamona	Sawmill	7600
Nam Yang Timber Company	Sawmill	2500
	Wood Chips	(inoperative)
EAST NEW BRITAIN PROVINCE		
Vudal Timbers P/L	Sawmill	6000
Temori Timbers P/L	Sawmill (balsa)	4500
Balsacraft P/L	Sawmill (balsa)	6000
G.S. Models P/L	Resaw (balsa)	300

In addition to the 35 plants as listed in table 1, there are possibly several hundred small "wokabout" sawmills operating in the country on a local basis. These mills may be producing up to 2 cubic meters of RST daily, but on a very sporadic basis. Further there are, undoubtably multiple domestic furniture factories scattered at various locations about the country. However the total output of these lesser mills is believed to be insignificant.

In 1990, a volume of some 6,660 cubic meters of sawnwood with a total value of K 11,674 was imported to PNG.

Appendix II contains a summary of log production (as recorded by the Department of Forests scale), exports (as recorded by the Department of Forests log export report) and the apparent domestic consumption of roundwood logs for local manufacture. In fact, the apparent domestic consumption calculation of roundwood may be in error due to the fact that no stockage or inventory figures are available to be used for elimination of short term (year end) abberations between production and shipping of export logs. However, in the long term these inconsistencies may be ignored as eventually all logs produced are either exported or used for domestic conversion.

It is noteworthy that in 1977 some 63% of logs produced were converted to product within the country, while by 1991 (the last year for which statistics are available), this figure had fallen to less than 15% - and that 15% includes the up to 180,000 cubic meters of logs harvested by Jant P/L for production of wood chips only. It is further apparent that in 1977 some 830,000 cubic meters were processed domestically while by 1991 this volume had fallen to only 237,000 cubic meters - including the volume processed by Jant for production of exportable wood chips.

2.2 Sawnwood

With very few exceptions, the sawmill sector may be characterized as obsolescent and poorly maintained in relation to other tropical hardwood timber processing areas. The exceptions are the more modern mills at Stettin Bay, Wawoi Guavi and Lae Builders. All milling operations - including the more modern bandmilling plants - are operating at substantially below any real capacity and an approximation for the entire industry would be between 20 and 30 percent.

It is further apparent that in addition to low production rates, the industry is characterized by extremely low recovery ratios, with published and verbal reports ranging from 20% to 45% of log input being recovered as sawnwood. This is in part due to the equipment configuration and mechanical condition (most mills are sawing with 7/16 inch kerfs and lack both positive positioning and positional stability in sawing), and partly due to poor operator training.

Production plant labor has been observed to be relatively effective in performance of job activities and responsibilities. Further the availability of required skills such as "saw doctors", mechanics and electricians doe not appear to be a major constraint to operations although many of the larger plants have developed their own apprenticeship/training programs.

The industry is presently sawing primarily for the domestic market, although some minor quantities of exceptionally high valued species (e.g. Rosewood) are being exported on a sporadic basis. For domestic utilization, non-exportable logs including cull grades of prime species (e.g Kwila) and non-exportable species from the 50 cm+ log harvest regulations are used. The problems of insectival attack on many of the species sawn for domestic structural applications have been overcome by use of both pressure treatment with Chromated Cuprous Arsenate (CCA) and diffusion treatment with other patented Boro-arsenate salts ("Koppers #7").

In addition to preservative treatments, a large portion of sawnwood for the domestic market is planed and/or profiled for use as dimensioned stock or as flooring/sidings. At least one of the mills listed - Vudal Timbers - is planing and/or moulding up to eighty percent of its product, and all this solely for the local market. A major problem in these processes is the lack of dimensional control (most mills are over-sawing by up to 1.5 cm in order to prevent under-sized production). A further problem is member straightness as a result of warpage due to "timber bind". Both of these problems greatly reduce both productivity and recovery, yet are readily preventable by use of reasonable equipment and sawing practices.

2.3 Wood-based Panels

At present there is only one wood-based panels plant in the country, namely, PNG Forest Products in Boroko. This plant is producing plywood - primarily cross grained pine - for the domestic market, although it does produce some exotic faced (long grain) panels for the domestic and, in the past, export markets. Lack of access to a reliable source of peelable hardwood logs has limited its ability to continue in the export market, and at present its sales activities are constrained to filling the bulk of the country's internal requirement for plywood. The company is currently installing a slicer for the production of high quality exportable plywood grades.

Some further volumes of specialty grades of plywood are still imported to the country. In 1990, the last year for which detailed statistics are available, PNG imported some 618 thousand square meters of non-coniferous plywood with a value approaching K190,000.00. A further K38 thousand of coniferous (softwood) plywood was imported in the same year.

While PNG has no re-constituted or specialty panel upgrading plants, it has a respectable import of such products. During the same 12 month period in 1990, some 156,000 square meters of these products were imported with an aggregate value of K544,948.

2.4 Furniture and Other Wood Manufacture

At least two first quality furniture manufacturers - Golden Square and Lae Builders - are in operation, producing high quality designer furniture for both domestic and export markets utilizing a variety of exotic species including Rosewood, Teak and Ebony. In addition to these producers, there is undoubtably a number of lower quality producers meeting a portion of the local requirement for conventional grades of furniture and case goods products.

2.5 Pulp and Paper

Of the two pulp chip mills in PNG, only Jant is presently producing. (Nam Yang has never produced chips and their plant is non-operable in its present condition due to deterioration, fire and vandalism. At least $US 1.5 million would be required to activate it.) Jant - part of the Honshu Paper Group - is still producing a mixture of eucalypt and native hardwood chips, however they are selling a large potion of their production to the MDF industry in Japan rather than to the pulp industry.

3. WOOD SPECIES AND PROCESSING OPTIONS

3.1 Wood Species

As with natural tropical rainforests in other regions of the world, Papua New Guinea has a wide profusion of tree species, in fact more than 480 commercial or potentially commercial species have been identified. From this panoply of resources, a relatively small number of species have been in major use up until recent years. Appendix 3 contains a selected listing of some 38 of the more commonly utilized commercial species and their respective primary industrial (commercial) applications.

Table 3.1 lists twenty of the primary exported log species, their percentage of 1988 export volume and primary applications.

Table 3.1
Commonly Exported PNG Wood Species and Uses - 1988

Trade Name	Volume %	Uses
Tuan	21.24	sawnwood, turnery,fine cabinetry
Kalofilum	6.57	sawnwood, veneer, furniture
Malas	6.21	sawnwood, heavy construction
Terminalia	5.08	sawnwood, exterior construction
Pencil Cedar	4.20	sawnwood, fine applications
Simpoh	3.74	veneer, plywood,sawnwood
Kwila	3.50	veneer, plywood,sawnwood
Mersawa	3.42	veneer, plywood,sawnwood
Red Canarium	3.09	veneer, plywood
Erima	2.98	veneer, plywood,sawnwood
Amberoi	2.89	veneer, plywood,sawnwood
Light Celtis	2.86	sawnwood, parquet
Water Gum	2.17	sawnwood, mouldings
Basswood	2.02	veneer, plywood,sawnwood
Kamarere	1.66	sawnwood, pulp chips
Nyatoh	1.55	sawnwood, fine carpentry
Walnut	1.52	sliced veneer, sawnwood
Red Planchonella	1.34	veneer, plywood,sawnwood
Mixed Red	1.24	veneer,plywood,sawnwood, pulp
Pink Satinwood	1.05	sliced veneer, sawnwood

Source: Forest Industries Council of PNG

It is apparent from table 3.1 and appendix 3 that end uses for most "commercial" species (i.e. those which exceed the minimum harvest diameter of 50 cm. DBH and have established export markets) are well known. In fact, practically every species found in the PNG forests and exceeding minimum harvest diameters can be utilized in all of the major utilization groupings for either domestic or export markets. This broad usage has been occasioned by a number of factors including:

- general global shortage of wood products
- increasing awareness of species characteristics
- use of anti-stain and anti-insectival chemical treatments (both vacuum-pressure and dip-diffusion applications) which render most species durable.

What is not clear from table 3.1 and appendix 3 is the distribution of species within the forest. Pending completion of the National Forest Inventory studies, it can only be pointed out that in PNG - in common with all tropical rainforests - no single species is truly dominant, and that both existence and concentration of species can be highly variant in various regions of the country. For example, Tuan is most prevalent in the provinces of New Britain while Kwila, which is found in reasonable volumes in most regions, is one of the major species in the upland regions of Western Province.

It is apparent that domestic processing facilities in remote locations may not have readily available to them the optimal species mix to serve both domestic and export finished goods markets, nor may they have the financial capability to install the full range of wood processing equipment to ensure maximal species utilization from the species profile in the immediate region of log supply. This situation in not unlike that of the export log buying regions where specialized plants and facilities have been established to process a selected range of wood species to a specialized range of value-added products.

3.2 Processing Options

Of primary consideration in examination of processing options is the need to:

1) Consider both environmental impact and industrial standards of the proposed industry;

2) Provide a stable industrial base for sustained processing operations;

3) Provide decentralized employment opportunities;

4) Provide internationally competitive product costing through cost efficient processing plants;

5) Maximize recovery of saleable product from roundwood input;

6) Provide milling opportunities that can optimize employment of PNG Nationals in all levels of operation.

Immediate options available to the processing sector of PNG include all of those end-uses to which export log buyers are currently applying PNG harvested and shipped logs, plus other down-stream value-added products which are produced by tertiary wood products processing plants in offshore utilizing/marketing regions. That is to say that the niche opportunity is to supply to the consuming market region those semi-finished and finished goods that are being supplied by offshore processing of PNG's raw materials.

To this proposed replacement of marketed product must be the concern that through disruption of the current supply pattern, markets may be lost, along with domestic jobs and revenues. In fact this potential problem has been faced up to by most other tropical hardwood producing countries, and virtually all have succeeded in the market conversion for the simple reason that the consuming countries must have a source of product to meet their consumer demands and distribution system needs. Provided that a conversion from log export to semi and fully finished end products is conducted in an orderly manner, no loss of final market is likely to occur, and in fact that conversion itself may become a stimulus to attract foreign joint-venture investment.

There is an apparent need for a re-vitalized sawmill industry, based on sound and proven process technology from other tropical hardwood processing regions to:

- improve sawnwood recovery
- reduce export of unprocessed resources
- create employment in the sector
- provide on-grade products to both the domestic and export markets.

Any new facilities installed should be equally capable of serving both export and domestic products by the ability to efficiently process sawnwood to international standards of dimension and grade. They should be capacity sized to fit with both the flow of logs and ability to reasonably serve both major markets. They should be so located as to provide stable long-term local employment compatible with available infrastructure and skilled labour availability.

There is an apparent opportunity to divert at least a portion of the peelable species of exported logs to at least one, and possibly two, moderately sized veneer/plywood plants for the production and sale of plywood to export markets, i.e. those markets currently being met through the offshore conversion of PNG produced and exported logs. This market will be secured by substitution or replacement of product to those offshore markets rather than by displacement of other traditional export suppliers.

There is also an apparent opportunity for the installation of at least one moderately sized Medium Density Fibreboard (MDF) plant for the production of export quality MDF for sales to existing markets in Japan, Korea, Taiwan, Australia and the U.S.A. This process would utilize the currently unused (wasted) slabs, edgings, cores, planer shavings etc. from existing or proposed sawmilling/plywood operations.

Due to the bulk and potential for damage in shipment of finished furniture, there is the opportunity for development of a highly labour-intense industry for production of furniture blank and component parts manufacture for export to industrialized export markets. This industry could process local species to standard component manufacture for final milling, assembly and finishing in end-user countries. Initially this value-added industry could be an integral part of a reasonably sized sawmill/kiln dry/planing/moulding operation that could produce furniture "square blank" components from selected species for shipment to primary markets.

Short fibre pulp and chips are currently in over-supply globally for a variety of reasons, including:

- installation of excess pulp and paper capacity in several developing regions
- increased re-cycling of paper products in developed regions
- reduction in use of linerboard/paper products in packaging.

Short and medium term prospects for further production of wood chips are not attractive, and in fact any further increase in chips production should be considered from mill residues and ear-marked for reconstituted wood panel manufacturing, i.e. MDF.

Pulp production in PNG is not considered to be an attractive option for a variety of reasons.

Firstly, there is no paper mill (for production of quality paper products) for utilization of the pulp grades producible with PNG wood species. Pulp would therefore have to be sold on a global market pulp basis and, as noted above, short fibre pulp is in over-supply.

Secondly, without a major change in land tenure and/or establishment of a major plantation program, insufficient reasonable cost roundwood may be available to sustain a world scale (and economic) pulp mill.

Thirdly, installation of a paper mill to convert the pulp production of a world scale pulp mill would result in a capacity far beyond foreseeable domestic requirements, hence product would have to be sold on a global market basis - for which markets are already saturated and depressed.

Lastly, the potential for environmental abuse - even from the latest technologies and closed-loop processes - may be in excess of the capability of absorption by the ecosystem.

4. SELECTION OF OPTIONS AND LEVEL OF STUDY

From the available options, a number have been selected for case study evaluation including the following.

4.1 Sawmilling and Sawnwood Value-added

Three levels of configuration have been considered for case study. These options and their levels are:

A) "Satellite" Sawmills

These mills would be located in non-centralized locations in close proximity to or contiguous with independent forest harvesting operations. Each mill would be configured for the precise sawing of rough-sawn timber (RST) and would have an annual output of 9,000 cubic meters. The mills would purchase logs from the "open log market" at competitive log prices, and would produce a variety of RST for shipment to immediate (local market), national and international markets. Product for national non-local markets from up to seven or eight satellite mills could be sold to the centralized sawmilling complex for further value added production, or to other consumers in the PNG marketplace.

B) Centralized Sawmilling Complex

One or more centralized complexes would be established in urbanized areas, such as Popondetta or Madang (due to the availability of surplus electric power) or any other major city to whichauxiliaryy (available) gas turbine generators could be re-located. The complex would be compose of a sawmill of 60,000 cubic meters per year output capacity, a dry-kiln/treating plant of 90,000 cubic meters output, and a planer mill/moulding plant of 90,000 cubic meters annual output.

The complex would purchase logs from the open log market for sawmilling, and RST from the satellite operations for value-added product upgrading to include:

- Domestic and Export RST
- Kiln dried RST (KDRST)
- Pressure treated RST (PTRST)
- Resawn KDRST
- Planed and/or profiled undried timber
- Planed and/or profiled KD
- Planed and/or profiled PT timber

C) "Wokabout" or Portable Sawmill

This option has been included for evaluation only of the cost-effectiveness of portable sawmilling on a village scale.

4.2 Plywood/Veneer Plant

Within the centralized sawmilling complex, a 30,000 cubic meters output per year rotary peeled veneer/plywood plant. The plant would purchased selected grade peelable quality logs from the open log market, and process them to export quality plywood for primary sale to export markets, although minor volumes could be sold to fill domestic requirements as appropriate to market demand.

While initially configured as a rotary peeled operation, future addition of a slicing process may be considered, depending on both market demand and availability of primary end-use sliceable veneer log species.

4.3 Medium Density Fibreboard Plant (MDF)

In close proximity to or as part of the centralized sawnwood/plywood plants, a 30,000 cubic meter per year output MDF plant.

The MDF plant would use the clean residues of both the plywood and sawmill complex for the production of international quality medium density fibreboard for primary shipment to the export markets (Japan and Korea). Since MDF is neither produced in PNG nor consumed in appreciable quantities in PNG, it is assumed that domestic market will not be a major factor in its sales.

MDF has been selected as the option for re-constituted panel product for consideration over such potential products as wet process hardboard, particleboard and Oriented Strand Board (OSB) for at least the following reasons:

- Extensive testing of PNG wood species has been undertaken in both New Zealand and Sweden, and the species have been demonstrated to produce product complying with international standards.
- MDF has been successfully produced from mixed tropical hardwood species in Philippines and Taiwan.
- MDF is in high international demand as a base furnish for quality case goods and panelling.
- MDF commands the highest net mill return (NMR) of all of the reconstituted panel products.
- Wet Process Hardboard is an obsolete product with low international demand.
- Wet Process Hardboard has severe environmental impact problems.
- Particleboard is becoming a "sunset" industry.
- Particleboard has a very low NMR from international markets.
- OSB is only saleable in market areas consuming untreated low value sheathing products.
- OSB has not been successfully tested using mixed tropical hardwood furnish.

4.4 Definition of Level of Study

For the plant types enumerated, case studies have been undertaken to develop pro-forma projections of profitability and financial ratios for evaluation of attractiveness of both concept and specific units within the overall concept. The level of study is defined as generic, non-site specific, non species specific and non market specific pre-feasibility level models only. Detailed feasibility studies for each case will have to be undertaken for specific sites, species mixes and market mixes when these are identified prior to commitment to construct.

The models include:

- capital cost
- manning and wages
- salaries and overheads
- operating supplies and consumables
- recovery calculation
- market prices and assumptions.

Equipment costs have been estimated on the basis of consultant's files for recently executed similar projects and augmented - where necessary - by budgetary quotations from machinery suppliers. Land, building, installation and electrical costs have been based on discussion with and data provided by local contractors, erectors etc.

Manning and wage costs have been developed on the basis of manning required to efficiently operate the facilities as applied to the currently published wage scale under the PNG Industrial Relations Act Chapter 174. Wages have been increased by a fringe benefit factor based on the experience of local producers.

Management salaries have been estimated on the basis of required personnel at either international costs (for highly specialized positions) or prevailing current cost as reported by PNG producers. Overheads have been estimated only to approximate such expenses.

Operating supplies and consumables have been estimated on the basis of international experience or calculated by item of cost as appropriate.

Recovery calculation has been made on the basis of the equipment selected and international experience.

Market prices have been estimated on the basis of current PNG wood products producers price lists, prevailing international export prices, and assumed product mixes.

5. CONCEPT OF ORGANIZATION

5.1 Conceptual Organization

The proposed industry organization would comprise of two basic mill configurations:

1) the "satellite" sawnwood plant, self contained with respect to power generation, and

2) an integrated plant complex on power grid, consisting of sawnwood, kiln drying, full dressing and profiling capability, a plywood plant and a Medium Density Fibreboard (MDF) plant.

The first or "satellite" mill is intended for location fairly close to or contiguous with logging operations, preferably adjacent to a log exporting (coastal) log yard. Each "satellite" would be a self contained facility capable of producing 9,000 cubic meters of sawnwood from a mixture of both low grade (export cull logs and non-exportable species) and higher quality export grade logs for which there is a demonstrable export RST market available. The mill would produce RST for the immediate local market, RST for direct shipment to export markets and RST in both exportable and non-exportable species which it would ship to a centralized milling complex where its out-turn would be further processed to re-sawn, dried and/or planed/profiled product for ultimate sale to both export and domestic markets.

Satellite mills could be located in any number of locations, and it may be appropriate to consider areas on the south coast of New Britain (both East and West), West and East Sepic, Northern Province, Mine Bay Province, Central and Gulf Provinces as well as several potential locations in the inland Western Province, particularly in upper but barge accessible regions of the Fly drainage.

The Integrated mill complexes which would likely require grid electric power availability, and this would restrict their locations to the more heavily populated rural areas. This restriction should enhance to ability to attract a stable, reasonably trained and stable labour force.

Each complex would consist of a sawmill producing 60,000 cubic meters per year of accurately sawn RST which could be sold on export markets, domestic markets or utilized for further value-added processing to re-sawn, planed/profiled dried and/or preservative treated products. The complex would have kiln drying and planing profiling capacity for up to 90,000 cubic meters per annum, hence would be capable of processing to final product RST supplied to it by satellite operations.

Each complex may also contain at least a plywood plant of 30,000 cubic meters output capacity, producing high quality plywood for sale to export markets. One or more of the complexes may also contain an MDF plant, primarily designed to produce 30,000 cubic meters annually (expandable to 100,000 cubic meters per annum).

Log supply to the complex would be by 5,000 cubic meters capacity coastal barge. Logs would be collected from various coastal log supply points. The same barge would collect exportable RST from the satellite mills (for export from major port facilities) and RST destined for further processing at the central complex. Furnish for the MDF plant would be primarily from slabs, edgings, sawdust, planer shavings, waste veneer and cores of the sawmill and plywood plants.

Given the requirement for surplus available grid power and tidewater access, potential locations for the complexes are currently restricted to Madang and Popondetta. However, given the Papua New Guinea Electricity Commission's (ELCOM) existing capacity to move major portable gas turbines into place, virtually any suitable industrialized centre with grid distribution can be considered. Further, consideration of self contained power generation could be given to remote and unserviced locations such as Western Province.

In order to ensure log supply to proposed satellite mills, proposed centralized complexes and to existing independent milling operations, it may become necessary to foster the establishment of a domestic log market. This may be accomplished through informal industry associations or agreements, or may require the establishment of a log marketing board.

The domestic log market should be so structured as to ensure that fair domestic market prices are established for domestic log consumption and should be on a grade comparable basis, i.e., similar prices should be in place for exportable log grades in order to provide an opportunity for profit from efficient log conversion, and a reasonable level of profit to the log producer.

Satellite mills which are located at a log loading site on tidewater would likely purchase their logs at prevailing competitive log prices for both domestic and export grade logs. The mill owner(s), who may or may not also have ownership in the log production organization would retain a "first right of refusal" basis for log supply, thus ensuring that the operating mill in each regional area would have an equal opportunity for purchase of raw materials for both export and domestic end markets.

Satellite mills would sell their products at three levels:

- to local customers
- to export (direct buyers)
- to a central processing/value-added facility.

The satellite mills may or may not be owned partially or in whole by the central processing facility, but in any case will sell their products to the value-added facility plant at prevailing competitive prices for both domestic and export products. Thus the satellite mills will be at no disadvantage in selling their products to either the immediate local market, the central processor or to direct export markets.

Their products will be transported to the central processor via a cost effective 5,000 ton coastal barge, and their supplies - when appropriate - will be returned to the remote sites via the same barge.

The larger centralized mill complex will secure its log supply on the open market from various remote log producers who maintain tidewater barge loading facilities. Logs will be purchased on the same basis as the satellite mill, i.e. at a competitive price by species and grade, but with a first right of refusal on all grades and species. It is anticipated that the centralized complex with its more complex manufacturing capability will purchase a higher grade of log, and will also select the more specialized grades and species available from a variety of source locations, for example peeler grades of Kwila.

Within the larger sawmill complex, the sawmill will produce RST for direct sale to both export and domestic markets. It will also sell RST to the other value-added facilities in the complex (dry kiln/treating plant and Planer/moulder plant). All sales and transactions will be at prevailing market prices, thus ensuring that each stage of the value-added process is a true profit centre. As such, the "upgrade" facilities may be owned independent of the sawmill, as may the plywood and MDF plants.

The plywood plant will produce export quality plywood primarily directed at replacement international markets which formerly bought peeler grade logs. It will also produce some quantities of plywood for sale on the domestic market as a displacement of currently imported panel products.

The MDF facility will draw its furnish in the form of debarked slabs, edgings,trim ends and green planer shavings from the sawmill complex, and peeler cores and green veneer trim from the plywood plant. It may also consume low quality logs from other sources or from mill yard "clean-up". This latter source will be hand de-barked prior to chipping and conversion to product.

The residues of all plants in the process will be converted to heat energy for drying and processing requirements in the dry kilns, plywood plant and MDF plant.

Pending the results of the current domestic market survey, no definite statement can be made. It is noteworthy that of the 14 mills visited to date, 12 reported that they could sell up to 50% more production locally - if they had the capacity and/or logs available to produce it. The remaining two mills reported an inability to market their out-turn locally, but that this was more a problem of payment for product than lack of demand.

It is assumed that future increased domestic sales would follow the now established patterns of ex-mill sales, sales to distributors (stocking yards), contractors, light industry and governmental agencies.

Export sawnwood sales may require a more complex and initially more expensive sales effort. Pending the results of the export marketing study, recommendations may be developed for establishment of a co-operative sales agency for penetration of import purchasing systems and/or consolidation of agency representation to the importing companies in Japan, Korea, Taiwan, Singapore, North America, Europe and the Middle East.

5.2 Material Flows

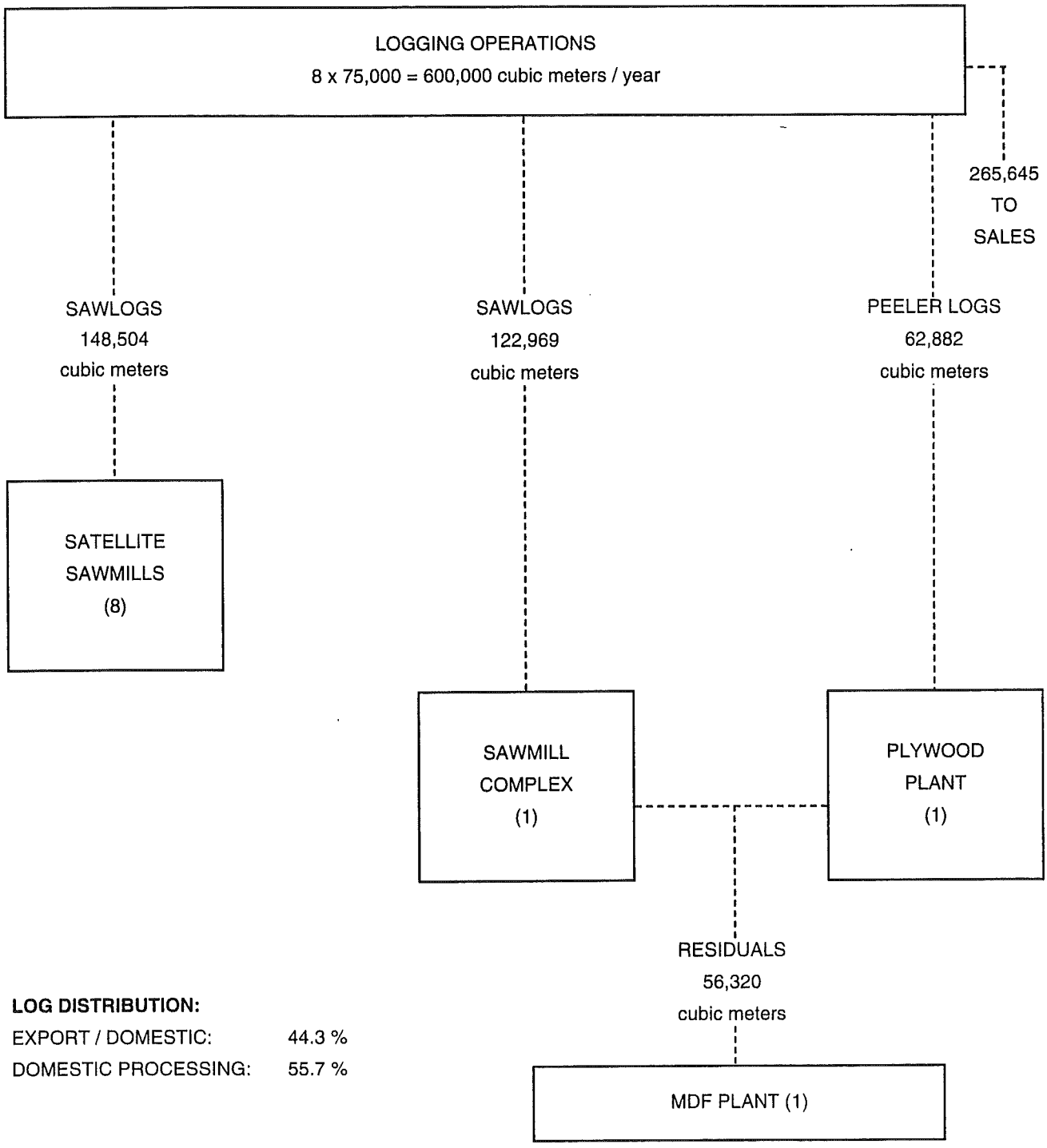
The proposed raw material flow for the aggregate of processing and production units is shown in diagram 5.1. It is emphasized that this raw material flow is based on the assumption that eight minimum economic scale log production units would supply logs through an open market to:

- eight satellite mills
- one centralized sawmill complex
- one plywood/veneer plant
- one MDF plant
- other domestic log market buyers
- export log sales.

As a first stage, after start-up of the satellite mills, centralized sawmill and plywood plant, 55.7% of the produced logs would be committed to the aggregate of the mills, and only 44.3% would be available for a combination of domestic open log market sales and/or log exports. Log export would therefore be reduced to a maximum of some 44% of production, and this maximum number could be systematically reduced by either the expansion of mills within the aggregate or by open log market sales to other domestic processors.

Diagram 5.1

Raw Material Flow to Processing Groups



LOG DISTRIBUTION:

EXPORT / DOMESTIC:	44.3 %
DOMESTIC PROCESSING:	55.7 %

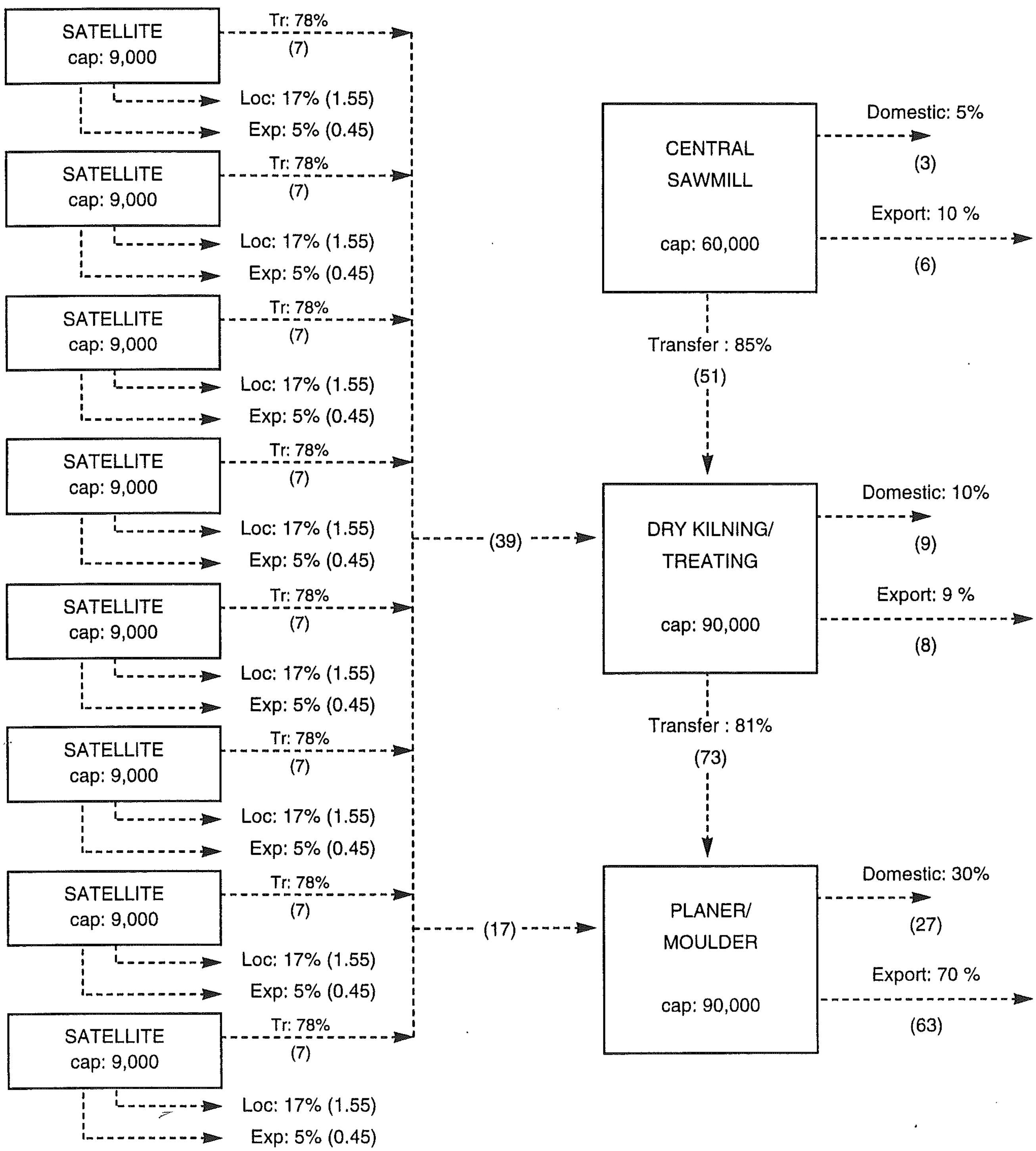
Diagram 5.2 indicates the potential product flow from the various processing plants. Again, this is a "suggested start" position only, and would likely be modified by actual operators once the plants were in position.

In concept each of the plants would produce product for sale to three markets:

- direct local (domestic) market
- direct export market
- direct local and export markets through value-added facilities.

Diagram 5.2

Proposed Product Flow



6. CASE STUDY OPTIONS - MILL OPERATION DESCRIPTIONS

A full description of each of the proposed processing plants is contained in Appendix 4. A brief description of each of the plant types follows.

6.1 Satellite Sawmill - 9,000 cubic meters/year output

Logs are delivered to the mill yard by supplier's truck, where they are unloaded to inventory using a rubber tyred heavy lift fork lift. The same loader will place logs on the infeed chains to the two primary breakdown units. Primary breakdown to slabs and cants will be accomplished utilizing two slab-floor mounted dual thin-kerf circular saw mobile type mills, each mill (one "right handed" the other "left handed" capable of producing up to 25 cubic meters per eight hour operating day.

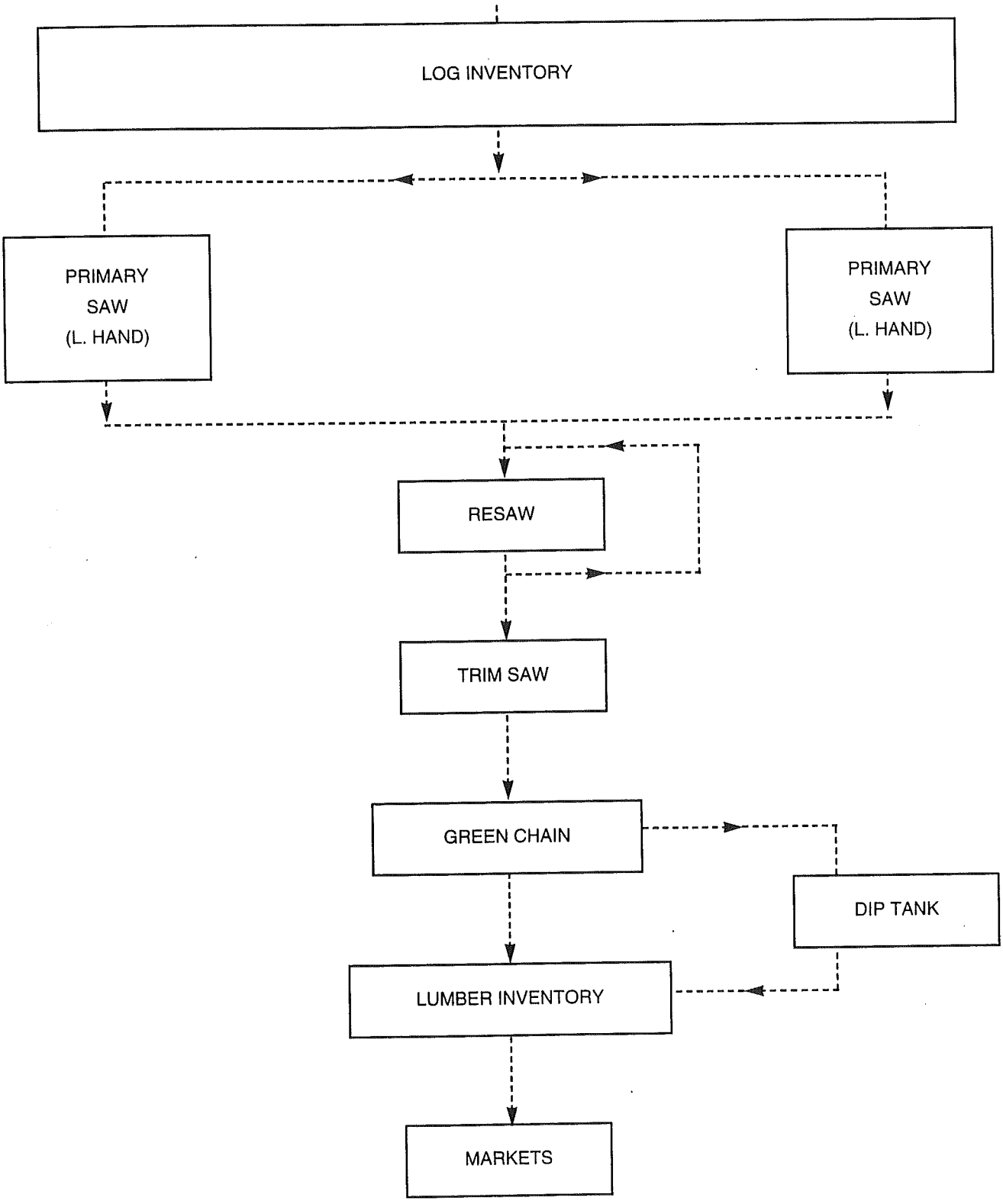
From the primary breakdown, slabs and cants will be power roll conveyed to a single narrow kerf circular resaw complete with set works and powered feed rolls, where timber will be broken down further to its final dimensions. From the re-saw dimensioned lumber product will be conveyed to a trim saw for cutting to precise length. From the trim saw, product will be power conveyed to a green chain where lumber will manually sorted by species, dimension and grade. Product will be strapped for storage or shipment at the green chain piling stations using a hand operated strapper. The loader will move finished product to inventory space or to an-off line diffusion dip tank as appropriate for further processing.

RST for local market will be loaded to buyers transport either by hand or by use of the fork truck. Product for direct export shipment will be packed to containers or export bundled for loading at the log supplier's barge loading facility. RST for shipment to the value-added central processing facility will be strapped and loaded to the coastal transport barge at the log supplier's facility.

Unusable residues from the milling process will be conveyed or blown to an open-type burning pit to ensure site cleanliness. Slabs, edging and trim that is saleable for use as fuelwood will be manually recovered from the waste conveyor, piled and strapped and disposed of by sale to local residents. Diagram 6.1 presents a simplified flow diagram for the satellite milling process.

Diagram 6.1

Process Flow Diagram - Satellite Sawmill



6.2 Centralized Sawmill - 60,000 cubic meters/year output

Logs are delivered to the Central complex's barge wharf via the coastal barging system's equipment. Logs will be moved from the barge unloading using a rubber tyred front-end loader and transported to inventory spaces. From the inventory, the same loader selects and carries the logs to the log yard debarking and bucking station.

Logs are mechanically debarked, and bark is conveyor transported for use as fuel in the plywood and dry kiln process heating plants. Following debarking, logs are bucked to length using a conveyor mounted cross cut saw, then infed to the mill saw infeed decks. At the infeed deck, logs are separated into sizes and species best suited to the two primary breakdown processes.

Logs of less than 60 cm. diameter are directed to a two-saw narrow kerf circular "scragg" saw for two sided sawing to prevent "timber bind". This unit is equipped with log positioning rollers to ensure best opening face, and adjustable saw spacing. Cants from the scragg saw are conveyed to a narrow kerf band resaw, to a "bull" edger or to a board edger. Lumber is then conveyed to the trimsaw infeed conveyor.

Large logs (minimum 40 cm.diameter) are conveyed to a four block (maximum 6.6 meter length) log carriage, complete with taper blocks and drop hammer log dogs. The logs are then sawn to cants and flitches using a high-strain narrow kerf bandmill. From the bandmill, flitches pass to either a bull edger, board edger or to a re-saw, complete with a recirculating conveyor.

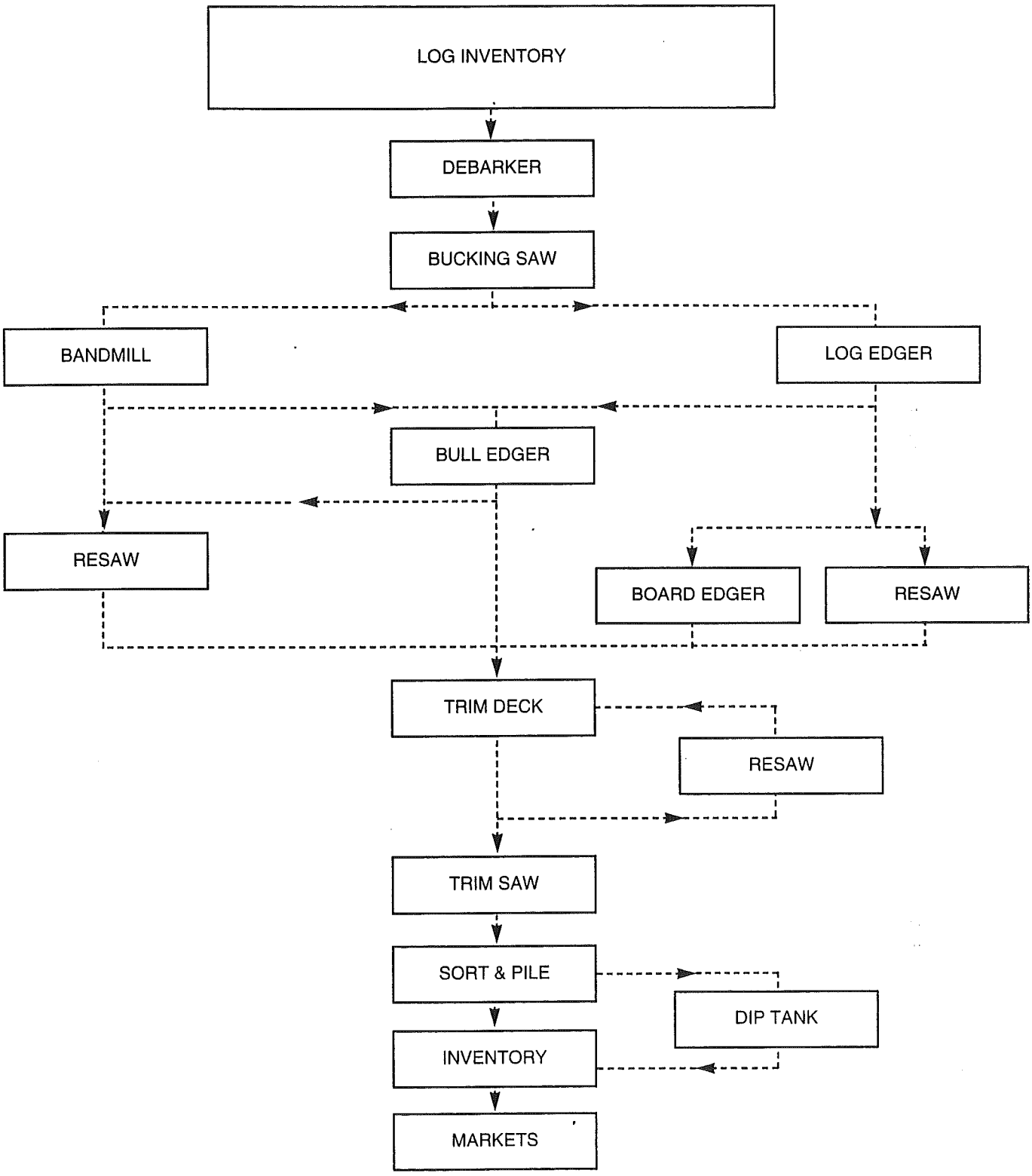
Lumber from the large log side merges at the trim-saw infeed table with lumber from the small log side. Lumber may be re-circulated for re-sawing past a third narrow kerf bandmill, complete with linebar.

Lumber then passes a two saw trimmer for reduction to accurate and required lengths. From the trimsaw it moves either to a "short" sorting line, or is conveyed to an edge sorter. At the two sort lines, lumber is separated by grade, species and dimension, then piled and strapped.

A fork lift moves lumber from the sorting stations to inventory or to a dip tank for anti-insectival/ anti fungal treatment, then to inventory. From inventory product can be sold to domestic markets, to export markets or to the further value-added plants in the complex. All clean residuals are conveyed or air transported to either the process heat producing plants or sold as furnish to the MDF plan. Electric power is supplied from grid power. Diagram 6.2 depicts the general flow plan of the centralized sawmill unit.

Diagram 6.2

Flow Diagram - Centralized Sawmill



6.3 Dry Kilns and Pressure Treatment Facility - 90,000 M3/year

RST is delivered to green inventory by lift truck as supplied from satellite sawmills and the centralized sawmilling facility. The same fork truck delivers loads of lumber to the semi-automated load unstacker at the sort line infeed.

Lumber is trimmed (when required) to meet grade requirements, diverted to a re-saw to meet order requirements or to maximize vale recovery, then piled and stickered for either dry-kiln loading or pressure treatment.

Lumber for kiln drying is loaded to kiln carts utilizing the fork truck, and carts are winched into the kiln cells. Heat and circulating air is applied to the loaded kilns for cycle times consistent with reduction of moisture content to finished product specifications. Upon completion of the kiln cycle carts are withdrawn form the cells and stickered lumber is removed to dry inventory or for recycling past the sorting line to unsticker, trim and grade and re-pack for shipment. Lumber for transfer to the planer/moulder plant is left stickered for unstickering at the next stage of value-added production.

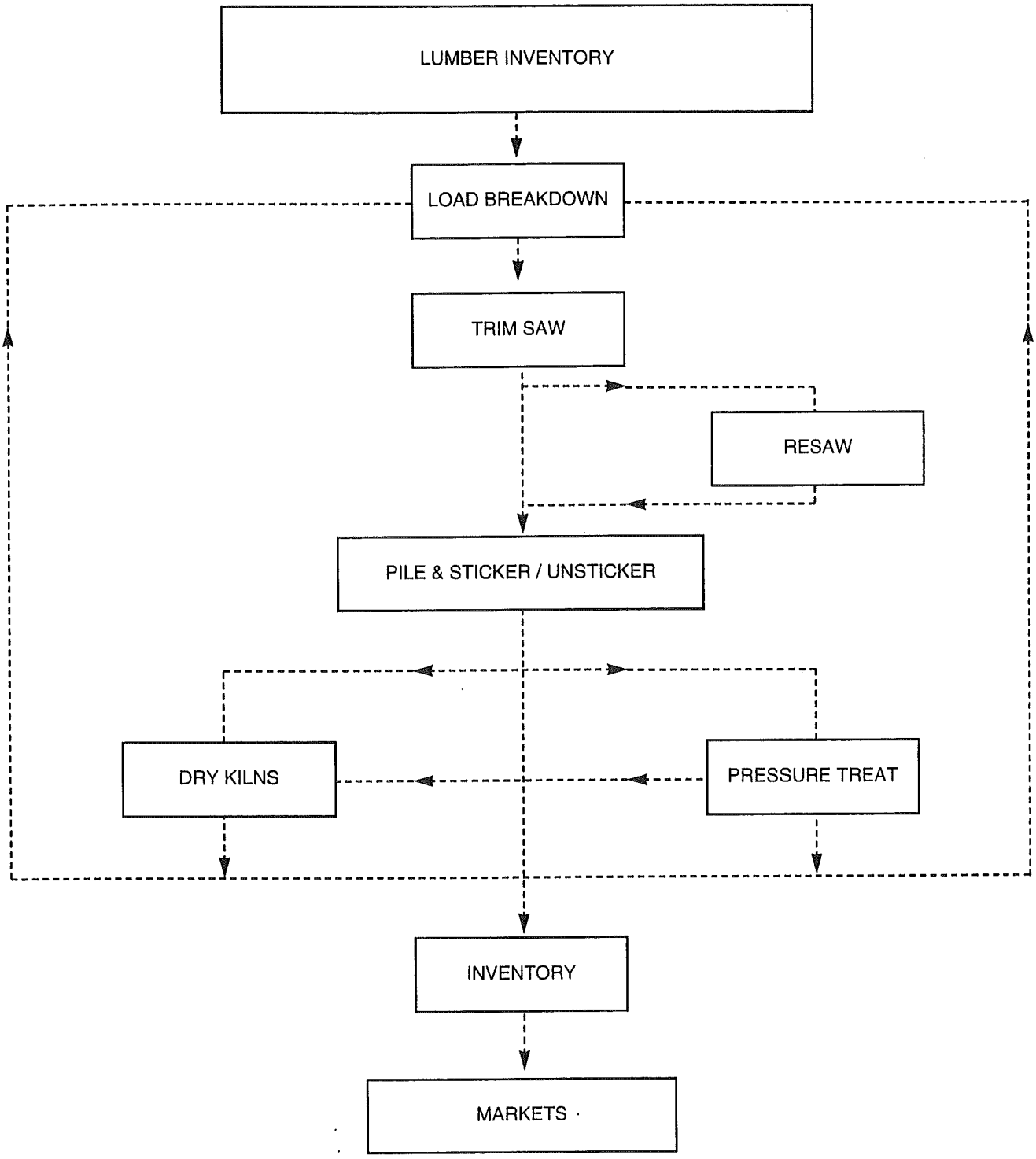
Lumber for pressure treatment is transferred to cylinder bogeys by fork-lift, then inserted to the vacuum-pressure cylinder for CCA impregnation. Treated product may then be withdrawn for unstickering and inventory, subsequent kiln drying or transfer to the planer-moulder plant for further value-added processing.

Process heat requirements for the kiln-drying is provided by collection and combustion of residues from the central sawmill, trimming/re-sawing processes and dry planer mill residues.

Diagram 6.3 shows the basic flow pattern for the dry kiln/pressure treatment plant.

Diagram 6.3

Flow Diagram - Dry Kilns and pressure Treatment Plant



6.4 Planer Moulder Mill - 90,000 cubic meters per year

Green RST is delivered to the mill inventory by fork lift from the centralized sawmill and from the satellite mills via the coastal barge unloading facility. Dry RST (treated and untreated) and green treated RST is also delivered by forklift to the inventory building. The same fork lift delivers RST from the inventory to the unstacker infeed.

RST is unstacked and unstickered at the load breakdown (with kiln and pressure treatment stickers saved and returned to the dry kiln and treatment plant). Unstickered RST can then be fed either directly to the planer moulder or by-passing the planer/moulder directly to the re-saw and/or sorting line (permitting selection or reduction prior to surfacing), then recirculated to the planer/moulder.

Surfaced product is conveyed on the sorting conveyor where it is graded and piled or passed for final trimming and stacking.

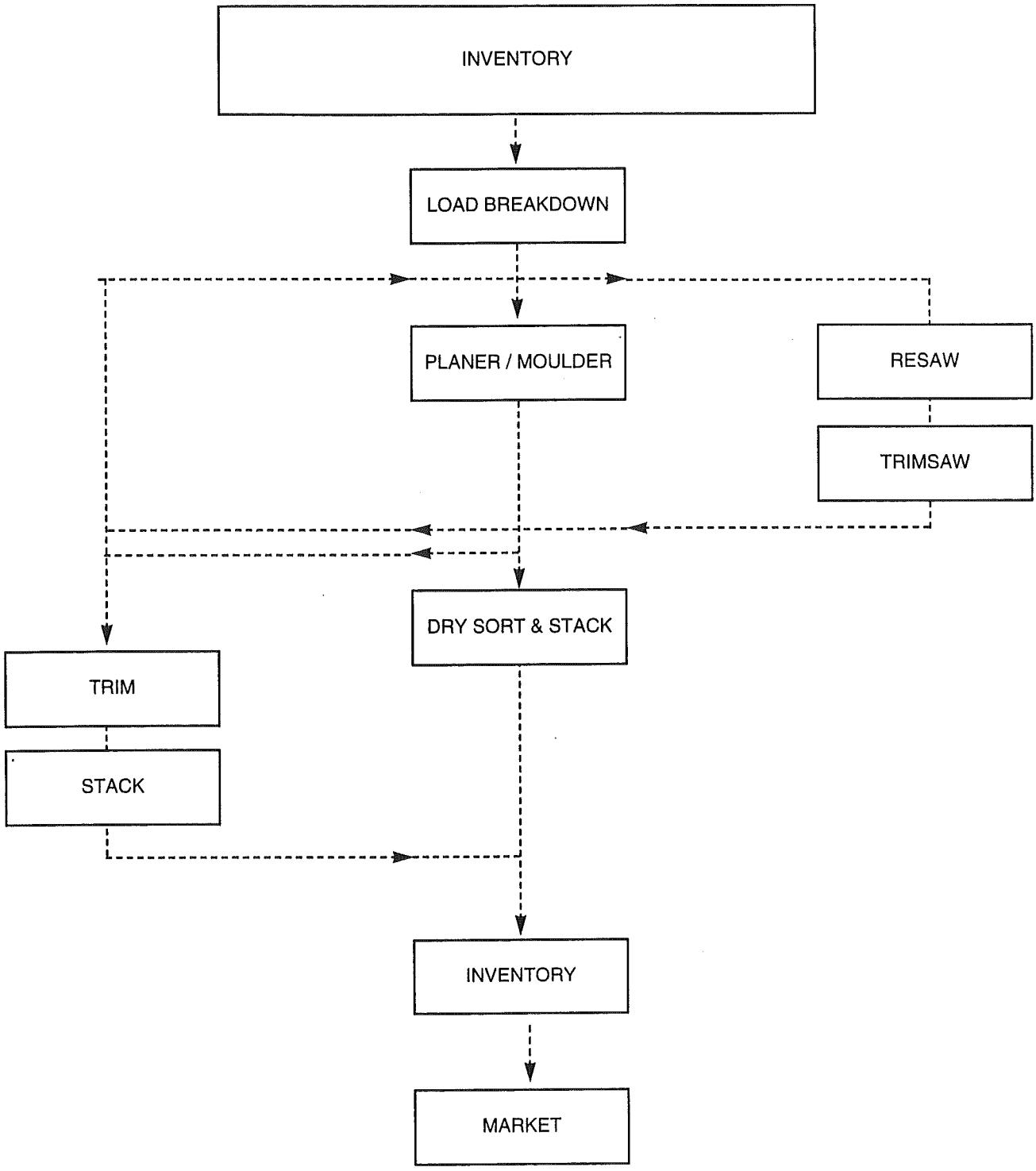
Finished product is strapped and protectively wrapped as appropriate to market requirements, then moved by fork lift to finished goods inventory.

All residuals from the planing and moulding process are recovered by conveyor and air conveyance systems and utilized either as furnish for the MDF plant or as process fuel for the dry kilns or plywood plant.

Diagram 6.4 shows the basic process flow for the paling and moulding plant.

Diagram 6.4

Flow Diagram - Planing and Moulding Plant



6.5 Plywood Plant - 30,000 cubic meters per year output

Logs are delivered to the plywood plant inventory area by front end loader via the coastal barge unloading facility. The same front end loader delivers logs from inventory to the infeed of bucking deck.

Logs are cut to peeler block length using a cross-conveyor cut-off saw. Peeler blocks are conveyed to the Rosser-head debarker, and are debarked. A overhead crane is used to transfer logs to the conditioning vats for heat conditioning, then to return logs to the lathe infeed deck.

The lathe - complete with retractable outer and inner spindles, fast thickness change feature and multiple retractable spurring knives - peels veneer for both face and innerply requirements. Face and other thin veneer is outfed to an automatics reeling system, while thicker "core" veneer is diverted to a lower level conventional green clipping and recovery system. Reeled veneer is stored on bobbins on a two level storage tray system which delivers a continuous ribbon of veneer to each of two screen conveying levels of a three level hot oil heated veneer dryer. Core material is moved from the green chain stackers to temporary inventory, then to the bottom roller deck of the dryer.

Face veneer is clipped for grade and maximum width at the dryer outfeed. Clipped dry veneer from all decks is then placed in temporary inventory.

Veneer is assembled to panels by applying adhesive to both sides of the core stock in a manually fed roller type glue spreader and manual assembly of alternate plies. Packages of uncured assembled panels are then pre-pressed to facilitate press loading, then loaded to a multiple opening hot oil heated hot press where the panels are consolidated and cured.

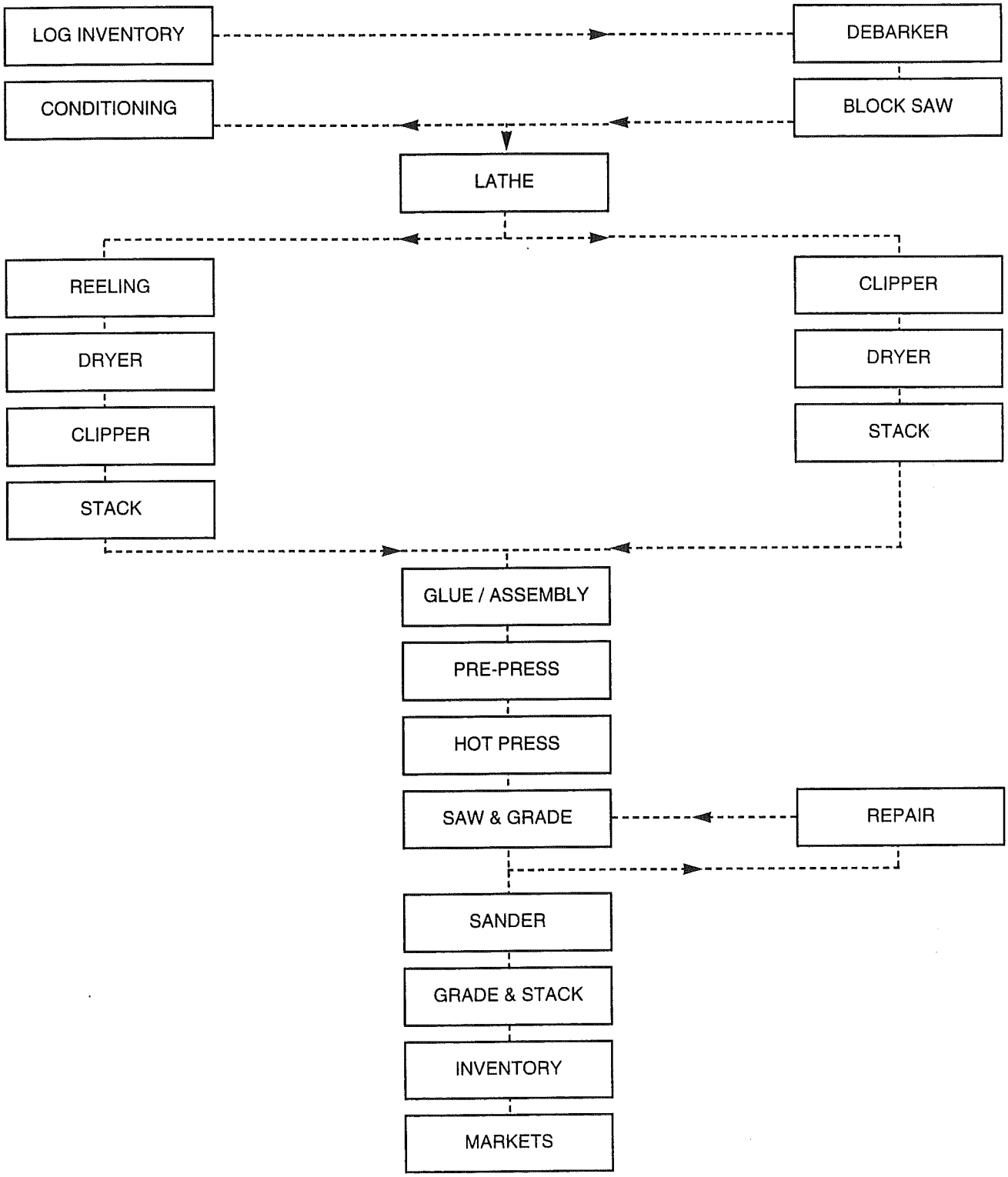
After pressing panels are moved by forklift to a sizing saw where they are cut to finished length and width. Panels then pass a grade line and are separated by potential grade and into those requiring minor repair to retain or upgrade. After grading and repair, panels are sanded, then final graded and/or repaired. Finished panels are then strapped and moved to inventory by fork lift.

All green residues (cores, green veneer waste, block ends, etc.) are conveyed to the MDF plant for consumption as furnish. Bark and dry waste is consumed as process heat fuel in the plywood plant.

Diagram 6.5 shows the general flow pattern of the Plywood plant.

Diagram 6.5

Flow Diagram - Plywood Plant



6.6 Medium Density Fibreboard (MDF) Plant - 30,000 M3/year

Chipped furnish for the MDF plant is delivered by blower systems from the plywood plant, planer mill and sawmill. Solid wood components (cores, low value logs and block ends) are delivered by fork lift to the chipper infeed deck where it is manually debarked then chipped and conveyed to the chip storage pile. Chips are transferred by a bucket equipped front end loader to the chip infeed and washing system (fully enclosed) and from the washing system to the defibrator infeed hopper.

Chips in the infeed hopper a subjected to pre-steaming, then auger conveyed to the vertical preheater of the defibrator where they are subjected to direct steam injection at 10 bars to soften the fibre. From the pre-heater the softened chips are conveyed through the centre of the fixed disc of the attrition defibrator where they are impelled under both pressure and centrifugal action past the pattern discs, reducing the chips to fibre and tracheid bundles.

Fibre exits the defibrator through the blow valve to the air conveyance flash tube dryer. At the blow tube entrance, urea-formaldehyde resin and wax are pressure pump injected. Moisture content of the fibre is reduced to approximately 8%. Dried fibre exits the dryer through a cyclone and rotary valve to the fibre metering bin. From the metering bin, fibre is conveyed to the Pendistor style fibre mat forming station.

Fibre is deposited an vacuum agglomerated to a continuous moving mesh belt, which moves the mat past side deckling panels,
top doffing roll, pre-compactor and flying cut-off saw, thus forming the fibre "lap" (unpressed panel). Laps are conveyed to a press loader, and then into the hot press where laps are consolidated under heat and pressure to form panels. Panels exit the press when cured and are cooled on a star cooler.

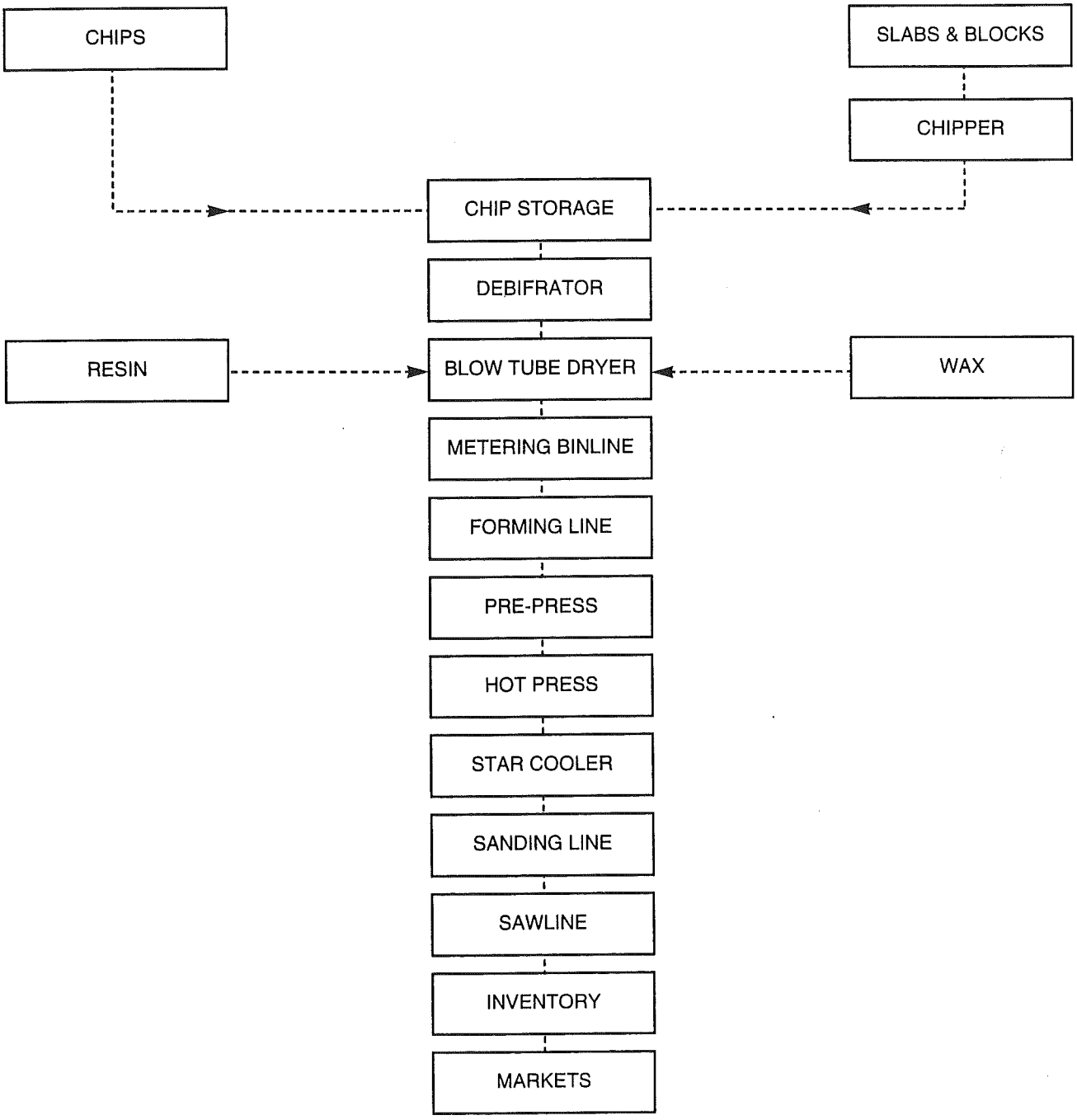
Cured panels are moved by fork lift to inventory or to the sander infeed. At the sander, panels are sanded (both sides) to final calliper and sanding specifications. From the sander outfeed they are conveyed to the saw line infeed and the sizing saw, where rough panels are precision cut to their final specified dimensions. After panel sizing, product is strapped and moved to inventory storage prior to market shipment.

All residuals from the MDF plant, along with a proportionate share of dry residuals from the planermill are converted to heat energy for the process. Electrical energy is drawn from grid power.

Diagram 6.6 presents a flow diagram for the MDF plant process.

Diagram 6.6

Flow Diagram - Medium Density Fibreboard (MDF)



6.7 Walkabout Sawmill (Portable Sawmill) - 1,000 M3/year

The walkabout or portable sawmill is located in a more remote location and is used for processing locally available logs from small permit holders, open log market or from merchantable species felled in the course of shifting agricultural activities. It produces RST in a variety of widths and thicknesses ranging from 25mm x 50mm up to 150mm x 300mm.

The mill is mounted on a wheeled trailer and can be moved from location to location by towing behind a tractor, utility or light truck. It is gasoline or diesel powered direct, hence can be used in the more remote rural locations if desired.

Logs are delivered to the mill infeed by small tractor or other available transport means. Logs of up to 40 cm diameter and 6 meters in length are raised to the carriage bed by means of the mill's self contained power unit. Alternatively, for larger logs (up to 1.5M diameter are rolled to the mill's bed position (dual circular saw configuration only).

Lumber is sawn by either the band mill or dual circular saw by traversing the saw assembly over the length of the log with sawing depth adjusted to the desired cut dimensions. At the end of each sawing cycle, the cut board is manually removed (or ejected for manual removal) for piling prior to transport from the area of the mill to buyer's locations or to other central stocking points.

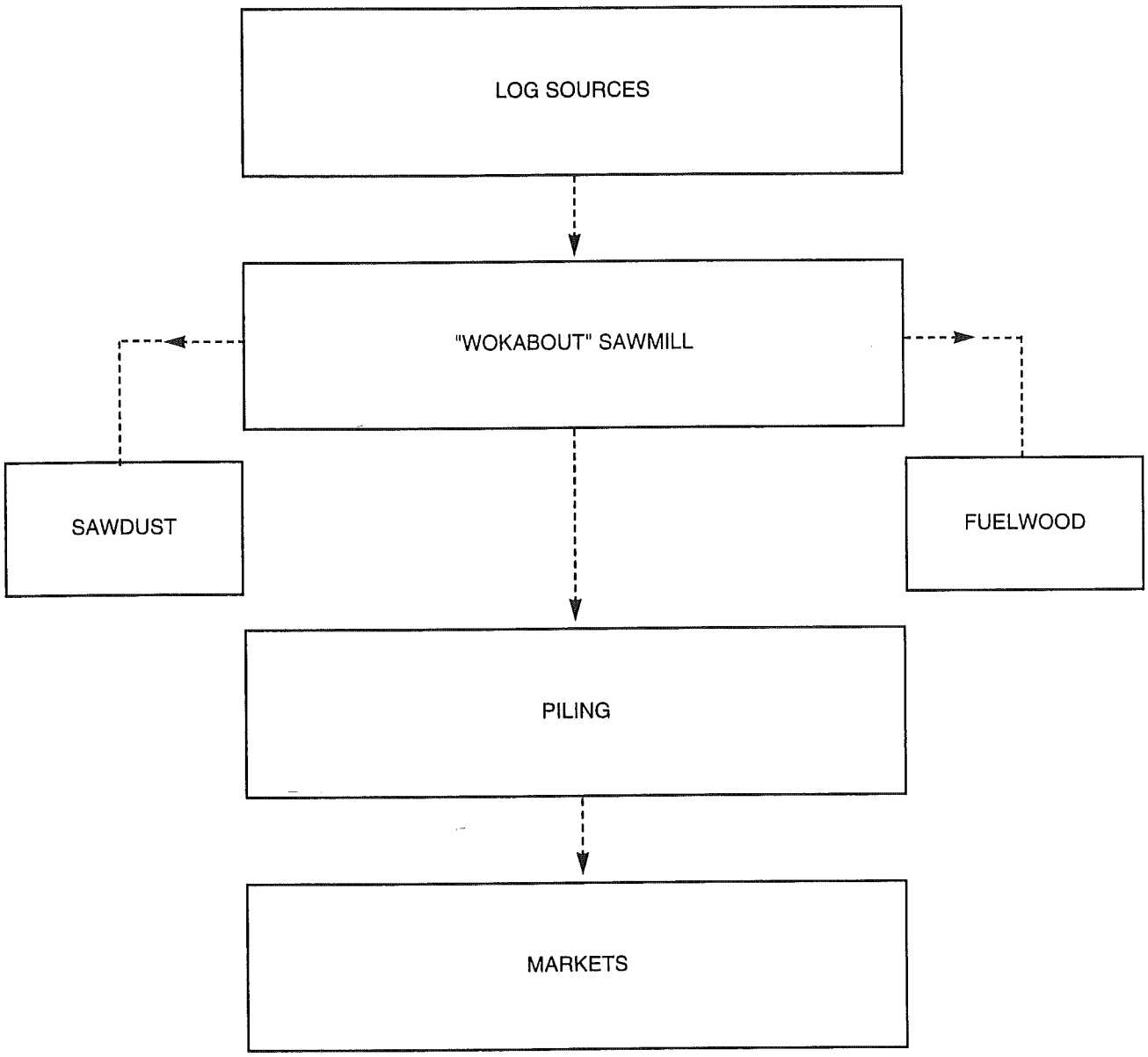
While the mill is primarily configured for production of building supplies for the local market (consisting in large part of the construction of local dwellings, schools, churches, etc), it is equally capable of producing accurately sawn RST from high value species that could be suitable for either direct export or for transport to other value added facilities for further processing.

Slabs and edgings, along with unusable lumber pieces are utilized in the immediate community for fuelwood. Sawdust is either collected for use in agricultural applications or dispersed to the surrounding soil for decomposition.

Diagram 6.7 presents a flow diagram for the walkabout sawmill.

Diagram 6.7

Flow Diagram - "Wokabout" Sawmill



7. ANALYSIS OF OPTIONS

For each of the processing options as described in section 6.0, a "Lotus 123" multiple spread sheet model has been developed. Prints of the mill models are contained in Appendix 5 and a disk copy of the program is an integral part of this report. The models are complete with a pro-forma projection of profitability as based on capital and operation costs as estimated and described in section 4.0. For each of the options as examined, the following ratios have been developed on the basis of pre-tax earnings:

- Return On Investment (ROI) on cash flow
- ROI on Operating Income
- Payback on cash flow
- Payback on operating income
- Internal rate of return.

In addition to the foregoing, for each of the options the following key indicators have been extracted:

- Capital cost
- Solid Wood Equivalent input (SWE)
- Numbers of employees
- Jobs per 1000 cubic meters of input
- Pre-tax operating profit per cubic meter of input.

For each of the modelled mill options, the summary of key indicators and ratios ensue.

7.1 Base Cases

A) SATELLITE SAWMILL - 9,000 cubic meters/year output

Capital Cost:	$US 1.043 million
Input (SWE):	18,563 M3/annum - log form
Output:	9,000 M3/annum
Number of Employees:	27
Jobs/1000 m3 of Input:	1.45
Operating profit /M3 of Input:	$US 31.3
ROI on Operating Income:	45.41 %
ROI on Cash Flow:	55.41 %
Payback on Operating Income:	2.2 yrs.
Payback on Cash Flow:	1.8 yrs.
IRR:	21.25 %

B) CENTRALIZED SAWMILL - 60,000 cubic meters/year output

Capital Cost:	$US 9.906 Million
Input (SWE):	122,969 M3/Annum - log form
Output:	60,000 M3/Annum
Number of Employees:	138
Jobs/1000 M3 of Input:	1.12
Operating Profit/M3 of Input:	$US 54.79
ROI on Operating Income:	58.02 %
ROI on Cash Flow:	68.02 %
Payback on Operating Income:	1.7 yrs.
Payback on Cash Flow:	1.5 yrs.
IRR:	28.44 %

C) DRY KILNS & TREATING PLANT - 90,000 cubic meters/year output

Capital Cost:	$US 4.043 Million
Input (SWE):	90,000 M3/Annum - RST
Output:	90,000 M3/Annum
Number of Employees:	70
Jobs/1000 M3 of Input:	0.37 (based on 48% recovery)
Operating Profit/M3 of Input:	$US 25.54 (sawnwood input)
ROI on Operating Income:	46.87 %
ROI on Cash Flow:	56.87 %
Payback on Operating Income:	2.1 yrs.
Payback on Cash Flow:	1.8 yrs.
IRR:	19.18 %

D) PLANER/MOULDER PLANT- 90,000 cubic meters/year output

Capital Cost:	$US 1.885 Million
Input (SWE):	90,000 M3/Annum - RST & KD Lumber
Output:	90,000 M3/Annum
Number of Employees:	56
Jobs/1000 M3 of Input:	0.30 (based on 48% recovery)
Operating Profit/M3 of Input:	$US 42.14 (sawnwood input)
ROI on Operating Income:	191.23 %
ROI on Cash Flow:	201.23 %
Payback on Operating Income:	0.5 yrs.
Payback on Cash Flow:	0.5 yrs.
IRR:	89.94 %

E) INTEGRATED COMPLEX - Sawmill, Dry Kilns, Treating, Planer/Moulder

Capital Cost:	$US 15.833 Million
Input (SWE):	187,500 M3/Annum
Output:	60,000M3/RST,90,000,M3/ KD,90,000 M3/Plywood
Number of Employees:	264
Jobs/1000 M3 of Input:	1.40 (based on 48% recovery)
Operating Profit/M3 of Input:	$US 68.43
ROI on Operating Income:	71.03 %
ROI on Cash Flow:	81.03 %
Payback on Operating Income:	1.4 yrs.
Payback on Cash Flow:	1.2 yrs.
IRR:	35.92 %

F) PLYWOOD PLANT - 30,000 cubic meters/year output

Capital Cost:	$US 16.844 Million
Input (SWE):	62,882 M3/Annum
Output:	30,000 M3/Annum
Number of Employees:	199
Jobs/1000 M3 of Input:	3.16
Operating Profit/M3 of Input:	$US 111.48
ROI on Operating Income:	31.62 %
ROI on Cash Flow:	41.62 %
Payback on Operating Income:	3.2 yrs.
Payback on Cash Flow:	2.4 yrs.
IRR:	18.90 %

G) MEDIUM DENSITY FIBREBOARD PLANT - 30,000 M3/ year output

Capital Cost:	$US 21.914 Million
Input (SWE):	56,320 M3/Annum
Output:	30,000 M3/Annum
Number of Employees:	98
Jobs/1000 M3 of Input:	1.74
Operating Profit/M3 of Input:	$US 94.53
ROI on Operating Income:	14.30 %
ROI on Cash Flow:	24.30 %
Payback on Operating Income:	7.0 yrs.
Payback on Cash Flow:	4.1 yrs.
IRR:	3.81 %

H) WALKABOUT SAWMILL - 1,000 cubic meters/year output

Capital Cost:	$US 47 Thousand
Input (SWE):	1667 M3/Annum
Output:	500 M3/Annum
Number of Employees:	10
Jobs/1000 M3 of Input:	6.0
Operating Profit/M3 of Input:	$US 31.19
ROI on Operating Income:	negative
ROI on Cash Flow:	negative
Payback on Operating Income:	N/A
Payback on Cash Flow:	N/A
IRR:	N/A

7.2 Sensitivity Analysis

For each of the major cases foregoing - the centralized sawmill, dry kiln/treating plant and planer/mouder plant has been consolidated - an analysis of sensitivity has been undertaken at two variants from the base case.

Variant 1 : Costs increased by 10% and sales increased by 10%

Variant 2 : Costs decreased by 10% and sales increased by 10%

A full analysis of these is contained in Appendix 6. It is to be noted that in the analysis of sensitivity, the capital costs and their associated depreciations have not been varied as function of cost, i.e. these have been kept constant in each of the variants for both cases.

Considering only one of the indicator factors of investment opportunity - Payback on Cash Flow - Table 7.1 lists the effect of selected cost and selling price fluctuation for each major case.

Table 7.1

Sensitivity to Cost and Revenue Fluctuation
Payback on Cash Flow

Option/Plant		Base case	Payback - Years Cost Up Sales Down (10%)	Cost Down Sales Up (10%)
A.	Satellite Sawmills	1.8	8.9	1.0
B-E.	Central Comlex (consolidated)	1.2	neg.	0.5
F.	Plywood	2.4	4.7	1.6
G.	M.D.F.	4.1	5.8	3.2
H.	"Wokabout"	neg.	neg. -0.6	neg. -2.1

Discussion of and recommendations resulting from these analyses is contained in section 8 following.

8. DISCUSSION AND RECOMMENDATIONS

It is apparent that a variety of processing plants may be justified for installation in PNG in order to:

- Improve utilization (recovery) of roundwood
- Fully serve domestic markets
- Access and serve export markets
- Increase domestic employment
- Ensure appropriate financial returns to the country.

Of the plant types examined, attractive returns can be secured from the following plant types:

- Satellite sawmills
- Centralized sawmills including sawnwood production dry kilning, pressure and diffusion dip treating, planing an moulding
- Plywood plants
- MDF production.

"Wokabout" or portable sawmills do not offer attractive financial returns, even when logs are supplied to the mills at less than the cost of minimum stumpage plus harvesting and delivery. They may, however, have some benefit as social projects in specific locations where other sawnwood supply is problematic.

The sizes (capacity) of mills suggested in this evaluation and the number of such mills in associated locations should be considered in a flexible manner. The mill sizes used in this study are considered to be "minimum economic scale". In site-specific detailed studies, other mill capacities may be considered. Should individual mill size be increased, in spite of increased capacity cost, it may be expected that efficiencies of scale will be realized and that cost of conversion and cost of sales will both decrease, with a consequent increase in profitability ratios.

Existing mills within the industry should be brought up to standards approximating those envisaged in this study series with respect to recovery, waste (by product) utilization/disposal, worker safety and relative man-hour productivity. Minimal recovery standards for the conversion industry should be established on a "phase in" basis in order to permit rational improvement of those existing mills that are salvable within the context of modern milling practices.

Existing mills that are unable to conform to reasonable standards for conversion, safety and environmental acceptability should be closed and replaced with competitive operations than can comply.

APPENDIX 1

GLOSSARY OF TERMS & ABBREVIATIONS

GLOSSARY OF TERMS, ABBREVIATIONS & SYMBOLS

Annum	Year or yearly
Cap.	Capacity
CCA	Chromated Cuprous Arsenate
cm	Centimetre
Co.	Company
Corp.	Corporation
c/w	Complete with
DBH	Diameter at Breast Height
Dev.	Development
e.g.	For example
ELCOM	Electricity Commission of Papua New Guinea
Exp.	Export
FBM	Foot, Board Measure
Ft.	Feet
FOB	Free or Freight, on board
Furn.	Furnish or Furniture
i.e	That is
IRR	Internal Rate of Return
K	Kina
KD	Kiln dried
KDRST	Kiln dried rough sawn timber
Kg.	Kilogram
KVA	Kilovolt amperes
L. Hand	Left Hand
Loc.	Domestic
M	Meter
M3	Cubic Meter(s)
mm	Millimetre
MDF	Medium Density Fibreboard
MFBM	Thousand Feet, Board Measure
MMFBM	Million Feet, Board Measure
MOF	Ministry of Forests
MSF	Thousand Square Feet
MSM	Thousand Surface (feet) Measure
N/A	Not Applicable or Not Available
NMR	Net Mill Return
O.S.B.	Oriented Strand Board
PNG	Papua New Guinea
p.s.i.g.	Pounds per square inch, guage (pressure)
PT	Pressure treated
PTRST	Pressure treated rough sawn timber

R. Hand	Right Hand
ROI	Return on Investment
RST	Rough sawn timber
Sm.	Sawmill
S.W.E.	Solid Wood Equivalent
Tr.	Transfer
U.S.	United States
U.S.A.	United States of America
Ven.	Veneer
$	Dollars
$000	Thousands of Dollars
$US	United States Dollars
/	Per
%	Percent
'	Foot (feet)
"	Inch (inches)

APPENDIX 2

SUMMARY OF LOG PRODUCTION, EXPORT AND APPARENT DOMESTIC CONSUMPTION

APPENDIX 2 9303LH.WK3

FOREST INDUSTRY DEVELOPMENT STUDY
PAPUA NEW GUINEA

LOG PRODUCTION, EXPORT AND APPARENT DOMESTIC CONSUMPTION
1971-1992

YEAR	PRODUCTION 000 M3	EXPORT LOGS 000M3	APPARENT DOMESTIC CONSUMPTION 000M3	DOMESTIC CONS. %
1971	870	409	461	52.99%
1972	699	425	274	39.20%
1973	983	655	328	33.37%
1974	804	383	421	52.36%
1975	918	370	548	59.69%
1976	1010	449	561	55.54%
1977	1114	402	712	63.9[illegible]%
1978	894	445	449	50.22%
1979	909	473	436	47.96%
1980	1218	642	576	47.29%
1981	1304	743	561	43.02%
1982	1487	1063	424	28.51%
1983	1872	1019	853	45.57%
1984	1558	1284	274	17.59%
1985	1878	1053	825	43.93%
1986	1719	1280	439	25.54%
1987	2203	1442	761	34.54%
1988	1812	1174	638	35.21%
1989	1693	1259	434	25.63%
1990	1488	1002	486	32.66%
1991	1598	1361	237	14.81%
1992	N/A	N/A	N/A	N/A

N/A = NOT AVAILABLE (DATA INCOMPLETE)

SOURCE: PNG FOREST REVENUE & FINANCIAL STUDY
NOVEMBER 1991
DEPARTMENT OF FORESTS, PNG

APPENDIX 2 9303LH.WK3

FOREST INDUSTRY DEVELOPMENT STUDY
PAPUA NEW GUINEA

LOG PRODUCTION AND EXPORT BY PROVINCE
1991-1992

PROVINCE	1991 SCALE M3	1991 EXPORT M3	1992 SCALE M3	1992 EXPORT M3
WESTERN PROVINCE				
Monford Catholic Misssion	233	0		
Forest Management Services	8986	0		
Wawood P/L	0			
West Papuan Timbers P/L	0			
Asian Pacific Christian Mission	0			
Tabutil Engineering P/L	62	0		
Wawoi Guavi Timber Company	277381	247300	246673	284
Pisi Sawmill P/L	0			
O K Menga Sawmill	0			
Agrim Sawmill	0			
TOTAL - WESTERN PROVINCE	286662	247300	246673	284
GULF PROVINCE				
Turama Forest Industries P/L	60623	97100	92893	133
Shisie Enterprises P/L	10437	0	6240	17
Delta Stores	0			
Lavera Traders	0			
Rimbunan Hijau	0			
Bairmuru Sawmilling	0			
Ahia Development P/L	0			
Catholic Mission - Tepapo	0			
Moveave Sawmill	0			
S.T.C. Ltd.	0			
ERA Sawmill	0			
TOTAL - GULF PROVINCE	71060	97100	99133	149
MANUS PROVINCE				
Kei Besseu Company P/L	29200	22000	31154	34
Monarch Investment (Jaha Dev. Corp.)	4850		17178	23
Kuriti Development	0			
Atouri-Kei Sawmill	0			
Kuriti Development Company	0			
Rossun Sawmill Group	0			
TOTAL - GULF PROVINCE	34050	22000	48332	57
NEW IRELAND PROVINCE				
Tasukolek P/L	2960	8300	0	3
Leytrac P/L	0			
Tezrac Development Corp.	0			
Nussau Timbers	0			
Mamirum Timbers P/L	0			

Timbers (PNG) P/L	2342			
Lenai Development Corp.	0			
New Ireland Otsuka Development	0			
Danfu Logging and Agric. Development	0			
New Ireland Enterprises P/L	0			
Matimba Development Corporation	0			
Channel Timbers	0			
Kotamanse Logging P/L	0			
Saki Management P/L	0			
Brothers Logging	0			
Bopire Plantation	0			
Patpatar Enterprises P/L	0			
Daha Na Malit P/L	0			
Timber Sales	0			
Nakmai Co. P/L	0			
Sopathian Development		17600		9500
Nation Wide Consultants P/L	0			
Djaul Development	0			
New Ireland Industries	0			
Swas Enterprises P/L	0			
Kaut Co. P/L	0			
M.W. Dunn	0			
Sopitan	0			
Komale P/L	0			
Senmibra P/L	0			
Lombda P/L	0			
Niugini Lumber P/L	0			
????	0			
TOTAL - NEW IRELAND PROVINCE	5302	25900	0	12500
E. SEPIC PROVINCE				
Assemblies of God Sawmill	0			
Angoram Sawmill	0			
Ambunti Sawmill	0			
Soverign Hills (PNG) P/L	0			
TOTAL - E. SEPIC PROVINCE	0	0	0	0
W.H. PROVINCE				
W.R. Carpenters & Co Estates	0			
Jimi Holdings	0			
Western Highlands Timber Bus/Kokombo	0			
Glen Eildon Timber P/L	0			
Warren Plantation P/L	0			
Koban Plantation	0			
N.G. Development	0			
Mamgogl P/L	0			
Kimil Sawmill	0			
TOTAL - W.H. PROVINCE	0	0	0	0
ENGA PROVINCE				
Meriamanda Sawmill	502			
Wanepop Sawmill	0			

TOTAL - ENGA PROVINCE	502	0	0	
E. HIGHLANDS PROVINCE				
Eastern Highlands Timbers P/L	0			
Highlands Christian Mission	0			
Swiss Evangelical Broth. - Kassam	0			
Marey Investment P/L	0			
Lapegu Forest Products	0			
Merv W. Dunn Sawmill	0			
K.S.S. Sawmill	0			
TOTAL - E. HIGHLANDS PROVINCE	0	0	0	
S. HIGHLANDS PROVINCE				
Beechwood P/L	10455		0	
Lama Sawmilling P/L	0			
Baptist Mission - Tari	0			
Asian Pacific Mission - Tari	0			
Menduli Sawmill P/L	0			
Christian Mission - Mendi	0			
Wapii Timbers P/L	0			
Bible Mission Church - Kagua	0			
Catholic Mission - Tari	0			
Evangelical Wesleyan Mission - Kagua	0			
Det Sawmill	0			
Fuga Wesleyan Mission - Koroba	0			
Erave Vocational Center	0			
TOTAL - S. HIGHLANDS PROVINCE	10455	0	0	
NORTHERN PROVINCE /				
Kumusi Timber Co.	3741			
Ambogo Sawmill P/L	0	21400	0	317
Collingwod Bay ??.	0			
Dewai Resources P/L	5678	5200		
Yema Gaiepa ??	0			
TOTAL - NORTHERN PROVINCE	9419	26600	0	317
MILNE BAY PROVINCE				
Milne Bay Logging (WIDCO)	12730	6200	0	30
Ulabo Timber Co.	34013	33900	0	47
Saban Investment/Suau Investment P/L	0	0	0	242
Saliba Slipway	0			
Nauwa Enterprises	0			
Sanacthum Group Holdings	0			
Maideba Sawmill	0			
Sidea Sawmill	0			
Gem Business Group	0			
TOTAL - MILNE BAY PROVINCE	46743	40100	0	31
WEST SEPIK PROVINCE				
Varimo Timber Company P/L	101217	71600	102000	73
Dept. of Works	0			
W.T.A. Realty P/L	25900	15800	54200	36

West Sepic Dev. Corp.	0			
Community Based Building Proramme.	0			
TOTAL - WEST SEPIC PROVINCE	127117	87400	156200	109500
MADANG PROVINCE				
Jant P/L	128066		49456	
Wewak Timbers P/L / Madang Timb. P/L	25445	9300	11406	6000
Catholic Mission/ Holy Ghost (Utu)	0			
Uligan Development Corp.	0			
Yoro Sawmill	0			
Kosmo Resources (Cancelled)	0			
Rossun Sawmill Group	0			
TOTAL - MADANG PROVINCE	153511	9300	60862	6000
WEST N.B. PROVINCE				
Stettin Bay Lumber Company	190814	164534	260477	232721
Shin Ashigawa	45379	39804	33786	30111
Catholic Mission - Ulamona	33394	11866	33888	20532
Nam Yang Timber Company	81013	77841	70260	60206
Cakara Alam (PNG) P/L	28782	6458	77583	73030
WTK Realty (GR Logging)	75916	37986	90202	91142
Fonsen (G.R. Logging)	121300	124384	200133	155262
Monarch Investments	62397	74444	68044	60309
Peninsula Logging Company	0			
Lolobau Dev. Co. P/L	0			
Kulu Lumber	0			
Timbers (PNG) P/L	0	0	50178	43710
Island Forest Resources	1476	0	64007	54461
?????	0			
TOTAL - WEST N.B. PROVINCE	640471	537317	948558	821484
EAST N.B. PROVINCE				
Open Bay Timber Company	89906	81800	39698	83800
Vudal Timbers P/L	0			
R.K. Gault Industries	5371	4200	2143	3200
Timbersales/Gaulim Logging Corp.	0			
Central Pomio Logging Corporation	0			
Teperoi Timbers P/L	3473	0	1020	0
Bismark Industries	18276	26900	0	5400
Niugini Lumber P/L	0	0	30694	21300
Paimalmal Investment P/L	9749	7500	3592	6300
Taraiwara P/L	9504	7200	657	3300
Levtrac P/L(New Brittain Hardwds)	0	0	1527	0
South Coast Logging	0			
Austin and McCarthy	0			
PNG Electricity Commission	0			
Roman Catholic (Ulomona??)	0	2600	0	0
?? Usevit Notremal Plantation	0			
?? Doilene Plantation	0			
Santrans P/L	0			
Weyco P/L	0			
Barakopo P/L	0			
Parparatava Dev.	0			

Payne & Chipper	0			
TOTAL - EAST N.B. PROVINCE	136279	130200	79331	1233
CENTRAL PROVINCE				
Sabusa S/M Laki Trading, Katundra	5353	0	0	
Goodwood P/L	0			
Pacific Timbers, ANG, McDuhi, etc.	0	0	8416	189
Angus, Santa, Maisi Trust P/L	22351	21700	17529	183
Brown River Timber Company	0			
Koneri Development, Pac. Logging	0	0	1226	
Koiari Timber Company	0			
Kuriva Timber Company	0			
Rimbunan Hijau/Magarida Timbers	11387	104500	86801	890
Abau Timbers (Rimbunan Hijau)	0			
Hugo Sawmilling P/L (Sup. Tropical)	0			
A.A.K. Investment	0			
Wooden Pole Supplies (F.J. Carriage)	11	0	31	
Amozon Bay S/M + Timber	0			
Magi Wopten Dev. P/L	0			
Tahira Holding P/L	0			
T.L. Investment/ Hugo Sawmilling	0			
Marara P/L	0			
TOTAL - CENTRAL PROVINCE	39102	126200	114003	1262
MOROBE PROVINCE				
PNG F.P P/L, Comm,So. Pac., et al.	24502	0	0	
Putput Logging P/L	0	0	0	669
P.I. Logging P/L	53			
TPMC P/L	12842	12000	0	177
RARS P/L	0			
FCK P/L	0			
RMA P/L	0			
Goala Logging P/L	0			
Kumbim Timbers	0			
Salvation Army Hostel	0			
Low Impact	0	0	0	301
TPMC	0			
Monarch Investment	0			
TOTAL - MOROBE PROVINCE	37397	12000	0	1147
TOTAL - ALL PROVINCES	1598070	1361417	1753092	1869

APPENDIX 3

PAPUA NEW GUINEA WOOD SPECIES

APPENDIX 3 93038PU.WK1
TABLE

PAPUA NEW GUINEA - WOOD SPECIES & UTILIZATION

LOCAL NAME	SCIENTIFIC NAME	USES
Aglaia	Chukrasia	sliced veneer, sawnwood, fine cabinetry
Amberoi	Pterocymbium	veneer, plywood, sawnwood carpentry & joinery
Amoora	Amoora	sawnwood, cabinetry, fine carpentr gunstocks
Antiaris	Antiatis	rotary veneer, plywood,sawnwood
Baswood	Endospemum	sliced or rotary veneer, sawnwood, carpentry, joinery
Blackbean	Castanospermum	rotary veneer, plywood,sawnwood fine cabinetry
Erima	Octomeles	sliced & rotary veneer, plywood, sawnwood, mouldings
Ebony	Diospyros	carving, musical instruments
Gluta	Melanorrhoea	sawnwood, furniture, turnery, wood carvings
Hoop	Auraucaria	rotary veneer, plywood, battery separators, sawnwood
Kalofilum	Calophyllum	sawnwood, furniture, sliced veneer,naval costruction
Kampas	Koompassia	sliced veneer, sawnwood, rail ties parquet, bridge construction
Kanerere	Eucalyptus deglupta	sawnwood, pulp chips, general carpentry, flooring
Kauri	Agathis	sliced or rotary veneer, plywood, sawnwood, exterior carpentry
Klinki pine	Araucaria	rotary veneer, plywood, sawnwood general carpentry
Kwila	Intsia	sliced & rotary veneer,sawnwood, parquet, rail ties, bridges

WOOD SPECIES AND USES (CONTINUED)

TRADE NAME	BOTANICAL NAME	USES
Light celtis	Celtis	sawnwood, parquet, cabinetry
Malas	Homalium	sawnwood, heavy construction
Mersawa	Anisoptera	sliced or rotary veneer, plywood sawnwood, parquet
Mixed Red		rotary veneer, plywood, sawnwood carpentry & cabinetry
Nyatoh	Burkella	sawnwood, fine carpentry
Pencil Cedar	Palaquium	sawnwood, fine applications
Pink Satinwood	Buchanania	sliced veneer, sawnwood, finee furniture
Podocarps	Podocarpus	sliced & rotary veneer, plywood
Red Canarium	Canarium	rotary veneer, plywood
Red Cedar	Toona	sliced veneer, fine plywood, furniture, cigar boxes
Red Planchonella	Planchonella	veneer, plywood, sawnwood, general light construction
Rosewood	Dysoxylum	sawnwood, fine furniture & mould
Sandalwood	Santalum	sliced veneer, fine cabinetry, ? perfumes (oil)
Silkwood	Flindersia	sliced & rotary veneer, sawnwood fine cabinetry, gunstocks
Simpoh	Dillenia	rotary veneer, plywood, sawnwood general construction
Teak	Tectona	sliced & rotary veneer, sawnwood flooring, boatbuilding, flooring
Terminalia	Terminalia	sawnwood, exterior costruction
Taun	Pometia	sawnwood, turnery, fine cabinetr tool manufacture
Vitex	Vitex	sawnwood, heavy construction

WOOD SPECIES AND UTILIZATIONS (CONTINUED)

TRADE NAME	BOTANICAL NAME	USES
Walnut	Dracontomelum spp.	sliced veneer, sawnwood, fine carpentry
Water gum	Syzygium	sawnwood, mouldings, cross arms,
Waubeech	Nothofagus	sawnwood, general construction joinery, turnery

Reference Sources:

Commercial Timbers of Papua New Guinea
Bois Tropicaux

APPENDIX 4

DESCRIPTION OF PROPOSED PROCESSING PLANTS

PROJECT CONCEPTS

If is proposed to provide a modern integrated timber manufacture facility to efficiently convert the indigenous mixed species hardwood timber to meet the increasing demand and needs of the export market as well as the domestic wood utilizing sectors of the industry. The objective shall be to optimize the return from each cubic metre of raw material consumed. By converting into "value added" products.

To attain this objective, it will be necessary to combine the correct facilities in order to obtain the highest, rough sawn, timber recovery possible from the timber converted, with practical considerations for both volume and quality yield. A central integrated sawmill and panelboard mill will provide the base from which to meet the above criteria. Such a installation is both feasible and viable as the panelboard plant will utilize the solid wood waste from the sawmill that would otherwise be directed to incineration.

Secondary manufacturing including select kiln dried lumber, value-added products, furniture component parts "pre-cut" and "pre-fabricated" housing, etc. is included in the basic overall design and layout of the sawmill and panelboard plant. Primary breakdown in satellite operation location adjacent to the log assembly points in the wood will supply a considerable volume in accurately sawn rough green lumber. It is further proposed to introduce what can be described as "medium tech" process with "state-of-the-art" equipment rather than the very latest so-called "high-tech". The equipment is specified and selected so that it can be up-graded at a minimum of cost as the "learning curve" is completed and additional investment justified.

PROCESS AND MAJOR EQUIPMENT

1. Log Yard, Barking and Bucking

a. Process

Logs are delivered to the mill log yard and received by the log yard receiver and checked for "log count tally". The grapple Log Loader unloads logs from the truck and places directly to the barker Infeed Deck or to storage. The log yard will have area sufficient to store a minimum of one month's supply to minimize both quality and volume. Log falling and delivery will be pre-programmed so that log storage is kept at a minimum, in sufficient inventory only to accommodate interruptions in delivery.

"Log-stop and loader" feeds full length logs into the Barker Infeed Conveyor and then through the Ring Barker. Oversize (diameter) logs are "hand barked" in the yard. If necessary, logs with excessive "crook" or "bow" will be bucked by hand chain saw on the log deck to facilitate barking and to maximize recovery.

"Log lifters" or "kickers" in the Barker Outfield Conveyor transfer bark free logs to the Bucking Saw Infeed Deck. Log-stop and loader in infeed deck transfers the log to the Bucking Saw Infeed Conveyor. Depending on log form (bow, twist, diameter), the log is bucked to lengths, minimum 2.4 m (8 ft.) to maximum 6.6 m (22 ft.) in order to maximize lumber recovery. This is done by means of either a Circular Cut-off Saw for the smaller diameter logs or a Deck-Mounted Chain Saw for the larger diameter logs. Log scale is recorded after bucking.

A combination of stops and log clamps at the bucking station and Bucking Saw Outfeed Conveyor will provide the capability to

"precision buck" logs for both length and squareness in order to minimize trimming necessary after sawing, and thus to further increase overall recovery.

Log lifters or kickers in the bucking saw outfeed conveyor transfers logs to either "small log" or "larger log" transfer decks to "log edger" or log carriage.

b. Major Equipment

Grapple Log Loader

- Equivalent to Cat 966 log loader
- Automatic fork controls adjustable kickout for lift height and time position
- Rubber tired
- c/w lumber forks option

Barker Infeed Deck

- Handle minimum log length of 2.4 m (8 ft.) to maximum of 12.5 m (40 ft.)
- Handle minimum log diameter of 40 cm (16" to maximum 100 cm (40")
- Log-stop and loader
- 7 - strand transfer deck

Barker Infeed Conveyor

- Chain c/w flights
- Reversible

Ring Barker

- Capacity - minimum 40 cm (16" diameter logs to maximum 100 cm (40")
- Hold downs and centering drives
- Lubricators

Barker Outfeed Conveyor

. Chain c/w flights
. Log lifters or kickers to bucking saw infeed deck

Bucking Saw Infeed Deck

. Gravity
. c/w log-stop and loader
. Chain c/w flights
. Reversible

Bucking Saw Station

. Circular cut-off saw for smaller diameter logs
. Deck-mounted chain saw for larger diameter logs- maximum 105 cm
. c/w positive length stops and clamps
. Chains c/w flights

Bucking Saw Outfeed Conveyor

. Chain c/w flights
. Dual set log lifts or kickers

2. Sawmill (Sawing, edging and trimming operations)

a. Process

For mill design input capacity of 125,000 m3/year (500 m3/ 8 hour shift) at 48% recovery if 60,000 m3/year or 240 m3/ 8 hour shift, a sawmill consisting of two distinct lines is proposed.

- A log carriage and band head saw for the larger diameter logs, and
- A twin saw log-edger (2 saw scrag) line for the smaller diameter logs.

It is noted that, with the exception of the very small and the very large diameter logs, the intermediate range of diameters (which is a major part) can be efficiently sawn by either line. Fast acting "set works" on both primary breakdown machines makes this possible. This, therefore, for a shift capacity of up to 250 m3/shift, precludes the necessity of sorting logs to close diameter categories with very significant savings in labour and machine costs in the log yard department, as well as saving yard space.

Further, it is very evident that, due to whatever conditions, "timber bind" is significant. Past experience confirms that this timber bind is more prevalent in the "younger" and smaller diameter logs than in the more mature and larger diameter logs. Therefore, in order to obtain "straight" cants (the slabs will bow, but can be sawn to uniform thickness through the resaw), the stresses inherent in the log and released by the saw cuts must be released simultaneously and in balance. The two saw scrag (log edger) does this most efficiently.

Being able to divert a large majority of this intermediate range of logs to either line is an important factor. This enables balanced production through both lines with high recovery and maximizes output of sawn timber from the mill on a daily basis, thereby increasing output per man which, in turn, translates into significant savings in labour costs.

Each line will have shifting saw edger and resaw capability with return of slab, cant or board when necessary. Additional edger and resaw capacity is provided (accessible to either of the two lines) in order to ensure over-capacity in this remanufacturing and critical recovery area.

b. Major Equipment

Log Carriage (large log scale)

- To accommodate logs with minimum diameter of 40 cm (16") to maximum diameter of 100 cm (40"), and minimum length of 2.4 m (8 ft.) to maximum lengths of 6.6 m (22 ft.).
- Four (4) adjustable head blocks appropriately spaced with 3" hand set tapers. Replaceable wear slides. Knees fully adjustable for quick realignment.
- Two (2) log dogs per bunk (drop-hammer parallelogram type). Dog tongs with replaceable wear slides.
- Set works - controlled from sawyer's position, motorized, all mechanical.
- c/w carriage track and carriage drive

Band Head Saw

- Heavy duty, all steel frame, extended columns.
- Minimum 72" diameter wheels to accommodate maximum 105 cm (42") diameter log.
- "High strain" capability of arbours and bearings.
- Automatic tracking and tensioning of saw blades.
- Water/lubricant spray application controllable by sawyer.

"Bull" Edger - two sides

- 10" depth of cut.
- 3 saw shifting one side - 4 saw cluster other side.
- Two speed feed works.
- Power assisted (hydraulic or air) set works.
- Operator to select sets (no scanning - capability to add later).

Log Edger - two saw scrag

. Minimum log diameter 30 cm (12"). Maximum log diameter 60 cm (24").
. Minimum log length 2.4 m (8").
. Twin saw with individual motors.
. Power (hydraulic or air) assisted "fast acting" set works.
. Minimum centre cant setting to 16 cm (4").
. Adjustable saw guides.
. c/w infeed log turning rolls for positioning log ("best opening face") to saws.

Band Resaw line bar. 3 required

. Maximum depth of cut 56 cm (14").
. Hydraulic or air assisted set works.
. Infeed table complete with line bar.
. Provision for "Pre set" selection addition at later date.
. Feed speed, variable to maximum 45 cm/minute (150").

Board Edger

. 3 saws one fixed, two moveable.
. 15 cm (6") depth of cut.
. Working width 60 cm (24") minimum.
. Adjustable straight edge.
. Bottom feed rolls, two in front of saw and two on discharge side, power driven.
. Anti-kickback fingers provided.

Board Unscramble

. Bar type flights
. To handle lumber 1.8 m (6") to maximum 6.6 m (22")
. c/w board pocket
. Air operated single board feeder arms

Two Saw Table Trimmer

- Complete with single board log feeder
- Precision chain strands c/w board lugs
- Motorized saw arbours
- Ending rolls on separate drive
- "Balanced", depressible length markers/stops

MSC, Transfers, Decks, Roll Cases and Conveyors

- As necessary to convey lumber between the various production machines and facilitate interchange for efficient production.

3. Rough Sawn Lumber Sorting, Stickering and Yard Storage

a. Process

Rough sawn lumber from the mill and from satellite operation is sorted for thickness (necessary for efficient drying) and for combined length classifications. All lengths, thicknesses and widths 0.9 m (3 ft.) to 2.7 m (8.8 ft.), will be directed to a short green chain for sorting into width and grouped length categories. Each category will be stickered by the green chain pullers as it is pulled from the chain and built on lumber pull-off carts into loads suitable for lift truck handling and kiln acceptance without further man handling. These loads are then transferred to storage to air dry or directly to kiln charge.

Similarly to the short lengths, all lengths from 3.0 m (9.8 ft.) to 6.6 m (21.6 ft.) are directed to edge sorter that will drop sort mechanically for thickness and grouped length categories. Teams of two men (one each end of piece) will build and sticker loads to pre-determined width and height suitable for kiln truck handling and kiln charge. These loads are built parallel to edge sorter and do not require lumber pull-off carts to permit access by lift truck, as in the case of the green

chain. Completed stickered load is transferred by lift truck directly to kiln charge or to storage, or air dry sheds.

As a rule, the manpower required for sorting on the edge sorter is less than it is for the green chain, as each pair will handle more than one sort. In addition, stickering is much lighter work, especially in the longer lengths, as all pieces are handled simultaneously from each end.

b. Major Equipment

Dip Tank

- Steel contruction
- "Make-up" tank complete with circulating pump to transfer solution to dip tank.
- Indicators and testing equipment to maintain necessary effective chemical concentration.
- "Hold-down" drum to ensure full immersion of each piece of lumber.

Edge Sorter - double sided, multiple sorts

- 4" wide belts, individual drives
- Each sort has shear bars and board skid panels to manual stacking bunks.
- Mechanically operated shear arms.
- To handle lumber lengths minimum 3.0 m (9.8 ft.) to maximum 6.6 m (21.6 ft.).
- Widths 7.6 cm (3") to 30.0 cm (12").

MSC Transfers and Conveyors

- As necessary to convey and transfer lumber to the short green chain and the edge sorter.

4. Dry Kiln and Dry Sorting and Grading

a. Process

Dry kiln capacity is designed to meet full capacity of sawmill and satellite operations. Steam boiler to supply steam to heat kilns is based on burning of unusable waste such as sawdust, bark, sander dust, planer shavings, etc., from sawmill and panel plant.

Kiln capacity of 90,000 m3/year. This will give capability to dry input of rough sawn lumber from satellite operation.

Kilns are of the medium to high temperature, batch type, with end loading and discharge.

Kiln charges are formed by individual stickered loads placed two loads wide and three loads high on kiln trucks.

Upon completion of drying schedule, loads are transferred from kiln to storage or directly to tilt breakdown hoist of dry chain. Lumber is sorted for grade and grade trimming is done by conventional "table trimmer".

As part of this sorting chain, a resaw is provided to enable vertical splitting (mainly central splitting) to change thickness as may be desired.

This resaw can be fed from the sorting chain or directly by lift truck.

b. Major Equipment - five only

Dry Kiln

- 60" long compartments, holding capacity approximately to 70 m3/kiln of average 50 mm (2") thick lumber.
- Single track (2 loads wide x 3 loads wide).
- Cross ventilation (reusable).
- Fan motors mounted outside of building.
- Controls to facilitate "conditioning" cycle at end of drying cycle (proprietary equipment).
- c/w rails and kiln tracks.
- Construction and erection drawings for reinforced concrete kiln buildings.

Tilt Hoist Feeder

- To feed kiln load packages to dry chain for sorting and grading.
- Two load storage feed.
- Maximum package size 4" x 4" x 22".
- Complete with hydraulic unit and controls.

Two Saw Table Trimmer

- Complete with single board lug feeder.
- Precision chain strands c/w lugs.
- Motorized saw arbours.
- Ending rolls on separate drive.
- "Balanced", depressible length markers/stops.

Line Bar Resaw (band)

- Maximum depth of cut 35 cm (14").
- Hydraulic or air assisted set works.
- Set works to allow for individual sets as well as "centre splitting".
- Feed speed variable to maximum 45 m (150")/minute.

Lumber Stacker - tilt type

- To handle logs to maximum 4" x 4" x 22".
- Suitable to location end of sorting chain.
- c/w outfeed rollcase (powered) to store two loads.
- c/w fork lift pick-up pockets.
- Self indexing contents.

MSC Transfers, Conveyors, Lumber Pull-off Carts

- Including dry chain and various transfers and conveyors as necessary to facilitate flow.

Steam Boiler

- Water tube, wood waste fired @ 150 p.s.i.g.
- 36,000 m2/hour capacity.
- "Dutch oven" furnace, step grate system, for wood waste.
- Induced draft fan.
- "Stub" stack and forced draft.
- c/w controls, instrumentation and piping.

5. Planer / Moulder Mill

a. Process

Planer/Moulder is provided as a separate operation to dress rough sawn lumber to meet the demand for dressed and accurately sized lumber for use in the different products as well as for the export market.

In addition to the standard rectangular/square shapes, heads will be able to carry pattern knives to produce other shapes, such as "shiplap" sheathing for the building and construction trade, "V" joint panelling, "lap" siding, etc.

"Out of line" trimmer will provide necessary trimming for increased grade recovery.

As the rough sawn lumber presented to the planer has already been sorted for length, only a short sorting chain will be required.

Flow will allow space for in-line spray chamber and "stress" grading.

"End sealing" and "grade stamping" just prior to sorting.

b. Major Equipment

Tilt Hoist Feeder

- To "break down" and feed lumber package loads either directly from dry kilns or from dry sort chain.
- Two loads storage feed.
- Maximum package size 4" x 4" x 22".
- Complete with hydraulic unit and controls.

Planer/Moulder

- Twelve knife heads.
- Side heads to carry pattern (profile) heads as needed for various profiles, i.e. shiplap, V joint, lap siding, etc.
- "Splitter" heads on outfeed.
- Planer infeed table c/w "pine-apple" feed roll arrangement and adjustable fence, driven from main planer drive.

Two Saw Grade Trimmer - for out of line trimming

- Infeed roll case with fixed straight edge.
- Precision length stops.
- Power feed rolls.
- Foot pedal control for stop-start operation and saw control.
- Side transfer board kick-off at outfeed.

Lumber Stacker - tilt type

- To handle loads to maximum 4" x 4" x 22" (same as for dry kiln, dry sorting and grading).

MSC Transfer, Conveyor, Lumber Pull-off Carts

- Including planer chain and various transfers and conveyors as necessary to facilitate flow.

6. Wood Treatment (Impregnation) Plant

a. Process

Plant will be located so that operation will not obstruct the normal flow of lumber between the sawmill, sorting, dry kilns and planer mill.

b. Major Equipment

- Pressure impregnation plant to treat 15,000 m3/annum of timber to maximum length of 6.6 m (22 ft.) using water-borne salts.
- Plant will be complete with autoclave, pumps, control valves, rail transverses for handling of timber "in" and "out", etc.

7. Residue and Waste Handling

a. Process

All residues (mainly sawdust and bark) from the sawmill will be collected in separate conveyors, put through a "hog" to obtain a uniform product (suitable for burning in the oven of the steam boiler) and thence to the fuel storage bunker.

This fuel will be drawn from the bunker as required by the steam boiler. Waste from the panelboard plant will also be transferred to this same bunker. The bunker storage capacity will provide sufficient storage to supply the steam boiler during the non-operating periods such as holidays, weekends, third shift, etc., when the sawmill and panel plant are not working. However, steam is required for kilns for continuous and uninterrupted operation.

A "smokeless" high temperature incinerator will be provided as a means of disposal of excess waste at a minimum cost.

The salvageable wood waste (mostly slabs, edgings and trim ends) are collected in a separate conveyor system, put through an appropriate chipper and conveyed to a storage bunker at the panelboard plant from which the chips are drawn for further processing to maintain panel production.

b. Major Equipment

Waste Wood Chipper

- 48" disk, 6 knife chipper.
- c/w with coupled drive mounted on common base.
- Top discharge or side discharge.
- Horizontal feed c/w vibrating conveyor and metal detector section in conveyor.

Chipper Screen package

- Vibrating chip screen.
- Cyclone discharge to screen.
- Steel support structure to accommodate chipper, receiving cyclone and chip screen.

Waste wood hog

- Hammer type hog.
- To take waste wood, log ends and bore.
- Hogged fuel satisfactory for dutch-oven type boiler, or travelling grate.

8. Mobile Equipment

a. Process

The necessary machines and equipment will be standardized as much as possible without loss of efficiency or wasteful oversizing. Spare machines will be provided as deemed necessary in order to allow adequate maintenance and repair.

b. Equipment

Grapple log loader

. To have lumber fork option.

Lift Truck

. c/w lumber forks.

. Side shifters.

9. Saw Service Shop

a. Process

The "saw doctoring" shop is equipped with state-of-the-art machines, equipment and hand tools necessary to sharpen, tension swage, set and maintain all the saws, circular and band, that are in use. Knife grinders will be provided for the chipper and hog knives.

Shop will use "stellite" method of "tipping" saw teeth.

10. Maintenance Shop

a. Process

A workshop for millwrights, electricians and mobile equipment mechanics, equipped with the machines and tools necessary for day to day maintenance and operation for the entire complex.

11. Miscellaneous Infrastructure

a. Site Area

Sufficient to allow for future expansions on the same centralized location, requirements as follows:

60,000 m3 sawmill	6 hectares
Planer mill and labour storage area	4 hectares
Wood panel plant	5 hectares
Future by-products manufacturing	5 hectares
Future sawmill expansion	5 hectares
Future wood panel plant	4 hectares
TOTAL	29 HECTARES

Consider minimum area of 30 hectares with dock access to tide water.

b. Power Supply

Provision for transformer station to obtain electricity from public utility network.

c. Water Supply

To supply process water (i.e. mill, steam, etc.), fire protection, sanitary requirements, etc.

d. Truck Loading and Shipping Dock

Sufficient length to allow efficient loading of trucks.

e. Security

Fence enclosures with controlled access and exit gates.

WOOD MANUFACTURING IN PAPUA NEW GUINEA

INTRODUCTION

The long term objectives of the wood manufacturing industry must be to produce Quality Products to international specification and standards. The export market plus the domestic market will maximize the "Value - added" benefits that can flow to the PNG wood based industry.

Lumber manufacture is considered in two categories:

i) "Satellite" Operation" "Rough Green" lumber, produced adjacent to log supply at point of extraction and assembly from the woods, or assembly of the logs for water shipment, i.e. a "satellite" operation that produces accurately sawn rough green lumber.

ii) "Centralized", fully integrated operation equipped with treating plant, dry kilns, resawing facilities and secondary processing equipment, including joiner and furniture and furniture component parts. This will enable full utilization of the raw material, maximum recovery, and the increase of earnings from a full line of value-added products.

I Satellite Operation - Relocatable

A number of advantages are really apparent.

* Located adjacent to the log supply, makes logs available at a reduced cost.

* The capital cost is within the means of the smaller private sector entrepreneur, or it may be considered as an extension of the centralized operation.

* Available present day converting equipment incorporates improved sawmill technologies enabling the production of accurately sawn lumber (even with minimal skills) with resultant increased recovery and just as important acceptability in the export market of a major part of the total production.

* This satellite location increases employment in the rural are - an important socio-economic consideration.

* Operating skills are not in the "high tech" category status, making possible a successful simple training program.

* Provide needed lumber for the surrounding rural community to meet the ever increasing housing needs.

* Provide firewood in the form of waste slabs and edgings.

* Accurately sawn lumber can be supplied directly to the export market or the central fully integrated centre.

* More efficient use of transportation facilities package "solid-pack" lumber packages instead of logs.

* Logs are sawn "hot" - sawing logs with minimum time delay avoids significant degradation of the log in storage as well as easier sawing, maximum grade recovery and volume recovery.

* The mill lends itself to setting up as a self-contained unit - internal power supply.

I.1 "Satellite Mill" Process and Major Equipment Description

The main production units consist of two "mobile" type mills, one being a "Right hand" mill and the other being a "Left hand" mill, set on a concrete slab working platform at ground level. The logs are placed on the infeed bunks by the front-end loader, or may also be positioned by manually rolling logs into place.

The mill system employs two "thin kerf" circular saws, cutting simultaneously at right angles to each other. The log remains stationery while the saw traces the length of the log. There is no practical maximum diameter limitation with this system.

The productive capacity of this arrangement (including a resaw), with a trained crew, will average 18 to 20 M3/day lumber output per unit.

Based on a recovery of 45 to 48%, under good log conditions, an output of up to as high as 40 M3/day is atainable. Forty M3/day is equal to an annual output of 10,000 M3.

The sawmills are of a "heavy duty" construction, are reasonably tolerant of rough handling and with proper maintenance will produce accurately sawn lumber on a continuing basis.

The narrow kerf circular resaw will enable the mill combination to cut to smaller sizes as may be desirable and still maintain the 45 to 48% volume recovery.

Trimming for length and grade is accomplished by means of a

single bladed swing trim saw.

Simple roll cases (some powered), gravity where transfers and conveyors are used to facilitate the material handling between machine centres.

The sawn, trimmed to length lumber is sorted along a roll case conveyor and is "block piled" and strapped and ready for immediate shipment or "stickered" for air drying. Lumber is ready for shipment to the central remanufacturing facility or direct to the market place.

Sawdust handling is accomplished by means of a pneumatic gathering system. The sawdust and the remaining slabs and edgings not required for firewood are directed to an open-top partially walled burner for final disposal.

Electric power is supplied by a diesel generator set.

One qualified tradesman is more than enough to perform the saw and mechanical maintenance tasks. Arrangements would be made with the logging maintenance shop to service the front end loader.

At start up, maintenance and operating training program will be supplied as part of the equipment package to insure efficient and continuing performance of the operation, with provision for additional short refresher training as may be required.

I.2 Equipment List and Supply

- Mobile type sawmill, right hand c/w infeed bunks
- Mobile type sawmill, left hand c/w infeed bunks
- Outfeed decks
- Resaw infeed transfer

- Resaw infeed roll case
- "Thin kerf" circular resaw c/w set works and power feed rolls.
- Resaw outfeed roll case
- Infeed transfer to trim saw
- Trim saw
- Trim saw outfeed/sorting roll case conveyor
- Wood residue and waste handling (pneumatic for sawdust)
- Strapping machine, hand operated
- Water piping, air piping and air compressor
- Saw filing and mechanical mtce.
- Diesel generator set and fuel tank and light plant - 100 kva
- Mobile equipment
- Start up and training
- Spare parts @ 7% of major equipment
- Site preparation, including concrete slab working platforms
- "open wall" equipment shelters
- Mechanical installation
- Electrical installation
- Office and maintenance facilities

I.3 Manning

Production

1	Lift truck driver
2	Sawmill operators
1	Sawmill operator's helper
1	Sawmill off bearer
1	Infeed to resaw
1	Resaw off bearer, incl. slabs and edgings
1	Grader
1	Trimsaw operator
2	Sorters
1	Sawfiler Mechanic
2	Clean up and waste handling

15	Total production

Management

1	Manager/Mill Superintendant
1	Mill Farmer
1	Office clerk, payroll, first aid
3	Total management

Appendix IV-C

PLYWOOD AND VENEER

Although plywood is currently manufactured in PNG, it is predominantly of pine species, cross grained and destined for domestic markets rather than exported. Some eighty five percent of PNG's wood commercially known wood species are utilizable in both veneer and plywood manufacture. A large proportion of the logs exported (primarily to Japan and Korea) have been destined for plywood manufacture. It is proposed that, to both domesticize the manufacturing process through value-added production and to maximize domestic profitability, as part of the centralized manufacturing operations plywood production should be an integral part of the process.

Process Description

Logs for the plywood manufacturing process will be delivered to the central manufacturing facility by the coastal barge system. Logs will be unloaded from the barge, then moved to temporary inventory using a pneumatic tyred Caterpillar 966 (or equivalent) front-end loader equipped with log grapples. From the temporary inventory, logs will be removed and placed on the bucking saw infeed deck using the same front end loader.

Logs will be bucked to peeler block length using a cross conveyor chain saw ("deck saw"), then blocks will be conveyed to the debarker infeed. At the Rosser head/scraper debarker, bark is removed (and conveyed to the waste fired boiler for use a s fuel). Debarked blocks may be conveyed to hot water soak tanks for conditioning via an overhead block chain hoist conveyor. Species not requiring conditioning may be conveyed directly to the lathe infeed, or moved to temporary inventory as required.

Conditioned or unconditioned blocks are presented to the lathe via the optical centring charger, and reduced to veneer ribbons of thicknesses ranging from 0.5 mm to 4.5 mm. The lathe is equipped with a quick change gearing and centre splitter knife to allow the production of at least two different thicknesses from the some block - i.e. face and core grades. The thinner veneers outfeed from the lathe to an automatic reeling system which reels veneer to spindles, then automatically stores or transfers the spindles to the unreeling station at the dryer infeed. Core veneer is directed to a lower level green chain where the veneer is automatically clipped to maximum width, then manually pulled and sorted, then delivered by fork lift to the lower two decks of the dryer, or to temporary inventory.

The top two levels of the dryer carry continuous ribbons of veneer for reduction to some 5% moisture content, while the bottom levels handle sheets and random veneer.

Veneer outfeeding from the upper dryer levels is automatically scanned for grade, clipped to width, then manually pulled to carts. Core veneer is manually sorted and pulled to carts. Veneer from both lines may then be either moved to inventory or further processed/upgraded as appropriate.

Plywood is manually assembled to unglued packages with either urea-formaldehyde or phenol formaldehyde resin glue applied. The packages are then consolidated under heat and pressure in the hot press. After pressing the panels are cut to final dimensions in the automatic sizing saw, then graded.

Panels requiring repair are manually repaired and then, along with all other panels, sanded to final specification prior to final grading, packaging and shipment.

Major Equipment Supply

Major equipment for the plywood/veneer operation would include the following:

- Log infeed deck for singulating and conveying tree length logs past block saws, and conveying of blocks to the debarker infeed.
- Deck mounted 110 inch (nominal) electric powered chain saw for reduction of logs to peelable block lengths.
- Rosser head/scraper type debarker complete with infeed chains, hydraulic lift/positioners and outfeed.
- Overhead crane system, 5 tonne capacity for transport of blocks to and from conditioning vats.
- Hot water soak conditioning vats c/w heat exchangers and re-circulating pumps as part of an entirely closed-loop system.
- Two meter swing rotary lathe complete with optically centering charger, powered back-roll, double retractable spindles, interchangeable nose and tripple roller bars, hydraulically operated retractable spurring knives and instantaneous thickness change settings.
- Three level (two storage, one return) automatic reeling/unreeling system complete with a lower level manual green chain system. Lower level green chain complete with electronically controlled optical scanner and clipper.
- Four level steam heated veneer dryer: Two upper levels with continuous screen drive

system, lower levels of roller drive configuration.

- Two 110 inch (nominal dry veneer clippers c/w electronic scanner controls, tipple tray to upper level dry chains and lower level sheet dry veneer sorting chain.
- Two veneer compositing system (one long grain full sheet and one full sheet cross grain).
- One glue storage and mixing system complete with resin storage tanks, transfer pumps and mixer.
- Two 110 inch (nominal) glue spreaders c/w assembly tables and transfer conveyors.
- One hydraulically operated top acting pre-press.
- One twenty opening hydraulically operated steam heated hot press, c/w platform type loader and pie rack unloader.
- One automatic sizing saw system c/w equalizing and skinner saws and grade line.
- One four head (two top, two bottom) sander, c/w infeed, outfeed and grade line system.
- Waste and hogging systems for waste removal and transport to the package boiler system.
- One waste wood fired package steam boiler system.
- Maintenance facility c/w late and chipper knife grinding system, saw sharpening and tipping system and small tools for normal maintenance operations
- Mobile equipment consisting of one Caterpillar 966 (or equivalent) pneumatic tyred grapple loader and two 3500Kg capacity solid tyred forklifts.

The equipment package to be complete with a training program for all key operators and supervisory personnel.

MEDIUM DENSITY FIBREBOARD (MDF)

MDF is a panel product producible from a wide variety of wood species, including mixed hardwood species, as has been confirmed by testing undertaken for the PNG Forest Service in New Zealand. Its basic process involves the pressurized attrition defibration of wood chips, in much the same manner as thermomechanical pulping. The chips are reduced to fibre bundles (1-2 1/2 cm x 0.25 mm), then blended with paraffin wax and resin (either phenol-formaldehyde or urea formaldehyde) and dried. Dried fibre is then deposited to a mat, which is consolidated under heat and pressure to form a panel of rough dimensions (in thicknesses from 9 to 27 mm). The rough panel is then trimmed and cut to size as per market specifications, sanded, graded and shipped.

Primary uses of MDF include substrate for high quality furniture manufacture, case goods manufacture, crating, room dividers and (if phenolic bonded) sheathing construction applications.

Current global production of MDF now exceeds 7,500,000 M3/Ann. Its main markets include Japan, Taiwan, Singapore, Korea, Europe and North America.

Process Description

For the application as envisaged for PNG, wood residues will be delivered by pneumatic conveyors to the chip pile, being separated (when required) by species groupings in order to stabilize pre-steaming conditions and board properties. Additionally, low grade logs may be delivered to the mill yard where they will be hand de-barked, then chipped , with the chips being conveyed to the chip storage piles. Residuals from the

debarker are conveyed to the steam plant for use as hog fuel.

From the storage area, chips are conveyed using a bucket equipped front-end loader to a reclaim hopper and conveyor which outfeeds to a metering conveyor over the defibrator pre-heater. At this point, steam at 10 bars (150 psig) is added to soften fibre.

Softened chips are screw conveyed from the pre-heater under pressure to the defibrator where they are attrited between a fixed and rotating disc into fibre bundles and individual fibres.

Fibre exits the defibrator through a blow valve, to the entry of the flash-tube dryers. At this point, urea formaldehyde resin (9% of fibre weight) and paraffin wax (0.25% of fibre weight) are metered to the fibre, blending with it in passage through the dryers. Dried fibre exits the dryers through a cyclone and rotary valve to storage/metering bins.

Furnish fibre is metered from storage to the Pendistor-type head forming line , from which it is drawn to the forming screen by vacuum drawn below the line. Over fines are extracted from the system and blown to the powerhouse for fuel. On exiting the nominal 1.25 m wide forming head, laps (press length unconsolidated fibre) are separated, on a continuous belt conveyor, by a moving vacuum saw which returns extracted fibre to the metering bin.

The fibre lap is then pre-compacted from a height of approximately 50 cm to 25 cm, then conveyed to a pre-press which consolidates the lap to approximately 10-12 cm.

From the pre-press, the lap is conveyed to a pre loader which provides surge time for the constantly moving line, then to a press loader . When the nominal 1.25 x 5 m press is ready,

the laps are charged to its 5 daylight openings. The hot press then closes, consolidating the laps and curing the resin binder at pressures up to 50 bars and 200 C.

At the end of the pressing cycle, the press discharges its "fill" to an unloader, which then singly delivers panels to cooling and the sizing saws, which reduce the 1.25 x 5 m rough panel to finished dimensions (nominal 1.2 x 2.4 m). Residuals from the sawline are blown to the boilerhouse as fuel. A grade line attached to the sawline sorts panels by grade.

Sawn panels are placed in inventory or to the sanding line by a hydraulic front-end forklift. Sanded panels are again graded, then delivered to the warehouse/shipping area by forklift. From the warehouse, bundles of panels are manually steel strapped, then forklift loaded to trucks for shipment to destination.

Major Equipment Supply

Major equipment for the MDF plant will include the following:

- Log infeed deck and hand debarking area c/w bark conveyors for clean-up.
- Eight knife chipper and chip conveyor system to chip storage piles.
- Chip storage and reclaim facilities for storage of chips as delivered from the sawmill, planermill and plywood plants.
- Chip infeed conveyors from reclaim to chip washing system (for grit and tramp metal removal).
- LVP 36 inch Defibrator (or equivalent) pressurized refiner c/w horizontal screw auger infeed, vertical preheater and all

motors, drives etc. Also complete with Gamma source and detection sensor for level control.

- High velocity air flash tube dryer c/w resin/ wax blow pipe injection nozzles.
- Resin and wax storage and metering system c/w PLC control interlock to the fiberization system and forming/pressing control systems.
- Live bottom metering bins c/w scalping rolls for fibre metering to forming line.
- Pendistor type (or equivalent) nominal 4 foot forming line complete with continuous belt forming bed, two head forming station, deckling and scalping systems, pre-compactor and storage (doubling) conveyor.
- Pressing system complete with press loader, simultaneous closing hot press and press unloader. Complete with all hydraulics and PLC controls.
- Star type cooler and board unloader system.
- Six head (three top and three bottom) sanding line complete with infeed, outfeed and three bin grade sort station.
- Automatic sawing station complete with equalizer and skinner saws, infeed and outfeed and automatic stacking system.
- All waste blowing and conveying systems for collection and delivery of waste product to the energy conversion system.
- Waste wood fired energy conversion system for provision of process heat and steam for the pre-heater, dryer and press systems.
- Maintenance facilities including saw sharpening and typing devices plus all small tools necessary for normal maintenance

procedures.

- Mobile equipment including one only Caterpillar 926 (or equivalent) front end-loader equipped with a bucket for chip loading and transport to the chip re-claim hopper, and a single 5000 Kg. hard tyred fork lift for product movement and loading.

Included in the package of supply and erection (installation) of the equipment would be the full operational training of key personnel and operators. Training to include the visitation to existing MDF operations (international) for purposes of familiarization and initial technical training of selected key personnel.

Appendix IV-E

PORTABLE ("WOKABAUT) SAWMILL

The portable or "wokabaut" sawmill is intended for the production of sawnwood, primarily for immediate local consumption, from small lot timber holdings or from timber felled during agricultural clearing operations on a village scale. While it is capable of sustained operation in a permanent location, its primary intent is for the utilization of logs as produced in remote locations and on a relatively small scale. It is a fully portable operation that can be transported to the immediate area of log production, thus eliminating the need for expensive and destructive logging road systems and major land clearing for mill site location.

In practice, logs would be dragged by farm tractor type vehicles to the mill site, rolled into position for the mill's sawing mode, and processed to sawnwood by a series of multiple passes by either a two saw circular travelling headrig, or by a travelling head band-type headrig. Sawnwood is manually lifted from the sawing bed and stacked for air drying in the mill yard, or may be diffusion dipped in a simple steel dip tank, then plastic wrapped for an appropriate period of time to complete the process.

Sawnwood (RST only) from the mill would be sold to immediate markets, and would be hand loaded to the local transport. Slabs would be sold or disposed of as firewood to local markets, and sawdust would be disposed of by either wasting to the ground or used in agricultural applications.

As the mill would be in a remote location, it would be powered by a direct coupled gasoline or diesel engine.

Major Equipment Supply

Major equipment supply to the plant would be in the form of one only trailer mounted portable sawmill system, either circular or bandmill type, complete with self contained internal combustion engine drive, tool kit and simple saw sharpening or insert-tooth replacement system.

APPENDIX 5

ANALYSIS OF OPTIONS

APPENDIX V

ANALYSIS OF OPTIONS

A - Sawmill Complex
B - Satellite Sawmill
C - Plywood Plant
D - MDF Plant
E - "Wokabaut Sawmill

APPENDIX 5 - A
FOREST INDUSTRY STUDIE PAPUA NEW GUINEA
CASH FLOW PROJECTION - 5 YEAR

SAWMILL

ITEM		VALUES IN '000$US YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Operating level		20.00%	75.00%	100.00%	100.00%	100.00%
Volume		12,000	45,000	60,000	60,000	60,000
Capital residual		8,916	8,024	7,222	6,499	5,849
Capital input		9,906				
Raw materials		2,213	8,300	11,067	11,067	11,067
Labor		290	580	580	580	580
Supplies		244	916	1,221	1,221	1,221
Power & fuels		149	336	373	373	373
Overhead		372	744	744	744	744
Interest	9.25%	550	495	445	401	361
D/E Ratio	60.00%					
Depreciation	10.00%	991	892	802	722	650
REVENUE		4,145	15,543	20,724	20,724	20,724
PROFIT/LOSS		(665)	3,280	5,491	5,615	5,728
CASH FLOW	(9,906)	326	4,172	6,293	6,338	6,378

RATE OF RETURN ESTIMATE (GUESS)	30.00%
INTERNAL RATE OF RETURN	28.44%

Note: Debt is reduced by 10% of residual depreciations
on declining scale of residual

APPENDIX 5 - A
FOREST INDUSTRY STUDIE PAPUA NEW GUINEA
CASH FLOW PROJECTION - 5 YEAR

DRY KILN AND TREATMENT PLANT

		VALUES IN '000$US				
ITEM		**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**
OPERATING LEVEL		20.00%	20.00%	20.00%	20.00%	20.00%
VOLUME		18,000	18,000	90,000	18,000	18,000
CAPITAL RESIDUAL		3,638	3,274	2,947	2,652	2,387
CAPITAL INPUT		4,043				
RAW MATERIALS		7,097	7,097	35,487	7,097	7,097
LABOR		132	264	264	264	264
SUPPLIES		213	213	1,063	213	213
POWER & FUELS		121	271	302	302	302
OVERHEAD		275	551	551	551	551
INTEREST	9.25%	224	202	182	164	147
D/E RATIO	60.00%					
DEPRECIATION	10.00%	404	364	327	295	265
REVENUE		7,993	7,993	39,966	7,993	7,993
PROFIT/LOSS		(474)	(969)	1,790	(892)	(846)
CASH FLOW	(4,043)	(69)	(605)	2,117	(597)	(581)

RATE OF RETURN ESTIMATE (GUESS)	30.00%
INTERNAL RATE OF RETURN	19.18%

Note: Debt is reduced by 10% of residual
depreciation is on declining scale of residual

APPENDIX 5 - A
FOREST INDUSTRY STUDIE PAPUA NEW GUINEA
CASH FLOW PROJECTION - 5 YEAR

PLANERMILL/MOULDER

		VALUES IN '000$US				
ITEM		**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**
OPERATING LEVEL		20.00%	75.00%	100.00%	100.00%	100.00%
VOLUME		18,000	67,500	90,000	90,000	90,000
CAPITAL RESIDUAL		1,696	1,527	1,374	1,237	1,113
CAPITAL INPUT		1,885				
RAW MATERIALS		6,942	26,031	34,709	34,709	34,709
LABOR		101	202	202	202	202
SUPPLIES		161	604	806	806	806
POWER & FUELS		94	211	235	235	235
OVERHEAD		261	523	523	523	523
INTEREST	9.25%	105	94	85	76	69
D/E RATIO	60.00%					
DEPRECIATION	10.00%	188	170	153	137	124
REVENUE		8,053	30,200	40,267	40,267	40,267
PROFIT/LOSS		201	2,364	3,555	3,579	3,601
CASH FLOW	(1,885)	389	2,534	3,708	3,717	3,724

RATE OF RETURN ESTIMATE (GUESS)	80.00%
INTERNAL RATE OF RETURN	89.94%

Note: Debt is reduced by 10% of residual
depreciation is on declining scale of residual

APPENDIX 5 - A
FOREST INDUSTRY STUDIE PAPUA NEW GUINEA
CASH FLOW PROJECTION - 5 YEAR

CONSOLIDATED SAWMILL, DRY KILN AND PLANING

		VALUES IN '000$US				
ITEM		**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**
OPERATING LEVEL		20.00%	75.00%	100.00%	100.00%	100.00%
VOLUME		48,000	180,000	240,000	240,000	240,000
CAPITAL RESIDUAL		14,250	12,825	11,543	10,388	9,350
CAPITAL INPUT		15,833				
RAW MATERIALS		16,253	60,947	81,263	81,263	81,263
LABOR		523	1,046	1,046	1,046	1,046
SUPPLIES		618	2,317	3,090	3,090	3,090
POWER & FUELS		364	819	910	910	910
OVERHEAD		909	1,818	1,818	1,818	1,818
INTEREST	9.25%	879	791	712	641	577
D/E RATIO	60.00%					
DEPRECIATION	10.00%	1,583	1,425	1,283	1,154	1,039
REVENUE		20,191	75,718	100,957	100,957	100,957
PROFIT/LOSS		(937)	6,554	10,836	11,035	11,215
CASH FLOW	(15,833)	646	7,979	12,118	12,189	12,254

RATE OF RETURN ESTIMATE (GUESS)	30.00%
INTERNAL RATE OF RETURN	35.92%

Note: Debt is reduced by 10% of residual
depreciation is on declining scale of residual

APPENDIX 5 - A
PAPUA NEW GUINEA
PRO-FORMA ANNUAL COST/REVENUE PROJECTION

SAWMILL, DRY KILN AND PLANING PLANT

			VALUES IN '000$US	
	UNITS	% OF TOTAL	NUMBER	$/UNIT
STATISTICS:				
OPERATING DAYS	DAYS		250	N/A
LOG INPUT	M3		122969	90.00
SAWNWOOD PRODUCED	M3		60000	352.70
KILN DRIED	M3		90000	457.80
PLANED	M3		90000	461.25
GREEN RECOVERY	%		48.79%	N/A
FUELWOOD	M3		24594	8.00
REVENUE: SAWMILL			'000$	$/UNIT
SAWNWOOD SALES (RST)			21162	352.70
KILNED WOOD SALES			0	457.80
PLANED WOOD SALES			0	461.25
FUELWOOD SALES			197	8.00
LESS ADVERTISING/COMMISS.	3.00%		-635	-10.58
TOTAL SALES			20724	345.40
EXPENSES: SAWMILL ONLY				
LOG COST			11067	184.45
PRODUCTION LABOR			469	7.81
MAINTENANCE LABOR			111	1.85
PRODUCTION SUPPLIES			663	11.05
MAINTENANCE SUPPLIES			438	7.30
SHIPPING SUPPLIES			120	2.00
ELECTRIC POWER			253	4.22
PROCESS FUELS			0	0.00
FUELS & LUBES.			120	2.00
PLANT O/H SALARIES			545	9.08
PLANT O/H EXPENSE			200	3.33
COST OF SALES			13985	233.09
OPERATING PROFIT			6738	112.31
DEPRECIATION			991	16.51
OPERATING INCOME			5748	95.80

RATIOS:	CASH FLOW	OPERATING INCOME
R.O.I. (%)	68.02%	58.02%
PAYBACK (YEARS)	1.5	1.7

PRO-FORMA COST/REVENUE PROJECTION (CONT'D)

REVENUE:	DRY KILN & TREATING ONLY	'000$	$/UNIT
SAWNWOOD SALES (RST)		0	0.00
KILNED WOOD SALES		41202	457.80
PLANED WOOD SALES		0	0.00
FUELWOOD SALES		0	0.00
LESS ADVERTISING/COMMISS.	3.00%	-1236	-13.73
TOTAL SALES		39966	444.07

EXPENSES:	DRY KILN & TREATING ONLY		
LUMBER COST		35487	394.30
PRODUCTION LABOR		212	2.36
MAINTENANCE LABOR		52	0.58
PRODUCTION SUPPLIES		334	3.72
MAINTENANCE SUPPLIES		549	6.10
SHIPPING SUPPLIES		180	2.00
ELECTRIC POWER		122	1.35
PROCESS FUELS		0	0.00
FUELS & LUBES.		180	2.00
PLANT O/H SALARIES		435	4.84
PLANT O/H EXPENSE		116	1.28
COST OF SALES		37667	418.52
OPERATING PROFIT		2299	25.54
DEPRECIATION		404	4.49
OPERATING INCOME		1895	21.05

RATIOS:	CASH FLOW	OPERATING INCOME
R.O.I. (%)	56.87%	46.87%
PAYBACK (YEARS)	1.8	2.1

PRO-FORMA COST/REVENUE PROJECTION (CONT'D)

REVENUE:	PLANER ONLY		'000$	$/UNIT
SAWNWOOD SALES (RST)			0	0.00
KILNED WOOD SALES			0	0.00
PLANED WOOD SALES			41513	461.25
FUELWOOD SALES			0	0.00
LESS ADVERTISING/COMMISS.		3.00%	-1245	-20.76
TOTAL SALES			40267	447.41
EXPENSES:	PLANER ONLY			
LUMBER COST			34709	385.65
PRODUCTION LABOR			125	1.39
MAINTENANCE LABOR			77	0.86
PRODUCTION SUPPLIES			279	3.10
MAINTENANCE SUPPLIES			347	3.85
SHIPPING SUPPLIES			180	2.00
ELECTRIC POWER			55	0.61
PROCESS FUELS			0	0.00
FUELS & LUBES.			180	2.00
PLANT O/H SALARIES			435	4.84
PLANT O/H EXPENSE			88	0.97
COST OF SALES			36474	405.27
OPERATING PROFIT			3793	42.14
DEPRECIATION			188	2.09
OPERATING INCOME			3604	40.05

RATIOS:	CASH FLOW	OPERATING INCOME
R.O.I. (%)	201.23%	191.23%
PAYBACK (YEARS)	0.5	0.5

PAPUA NEW GUINEA
PRO-FORMA ANNUAL COST/REVENUE PROJECTION
CONSOLIDATED
SAWMILL, DRY KILN AND PLANING PLANT

		UNITS	% OF TOTAL	NUMBER	$/UNIT
STATISTICS:					
OPERATING DAYS		DAYS		250	N/A
LOG INPUT		M3		122969	90.00
SAWNWOOD PRODUCED		M3		60000	250.00
KILN DRIED		M3		90000	300.00
PLANED		M3		90000	350.00
GREEN RECOVERY		%		48.79%	N/A
FUELWOOD		M3		24594	8.00
REVENUE:	CONSOLIDATED			'000$	$/UNIT
SAWNWOOD SALES (RST)				21162	250.00
KILNED WOOD SALES				41202	300.00
PLANED WOOD SALES				41513	350.00
FUELWOOD SALES				197	8.00
LESS ADVERTISING/COMMISS.		3.00%		-3116	-51.94
TOTAL SALES				100957	420.65
EXPENSES:	CONSOLIDATED				
FURNISH COST				81263	338.59
PRODUCTION LABOR				806	3.36
MAINTENANCE LABOR				240	1.00
PRODUCTION SUPPLIES				1276	5.32
MAINTENANCE SUPPLIES				1334	5.56
SHIPPING SUPPLIES				480	2.00
ELECTRIC POWER				430	1.79
PROCESS FUELS				0	0.00
FUELS & LUBES.				480	2.00
PLANT O/H SALARIES				1415	5.90
PLANT O/H EXPENSE				403	1.68
COST OF SALES				88127	367.20
OPERATING PROFIT				12830	53.46
DEPRECIATION				1583	26.39
OPERATING INCOME				11247	187.45

RATIOS:	CASH FLOW	OPERATING INCOME
R.O.I. (%)	81.03%	71.03%
PAYBACK (YEARS)	1.2	1.4

APPENDIX 5 - A

PAPUA NEW GUINEA
CAPITAL COST ESTIMATE

SAWMILL, DRY KILN AND PLANING PLANT

SAWMILL ONLY — VALUES IN '000$US

ITEM	LOAD HP	CUBIC M3	COST $US
LAND			50
SITE PREPARATION			281
ACCESS ROADS			10
WATER SYSTEM	10		20
BUILDINGS	100		510
ELECTROGENERATION			
LOG INFEED	75	1	1000
DEBARKER	250	30	650
OUTFEED TRANSFER	20		40
INFEED CONVEYOR	10		30
SAW FEED DECKS (2)	20		75
HEADRIG (BAND) & CARRIAGE	125	40	475
LOG EDGER	90	20	225
OUTFEED CONVEYORS	15		40
TRANSFER CONVEYORS	15		60
BULL EDGER	125	20	225
OUTFEED CONVEYORS	20		40
TRANSFER CONVEYORS	15		20
BAND RESAW (3)	210	60	375
OUTFEED CONVEYOR	10		25
BOARD UNSCRAMBLER	15	20	65
TWO SAW TRIMMER	20	20	40
DIP TANK	10		30
GREEN CHAIN	20		45
STRAPPING MACHINE	5	4	18
AIR COMPRESSOR	50	12	40
WASTE CONVEYORS	50		200
BLOW SYSTEM	100	20	200
SUPPORT STEEL			150
PIPING			20
CHIPPER	150		125
HOG	60		85
SAW SHOP	25		90
MECHANICAL SHOP	20		50
LOG LOADER			330
FORKLIFTS			150
SPARES			369
TOTALS	1635	247	6158
IMPORT DUTY & TAXES @	10.00% OF EQUIP.		529
ELECTRICAL INSTALLATION @	$360.00 / HP		589
MECHANICAL INSTALLATION @	17.00% OF MECH		731

SAWMILL ONLY - CAPITAL COST ESTMATE CONT'D.

OCEAN FREIGHT @	$140.00 /M3				35
INLAND FREIGHT (EST.)					50
SUBTOTAL					8091
ENGINEERING & P.M. @		8.50%	OF EQUIP.		523
SUBTOTAL					8614
CONTINGENCY @		15.00%	OF PROJECT COST		1292
TOTAL ESTIMATED COST SAWMILL					9906

				$US
LAND AREA :	5	HECTARES		
LAND VALUE :	$10,000	PER HECTARE =		50000
SITE PREP @	$25,000	PER HECTARE =		125000
GRAVEL	25000 M2 @	$6.25	PER SQUARE METER =	156250
SITE PREPARATION				281250
BUILDING	2680 M2 @	$60.00	PER SQUARE METER =	160800
FLOORS	2680 M2 @	$90.00	PER SQUARE METER =	241200
FOUND.	120 M3 @	$900.00	PER CUBIC METER =	108000
BUILDINGS, FLOORS AND FOUNDATIONS				510000

CAPITAL COST ESTIMATE (CONT'D)
DRY KILNS & TREATING ONLY

ITEM	LOAD HP	CUBIC M3	COST $US
LAND			30
SITE PREPARATION			169
ACCESS ROADS			4
WATER SYSTEM			10
BUILDINGS	20		309
KILNS, TRACKS AND CARTS	200	40	600
TILT HOIST FEEEDER	25	20	65
TWO SAW TABLE TRIMMER	15	10	30
LINE BAR RESAW	65	8	75
LUMBER STACKER	10	20	80
TRANSFERS AND CONVEYORS	30		60
STEAM BOILER	150	40	500
STRAPPING TOOLS		2	6
TREATING CYLINDERS	120	40	225
DUST EXTRACTION	75	5	100
WASTE SYSTEM	75	5	60
FORKLIFT			60
SPARES			49
TOTALS	785	190	2432
IMPORT DUTY & TAXES @	10.00% OF EQUIP.		191
ELECTRICAL INSTALLATION @	$350.00 / HP		275
MECHANICAL INSTALLATION @	17.00% OF MECH		374
OCEAN FREIGHT @ $140.00 /M3			27
INLAND FREIGHT (EST.)			10
SUBTOTAL			3309
ENGINEERING & P.M. @	8.50% OF EQUIP.		207
SUBTOTAL			3515
CONTINGENCY @	15.00% OF PROJECT COST		527
TOTAL ESTIMATED COST DRY KILNS			4043
LAND AREA :	3 HECTARES		$US
LAND VALUE :	$10,000 PER HECTARE =		30000
SITE PREP @	$25,000 PER HECTARE =		75000
GRAVEL 15000 M2 @	$6.25 PER SQUARE METER =		93750
SITE PREPARATION			168750
BUILDING 920 M2 @	$60.00 PER SQUARE METER =		55200
FLOORS 2220 M2 @	$90.00 PER SQUARE METER =		199800
FOUND. 60 M3 @	$900.00 PER CUBIC METER =		54000
BUILDINGS, FLOORS AND FOUNDATIONS			309000

CAPITAL COST ESTIMATE (CONT'D)

PLANERMILL/MOULDER ONLY

ITEM	LOAD HP		CUBIC M3	COST $US
LAND				30
SITE PREPARATION				75
ACCESS ROADS				3
WATER SYSTEM				5
BUILDINGS				288
ELECTROGENERATION				
TILT HOIST FEEDER	25		20	65
INFEED CONVEYOR	10		1	15
PLANER/MOULDER	60		8	175
OUTFEED CONVEYORS	5		1	8
TWO SAW GRADE TRIMMER	15		10	30
LUMBER STACKER	10		20	80
MISC. TRANSFERS & CONV.	15			40
STRAPPING TOOLS			2	6
DUST EXTRACTION	125		6	150
WASTE SYSTEM	90		6	100
FORKLIFT				60
SPARES				22
TOTALS	355		74	1152
IMPORT DUTY & TAXES @	10.00%	OF EQUIP.		75
ELECTRICAL INSTALLATION @	$350.00	/ HP		124
MECHANICAL INSTALLATION @	17.00%	OF MECH		177
OCEAN FREIGHT @ $140.00 /M3				10
INLAND FREIGHT (EST.)				2
SUBTOTAL				1541
ENGINEERING & P.M. @	8.50%	OF EQUIP.		98
SUBTOTAL				1639
CONTINGENCY @	15.00%	OF PROJECT COST		246
TOTAL ESTIMATED COST PLANERMILL				1885

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TOTAL COST SAWNWOOD COMPLEX 15833

CAPITAL COST ESTIMATE (CONT'D)

					$US
LAND AREA :		3	HECTARES		
LAND VALUE :		$10,000	PER HECTARE =		30000
SITE PREP @		$25,000	PER HECTARE =		75000
GRAVEL	15000 M2 @		$6.25	PER SQUARE METER =	93750
		SITE PREPARATION			168750
BUILDING	1860 M2 @		$60.00	PER SQUARE METER =	111600
FLOORS	1860 M2 @		$90.00	PER SQUARE METER =	167400
FOUND.	10 M3 @		$900.00	PER CUBIC METER =	9000
		BUILDINGS, FLOORS AND FOUNDATIONS			288000

APPENDIX 5 - A

PAPUA NEW GUINEA
MANNING AND LABOR COSTS

SAWMILL

POSITION	RATE $/DAY	NUMBER PER SHIFT SHIFT 1	SHIFT 2	SHIFT 3	TOTAL	COST $/DAY
PRODUCTION LABOR		COSTS IN $US				
LOG LOADER OP.	16.67	1	1		2	33.34
YARD LABOR	12.57	4	4		8	100.56
DEBARKER OP.	15.33	1	1		2	30.66
DECK LABOR/BUCK.	14.21	2	2		4	56.84
HEADRIG SAWYER	16.67	1	1		2	33.34
SAWYER TRAINEE	15.33	1	1		2	30.66
SCRAGG SAW OP.	15.33	1	1		2	30.66
SCRAGG TRAINEE	14.21	1	1		2	28.42
EDGER OP.	15.33	1	1		2	30.66
RESAW OPERATOR	15.33	1	1		2	30.66
RESAW TRAINEE	14.21	1	1		2	28.42
TRIM SAW OPERATO	14.21	1	1		2	28.42
GRADER	15.33	2	2		4	61.32
GREEN CHAIN O/B	12.57	10	10		20	251.40
PILERS	12.57	6	6		12	150.84
STRAPPERS	12.57	2	2		4	50.28
FORK LIFT	15.33	1	1		2	30.66
TRUCK LOADERS	12.57	4	4		8	100.56
UTILITY	12.57	8	8		16	201.12
CHIPPERMAN	15.33	1	1		2	30.66
					0	0.00
TOTAL		50	50	0	100	1339.48
PLUS FRINGE BENEFITS @			40.00%			535.79
TOTAL OPERATING LABOR/DAY						1875.27
MAINTENANCE & TECHNICAL						
MILLWRIGHTS	19.36	3	2		5	96.80
ELECTRICIANS	19.36	2	1		3	58.08
TECHNICAL	19.36	2	1		3	58.08
SAWFILER	18.01	3			3	54.03
TRAINEES	16.57	2	1		3	49.71
TOTAL		12	5	0	17	316.70
PLUS FRINGE BENEFITS @			40.00%			126.68
TOTAL MAINTENANCE LABOR/DAY						443.38
TOTAL WORKERS			117			

PAPUA NEW GUINEA
MANNING AND LABOR COSTS (CONTINUED)

DRY KILNS & TREATMENT PLANT

POSITION	RATE $/DAY	NUMBER PER SHIFT SHIFT 1	SHIFT 2	SHIFT 3	TOTAL	COST $/DAY
PRODUCTION LABOR		COSTS IN $US				
FORKLIFT OP.	15.33	1			1	15.33
PILERS	12.57	4			4	50.28
KILN OP.	15.33	1			1	15.33
KILN TRAINEE	14.21	2	2	2	6	85.26
YARD LABOR	12.57	4			4	50.28
INFEED OP.	14.21	1			1	14.21
TRIMSAW OP	15.33	1			1	15.33
GRADER	15.33	1			1	15.33
DRY CHAIN	12.57	6			6	75.42
STRAPPERS	12.57	2			2	25.14
LINEBAR OP.	15.33	1			1	15.33
LINEBAR ASST.	14.21	1			1	14.21
PILERS	12.57	2			2	25.14
BOILER OP.	18.01	2	2	2	6	108.06
CYLINDER LOADERS	12.57	4			4	50.28
CYLINER OP.	16.67	1			1	16.67
CYLINDER ASST.	15.33	1			1	15.33
					0	0.00
					0	0.00
					0	0.00
					0	0.00
TOTAL		35	4	4	43	606.93
PLUS FRINGE BENEFITS @			40.00%			242.77
TOTAL OPERATING LABOR/DAY						849.70
MAINTENANCE & TECHNICAL						
MILLWRIGHTS	19.36	2			2	38.72
ELECTRICIANS	19.36	1			1	19.36
TECHNICAL	19.36	2			2	38.72
SAWFILER	18.01	1			1	18.01
TRAINEES	16.57	2			2	33.14
TOTAL		8	0	0	8	147.95
PLUS FRINGE BENEFITS @			40.00%			59.18
TOTAL MAINTENANCE LABOR/DAY						207.13
TOTAL WORKERS			51			

PAPUA NEW GUINEA
MANNING AND LABOR COSTS (CONTINUED)

PLANERMILL, REMAN & MOLDING

POSITION	RATE $/DAY	NUMBER PER SHIFT SHIFT 1	SHIFT 2	SHIFT 3	TOTAL	COST $/DAY
PRODUCTION LABOR						
FORKLIFT OP.	15.33	1	1		2	30.66
UNSCRAMBLER	12.57	1	1		2	25.14
PLANER OP.	16.67	1	1		2	33.34
PLANER TRAINEE	15.33	1	1		2	30.66
GRADER	15.33	1	1		2	30.66
RETRIM LABOR	12.57	1	1		2	25.14
RETRIM OP.	15.33	1	1		2	30.66
DRY CHAIN	12.57	4	4		8	100.56
STRAPPERS	12.57	2	2		4	50.28
					0	0.00
					0	0.00
					0	0.00
					0	0.00
					0	0.00
					0	0.00
					0	0.00
					0	0.00
					0	0.00
					0	0.00
					0	0.00
TOTAL		13	13	0	26	357.10
PLUS FRINGE BENEFITS @			40.00%			142.84
TOTAL OPERATING LABOR/DAY						499.94
MAINTENANCE & TECHNICAL						
MILLWRIGHTS	19.36	1	1		2	38.72
ELECTRICIANS	19.36	1	1		2	38.72
TECHNICAL	19.36	2	1		3	58.08
SAWFILER	18.01	2			2	36.02
TRAINEES	16.57	2	1		3	49.71
TOTAL		8	4	0	12	221.25
PLUS FRINGE BENEFITS @			40.00%			88.50
TOTAL MAINTENANCE LABOR/DAY						309.75

TOTAL WORKERS 38

TOTAL WORKERS FOR COMPLE 206

APPENDIX 5 - A

PAPUA NEW GUINEA
PLANT OVERHEAD

SAWMILL ONLY

WAGES:

POSITION	RATE $/ANNUM	NUMBER	COST $/YEAR
PLANT MANAGER	75000	1	75000
SHIFT SUPERVISORS	20000	2	40000
CONTROLLER	38000	1	38000
RECEPT/ADMIN	10000	8	80000
PAROLL/SHIP.	21000	2	42000
LOG BUYER	30000	1	30000
GUARDS	14000	6	84000
	TOTAL WAGES	21	389000
	PLUS FRINGES @	40.00%	155600
	TOTAL PAYROLL COST		544600

EXPENSES:	$/ANNUM	
SUPPLIES	5000	
TEL & TEL.	6000	
INSURANCE	79249	$0.80 /$100 OF CAPITAL
AUDIT/LEGAL	30000	
TAXES	49531	$0.50 /$100 OF CAPITAL
TRAVEL	30000	
TOTAL	199780	

TOTAL EMPLOYEES INCL O/H 138

PAPUA NEW GUINEA
PLANT OVERHEAD (CONTINUED)

DRY KILNS AND TREATING

WAGES:

POSITION	RATE $/ANNUM	NUMBER	COST $/YEAR
PLANT MANAGER	50000	1	50000
SHIFT SUPERVISORS	20000	1	20000
CONTROLLER	35000	1	35000
RECEPT/ADMIN	10000	8	80000
PAROLL/SHIP.	21000	2	42000
LOG BUYER	30000	0	0
GUARDS	14000	6	84000
	TOTAL WAGES	19	311000
	PLUS FRINGES @	40.00%	124400
	TOTAL PAYROLL COST		435400

EXPENSES:	$/ANNUM	
SUPPLIES	5000	
TEL & TEL.	8000	
INSURANCE	32340	$0.80 /$100 OF CAPITAL
AUDIT/LEGAL	30000	
TAXES	20213	$0.50 /$100 OF CAPITAL
TRAVEL	20000	
TOTAL	115553	

TOTAL EMPLOYEES INCL O/H 70

PAPUA NEW GUINEA
PLANT OVERHEAD (CONTINUED)

PLANER/MOULDER

WAGES:

POSITION	RATE $/ANNUM	NUMBER	COST $/YEAR
PLANT MANAGER	50000	1	50000
SHIFT SUPERVISORS	20000	2	40000
CONTROLLER	35000	1	35000
RECEPT/ADMIN	10000	6	60000
PAROLL/SHIP.	21000	2	42000
LOG BUYER	30000	0	0
GUARDS	14000	6	84000
	TOTAL WAGES	18	311000
	PLUS FRINGES @	40.00%	124400
	TOTAL PAYROLL COST		435400

EXPENSES:	$/ANNUM	
SUPPLIES	5000	
TEL & TEL.	8000	
INSURANCE	15078	$0.80 /$100 OF CAPITAL
AUDIT/LEGAL	30000	
TAXES	9424	$0.50 /$100 OF CAPITAL
TRAVEL	20000	
TOTAL	87502	

TOTAL EMPLOYEES INCL O/H	56
TOTAL EMPLOYEES FOR COMPL	264

APPENDIX 5 - A

PAPUA NEW GUINEA
OPERATING/MAINTENANCE SUPPLIES & CONSUMABLES

SAWMILL ONLY

PRODUCTION SUPPLIES:
BASED ON INDUSTRY RANGE OF $US3.75 - $US4.30/CUBIC METER, A COST OF $4.30 /CUBIC METER HAS BEEN APPLIED. TO THIS IS ADDED THE COST OF DIFFUSION DIP FOR 30.00% OF THE TOTAL VOLUME AT A COST OF $22.50 PER CUBIC METER FOR A TOTAL COST OF $11.05 /CUBIC METER.

MAINTENANCE SUPPLIES:
BASED ON INDUSTRY RANGE OF $US6.80 - $US7.30/CUBIC METER, A COST OF $7.30 /CUBIC METER HAS BEEN APPLIED.

SHIPPING SUPPLIES:
BASED ON INDUSTRY RANGE OF $US1.95 - $US1.99/CUBIC METER, A COST OF $2.00 /CUBIC METER HAS BEEN APPLIED.

ELECTRIC POWER:
THE SAWMILL IS ESTIMATED TO HAVE A CONNECTED LOAD OF 1218 KW. THIS HAS BEEN CALCULATED AT HOURS PER DAY, 250 DAYS PER YEAR, 80% DEMAND FACTOR AND 60% LOAD FACTOR. A RATE OF $0.0923 , AND A DEMAND RATE OF $11.56 PER KVA HAS BEEN APPLIED.
ANNUAL COST= $ 253253

PROCESS FUELS:
THE SAWMILL WILL NOT CONSUME PROCESS FUELS, THERFORE A COST O $0.00 /ANNUM HAS BEEN APPLIED.

FUELS AND LUBRICANTS:
BASED ON INDUSTRY RANGE OF $US1.00 - $US1.25/CUBIC METER, A COST OF $2.00 /CUBIC METER HAS BEEN APPLIED.

DRY KILNS AND TREATMENT ONLY

PRODUCTION SUPPLIES:
BASED ON INDUSTRY RANGE OF $US2.50 - $US2.65/CUBIC METER, A COST OF $2.65 /CUBIC METER HAS BEEN APPLIED. TO THIS IS ADDED THE COST OF PRESSURE TREATIN 5.00% OF THE TOTAL VOLUME AT A COST OF $21.30 PER CUBIC METER FOR A TOTAL COST OF $3.72 / CUBIC METER

MAINTENANCE SUPPLIES:
BASED ON INDUSTRY RANGE OF $US5.25 - $US6.10/CUBIC METER, A COST OF $6.10 /CUBIC METER HAS BEEN APPLIED.

SHIPPING SUPPLIES:
BASED ON INDUSTRY RANGE OF $US1.95 - $US1.99/CUBIC METER, A
COST OF $2.00 /CUBIC METER HAS BEEN APPLIED.

ELECTRIC POWER:
THE DRY KILN IS ESTIMATED TO HAVE A CONNECTED LOAD OF
585 KW. THIS HAS BEEN CALCULATED AT HOURS PER DAY,
250 DAYS PER YEAR, 80% DEMAND FACTOR AND 60% LOAD FACTOR.
A RATE OF $0.0923 , AND A DEMAND RATE OF $11.56
PER KVA HAS BEEN APPLIED.
ANNUAL COST= $ 121593

PROCESS FUELS:
THE DRY KILN WILL CONSUME RESIDUALS ASPROCESS FUELS, THERFORE
A COST O $0.00 /ANNUM HAS BEEN APPLIED.

FUELS AND LUBRICANTS:
BASED ON INDUSTRY RANGE OF $US1.00 - $US1.25/CUBIC METER, A
COST OF $2.00 /CUBIC METER HAS BEEN APPLIED.

PLANERMILL AND PROFILING ONLY

PRODUCTION SUPPLIES:
BASED ON INDUSTRY RANGE OF $US2.60 - $US3.10/CUBIC METER, A
COST OF $3.10 /CUBIC METER HAS BEEN APPLIED.

MAINTENANCE SUPPLIES:
BASED ON INDUSTRY RANGE OF $US3.60 - $US3.85/CUBIC METER, A
COST OF $3.85 /CUBIC METER HAS BEEN APPLIED.

SHIPPING SUPPLIES:
BASED ON INDUSTRY RANGE OF $US1.95 - $US1.99/CUBIC METER, A
COST OF $2.00 /CUBIC METER HAS BEEN APPLIED.

ELECTRIC POWER:
THE PLANERMILL IS ESTIMATED TO HAVE A CONNECTED LOAD OF
264 KW. THIS HAS BEEN CALCULATED AT HOURS PER DAY,
250 DAYS PER YEAR, 80% DEMAND FACTOR AND 60% LOAD FACTOR.
A RATE OF $0.0923 , AND A DEMAND RATE OF $11.56
PER KVA HAS BEEN APPLIED.
ANNUAL COST= $ 54988

PROCESS FUELS:
THE PLANERMILL WILL NOT CONSUME PROCESS FUELS, THERFORE
A COST O $0.00 /ANNUM HAS BEEN APPLIED.

FUELS AND LUBRICANTS:
BASED ON INDUSTRY RANGE OF $US1.00 - $US1.25/CUBIC METER, A
COST OF $2.00 /CUBIC METER HAS BEEN APPLIED.

APPENDIX 5 - A

PAPUA NEW GUINEA

CONVERSION FACTORS EMPLOYED, SELLING PRICES AND TRANFER PRICES

SELLING PRICES

FINAL PRICING TO BE DETERMINED UPON COMPLETION OF THE INTERNATIONAL AND DOMESTIC MARKET SURVEYS. FOLLOWING IS BASED ON SELECTIVE REVIEW OF CURRENT (MARCH/APRIL, 1993) PRIVE LISTS FROM CURRENT PRODUCERS IN PNG.

PRICES:	K/M3
MIXED HARDWOOD/SOFTWOOD RST - DOMESTIC	256
KWILA/ROSEWOOD, RST - DOMESTIC	384
MIXED HARDWOOD, RST, DIFFUSION DIPPED	279
ROSEWOOD/KWILA RST - EXPORT	450
ROSEWOOD/KWILA DRESSED 4 SIDE - EXPORT	650
KILN DRYING PREMIUM	60
IMPREGNATION PREMIUM	70
PLANING FOUR SIDE PREMIUM	50
PROFILING PREMIUM	100

ASSUMED MIX:

SAWMILL ONLY	RATIO	CONTRIBUTION
MIXED HARDWOOD/SOFTWOOD RST - DOMESTIC	5.00%	13
KWILA/ROSEWOOD, RST - DOMESTIC	55.00%	211
MIXED HARDWOOD, RST, DIFFUSION DIPPED	30.00%	84
ROSEWOOD/KWILA RST - EXPORT	10.00%	45
AVERAGE SALES PRICE		353

DRY KILN/PRESSURE TREATMENT

KILN DRY ONLY		
MIXED HARDWOOD/SOFTWOOD - DOMESTIC	5.00%	16
KWILA/ROSEWOOD - DOMESTIC	55.00%	244
ROSEWOOD/KWILA - EXPORT	35.00%	179
PRESSURE TREATED & KILN DRIED		
MIXED HARDWOOD/SOFTWOOD RST - DOMESTIC	5.00%	19
AVERAGE SALES PRICE	100.00%	458

SELLING PRICES (CON'T)

PLANING/PROFILING		
PLANED ONLY		
MIXED HARDWOOD/SOFTWOOD - DOMESTIC	20.00%	61
KWILA/ROSEWOOD - DOMESTIC	5.00%	22
MIXED HARDWOOD, DIFFUSION DIPPED	5.00%	16
ROSEWOOD/KWILA - EXPORT	10.00%	50
		0
PLANED AND KILN DRIED		
MIXED HARDWOOD/SOFTWOOD - DOMESTIC	10.00%	37
KWILA/ROSEWOOD - DOMESTIC	5.00%	25
MIXED HARDWOOD, DIFFUSION DIPPED	5.00%	19
ROSEWOOD/KWILA - EXPORT	10.00%	65
KILN DRIED AND PROFILED		
MIXED HARDWOOD/SOFTWOOD - DOMESTIC	5.00%	21
MIXED HARDWOOD, DIFFUSION DIPPED	5.00%	22
KWILA/ROSEWOOD - DOMESTIC	10.00%	54
ROSEWOOD/KWILA - EXPORT	10.00%	69
	100.00%	461

TRANSFER PRICES

TRANSFER TO UPGRADE (VALUE ADDED) AT SAME PRICES AS SALES TO OTHER CUSTOMERS

		COST CONTRIBUTION
TO DRY KILNS:		
MIXED HARDWOOD/SOFTWOOD - DOMESTIC	5.00%	13
KWILA/ROSEWOOD - DOMESTIC	55.00%	211
ROSEWOOD/KWILA - EXPORT	35.00%	158
	0.00%	
PRESSURE TREATED	0.00%	
MIXED HARDWOOD/SOFTWOOD RST - DOMESTIC	5.00%	13
AVERAGE TRANSFER PRICE	100.00%	394

TO PLANER/MOULDER:

		COST CONTRIBUTION
PLANED ONLY		
MIXED HARDWOOD/SOFTWOOD - DOMESTIC	20.00%	51
KWILA/ROSEWOOD - DOMESTIC	5.00%	19
MIXED HARDWOOD, DIFFUSION DIPPED	5.00%	14
ROSEWOOD/KWILA - EXPORT	10.00%	45
	0.00%	
	0.00%	
PLANED AND KILN DRIED	0.00%	
MIXED HARDWOOD/SOFTWOOD - DOMESTIC	10.00%	32
KWILA/ROSEWOOD - DOMESTIC	5.00%	22
MIXED HARDWOOD, DIFFUSION DIPPED	5.00%	17
ROSEWOOD/KWILA - EXPORT	10.00%	51
	0.00%	
	0.00%	

KILN DRIED AND PROFILED	0.00%	
MIXED HARDWOOD/SOFTWOOD - DOMESTIC	5.00%	22
MIXED HARDWOOD, DIFFUSION DIPPED	5.00%	17
KWILA/ROSEWOOD - DOMESTIC	10.00%	44
ROSEWOOD/KWILA - EXPORT	10.00%	51
AVERAGE TRANSFER PRICE	100.00%	386

APPENDIX 5 - A

PAPUA NEW GUINEA
LUMBER RECOVERY FROM LOGS

SAWMILL

	FACTOR	CUBIC METERS
LOG INPUT		1.000
LESS LOG TRIM ALLOWANCE	3.33%	0.033
LESS SLABS	30.00%	0.290
LESS KERF	11.00%	0.074
LESS SHRINKAGE	4.00%	0.024
LESS PLANING LOSS	12.70%	0.073
LESS END TRIM	3.33%	0.017
NET LUMBER VOLUME		0.488
PERCENT RECOVERY FROM LOGS		48.79%

APPENDIX 5 - B

PAPUA NEW GUINEA
CASH FLOW PROJECTION - 5 YEARS

SATELLITE SAWMILL

VALUES IN '000$US

ITEM	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
OPERATING LEVEL	40.00%	80.00%	100.00%	100.00%	100.00%
VOLUME OUTPUT (M3	3600	7200	9000	9000	9000
CAPITAL RESIDUAL	938	845	760	684	616
CAPITAL INPUT	1043				
RAW MATERIALS	594	1188	1485	1485	1485
LABOR	64	107	107	107	107
SUPPLIES	69	138	173	173	173
POWER & FUELS	36	61	61	61	61
OVERHEAD	142	189	189	189	189
INTEREST 9.25%	58	52	47	42	38
D/E RATIO 60.00%					
DEPRECIATION 10.00%	104	94	84	76	68
REVENUE	1037	2074	2592	2592	2592
PROFIT/LOSS	-31	245	446	460	471
CASH FLO -1043	74	339	531	536	540

RATE OF RETURN ESTIMATE (GUESS)	20.00%
INTERNAL RATE OF RETURN	21.25%

APPENDIX 5 - B

PAPUA NEW GUINEA
PRO-FORMA ANNUAL COST/REVENUE PROJECTION

SATELLITE SAWMILL

	VALUES IN '000$US			
	UNITS	% OF TOTAL	NUMBER	$/UNIT
STATISTICS:				
OPERATING DAYS	DAYS		250	N/A
LOG INPUT	M3		18563	80.00
SAWNWOOD PRODUCED	M3		9000	293.53
KILN DRIED	M3	0%	0	300.00
PLANED	M3	0%	0	350.00
GREEN RECOVERY	%		48.48%	N/A
FUELWOOD	M3		3713	8.00
REVENUE:			000$	$/UNIT
SAWNWOOD SALES (RST)			2642	293.53
KILNED WOOD SALES			0	0.00
PLANED WOOD SALES			0	0.00
FUELWOOD SALES			30	8.00
LESS ADVERTISING/COMMISS.	3.00%		-79	-8.81
TOTAL SALES			2592	288.03
EXPENSES:	SAWMILL			
LOG COST			1485	165.00
PRODUCTION LABOR			88	9.76
MAINTENANCE LABOR			19	2.08
PRODUCTION SUPPLIES			89	9.93
MAINTENANCE SUPPLIES			66	7.30
SHIPPING SUPPLIES			18	2.00
ELECTRIC POWER			49	5.48
PROCESS FUELS			0	0.00
FUELS & LUBES.			11	1.25
PLANT O/H SALARIES			157	17.42
PLANT O/H EXPENSE			33	3.62
COST OF SALES			2015	223.83
OPERATING PROFIT			578	64.19
DEPRECIATION			104	11.59
OPERATING INCOME			473	52.61

RATIOS:	CASH FLOW	OPERATING INCOME
R.O.I. (%)	55.41%	45.41%
PAYBACK (YEARS)	1.8	2.2

APPENDIX 5 - B

PAPUA NEW GUINEA
CAPITAL COST ESTIMATE

SATELLITE SAWMILL

SAWMILL	VALUES IN '000$US		
ITEM	LOAD HP	CUBIC M3	COST 000$US
LAND			30
SITE PREPARATION			169
ACCESS ROADS			5
WATER SYSTEM			5
BUILDINGS AND FOUND.			72
ELECTROGENERATION			60
MOBILE S/M, RIGHT HAND	87	20	45
MOBILE S/M, LEFT HAND	87	20	45
OUTFEED DECK			3
RESAW INFEED TRANSFER			3
RESAW INFEED ROLLCASE	10		2.5
CIRCULAR RESAW	40	10	65
RESAW OUTFEED ROLLCASE			2.5
INFEED TRANS. - TRIMSAW			3
TRIMSAW	10	2	7.5
TRIMSAW OUTFEED/SORTING	10		3
WASTE HANDLING	40	10	20
STRAPPER		0.5	1.5
AIR SYSTEM	10	0.5	4
MAINT. & FILING	10	1	7
SPARE PARTS		2	19
LOG LOADER			60
FORKLIFTS			40
TOTALS	304	66	672
IMORT DUTY & TAXES @	10.00% OF EQUIP.		29
ELECTRICAL INSTALLATION @	$150.00 / HP		46
MECHANICAL INSTALLATION @	10.00% OF MECH		57
OCEAN FREIGHT @ $240.00 /M3			16
INLAND FREIGHT (EST.)			20
SUBTOTAL			840
ENGINEERING & TRAINING @	10.00% OF EQUIP.		67
SUBTOTAL			907
CONTINGENCY @	15.00% OF PROJECT COST		136
TOTAL ESTIMATED COST SAWMILL			1043

DEPRECIATION: 10 YEAR STRAIGHT LINE ON TOTAL INVESTMENT COS

= 10.00% 1043 = 104 $US

LAND AREA :	3	HECTARES		
LAND VALUE :	$10,000	PER HECTARE =		30000
SITE PREP @	$25,000	PER HECTARE =		75000
GRAVEL 15000	M2 @	$6.25	PER SQUARE METER =	93750
SITE PREPARATION				168750
BUILDING	420 M2 @	$60.00	PER SQUARE METER =	25200
FLOORS	420 M2 @	$90.00	PER SQUARE METER =	37800
FOUND.	10 M3 @	$900.00	PER CUBIC METER =	9000
BUILDINGS, FLOORS AND FOUNDATIONS				72000

NOTE: LAND VALUE HAS BEEN ASSIGNED, ALONG WITH ACCESS COST.
THIS MAY BECOME PART OF LANDOWNER'S EQUITY IN INVESMENT

APPENDIX 5 - B

PAPUA NEW GUINEA
MANNING AND LABOR COSTS

SATELLITE SAWMILL

POSITION	RATE $/DAY	NUMBER PER SHIFT SHIFT 1	SHIFT 2	SHIFT 3	TOTAL	COST $/DAY
PRODUCTION LABOR		COSTS IN $US				
LIFT TRUCK OP.	16.00	1			1	16.00
SAWYER	16.00	2			2	32.00
ASST. SAWYER	14.50	2			2	29.00
OFFBEARER	12.50	2			2	25.00
RESAW INFEED	13.50	1			1	13.50
RESAW OP.	15.00	1			1	15.00
RESAW O/B	12.50	1			1	12.50
GRADER	15.00	1			1	15.00
TRIM SAW OP.	14.00	1			1	14.00
SORTERS	13.50	4			4	54.00
CLEAN UP	12.50	2			2	25.00
					0	0.00
					0	0.00
					0	0.00
TOTAL		18	0	0	18	251.00
PLUS FRINGE BENEFITS @			40.00%			100.4
TOTAL OPERATING LABOR/DAY						351.4
MAINTENANCE & TECHNICAL						
MILLWRIGHTS	19.00	2			2	38.00
ELECTRICIANS	19.00				0	0.00
TECHNICAL	19.00				0	0.00
GRINDERMAN	15.50	1			1	15.50
					0	0.00
TOTAL		3	0	0	3	53.50
PLUS FRINGE BENEFITS @			40.00%			21.4
TOTAL MAINTENANCE LABOR/DAY						74.9
TOTAL MANNING					21	

APPENDIX 5 - B

PAPUA NEW GUINEA
PLANT OVERHEAD

SATELLITE SAWMILL

WAGES: COSTS IN $US

POSITION	RATE $/ANNUM	NUMBER	COST $/YEAR
PLANT MANAGER	38000	1	38000
SHIFT SUPERVISORS	18000	0	0
CONTROLLER	20000	1	20000
RECEPT/ADMIN	12000	1	12000
PAROLL/SHIP.	11000	0	0
GUARDS	14000	3	42000
	TOTAL WAGES	6	112000
	PLUS FRINGES @	40.00%	44800
	TOTAL PAYROLL COST		156800

EXPENSES:	$/ANNUM	
SUPPLIES	500	
TEL & TEL.	500	
INSURANCE	8342	$0.80 /$100 of capital
AUDIT/LEGAL	8000	
TAXES	5213	$0.50 /$100 of capital
TRAVEL	10000	
TOTAL	32555	

TOTAL MANNING INCL. O/H 27

APPENDIX 5 - B

PAPUA NEW GUINEA
OPERATING/MAINTENANCE SUPPLIES & CONSUMABLES

SATELLITE SAWMILL

COSTS IN $US

PRODUCTION SUPPLIES

BASED ON INDUSTRY RANGE OF $US3.75 - $US4.30/CUBIC METER, A COST OF $4.30 /CUBIC METER HAS BEEN APPLIED.
ADDITIVE TO THE COST OF GENERAL PRODUCTION SUPPLIES IS DIFFUSION DIP CHEMICALS. 25.00% OF ALL PRODUCTION WILL BE TREATED AT A COST OF $22.50 PER CUBIC METER, FOR AN AGGREGATE COST OF $9.93 /CUBIC METER

MAINTENANCE SUPPLIES:

BASED ON INDUSTRY RANGE OF $US6.80 - $US7.30/CUBIC METER, A COST OF $7.30 /CUBIC METER HAS BEEN APPLIED.

SHIPPING SUPPLIES

BASED ON INDUSTRY RANGE OF $US1.95 - $US1.99/CUBIC METER, A COST OF $2.00 /CUBIC METER HAS BEEN APPLIED.

ELECTRIC POWER

THE SAWMILL PLANT IS ESTIMATED TO HAVE A CONNECTED LOAD OF 226 KW. THIS WILL BE SUPPLIED FROM A 175 KVA GENERATOR OPERATIN 250 DAYS PER YEAR, 9 HOURS PER DAY CONSUMING 70 LITRES PER HOUR @ $0.313 PER LITER HAS BEEN CALCULATED.

ANNUAL COST= $ 49298

PROCESS FUELS

THE SATELLITE SAWMILL WILL NOT CONSUME PROCESS FUELS, THEREFORE A COST OF $0.00 / ANNUM HAS BEEN APPLIED.

FUELS AND LUBRICANTS:

BASED ON INDUSTRY RANGE OF $US1.00 - $US1.25/CUBIC METER, A COST OF $1.25 /CUBIC METER HAS BEEN APPLIED.

APPENDIX 5 - B

PAPUA NEW GUINEA
LUMBER RECOVERY FROM LOGS

SATELLITE SAWMILL

	FACTOR	CUBIC METERS
LOG INPUT		1.000
LESS LOG TRIM ALLOWANCE	5.00%	0.050
LESS SLABS	35.00%	0.333
LESS KERF	13.00%	0.080
LESS OVERSAW	5.00%	0.027
LESS END TRIM	5.00%	0.026
NET LUMBER VOLUME		0.485
PERCENT RECOVER FROM LOGS		48.48%

APPENDIX 5 - B

PAPUA NEW GUINEA
CONVERSION FACTORS EMPLOYED, SELLING PRICES

SATELLITE SAWMILL

	COMPANY		PNG	STETTIN	STETTIN		
	DATE		1/9/91	01/01/93	01/01/93		
			DIP	UNTREAT	TREATED	DIP	UNTREAT
DOMESTIC RST		CO:				PNG	STETTIN
DIPPED	NOM	L/M	KINA FOB			KINA FOB	KINA FOB
GROUP 6	SIZE	PER M3	PER L/M			PER M3	PER M3
	50X 25	800	0.35			280	0
	75X25	533.333	0.52	0.49	0.61	277	261
	100X25	400	0.70	0.64	0.81	280	256
	125X25	320	0.87	0.80	1.02	278	256
	150X25	266.667	1.05	0.96	1.22	280	256
	175X25	228.571	1.22	1.12	1.42	279	256
	200X25	200	1.40	1.28	1.62	280	256
	250X25	160	1.75	1.59	2.03	280	254
	300X25	133.333	2.10	1.91	2.44	280	255
					AVERAGE	279	256
GROUP 7	50X38	526.315	0.53			279	0
	75X38	350.817	0.80			281	0
	100X38	263.157	1.06			279	0
	125X38	210.562	1.33			280	0
	150X38	175.438	1.60			281	0
	200X38	131.578	2.13			280	0
	250X38	105.263	2.66			280	0
	300X38	87.719	3.19			280	0
					AVERAGE	280	
							0
	50X50	400	0.70			280	0
	75X50	266.667	1.05			280	0
	100X50	200	1.40			280	0
	125X50	160	1.75			280	0
	150X50	133.333	2.10			280	0
	200X50	100	2.80			280	0
	250X50	80	3.50			280	0
	300X50	66.667	4.20			280	0
						0	0
	75X75	177.778	1.57			279	0
	100X75	133.333	2.10			280	0
	125X75	106.667	2.62			279	0
	150X75	88.889	3.15			280	0
	200X75	66.667	4.20			280	0
	250X75	53.333	5.25			280	0
	300X75	44.444	6.30			280	0
						0	0
	100X100	100	2.80			280	0

DRESSED GROUP 6	NOM SIZE	L/M PER M3	KINA FOB PER L/M		
	50X 25	800	0.39		312
	75X25	533.333	0.59		315
	100X25	400	0.79		316
	125X25	320	0.98		314
	150X25	266.667	1.18		315
	175X25	228.571	1.38		315
	200X25	200	1.58		316
	250X25	160	1.97		315
	300X25	133.333	2.36		315
				AVERAGE	315
GROUP 7	50X38	526.315	0.57		300
	75X38	350.817	0.85		298
	100X38	263.157	1.14		300
	125X38	210.562	1.42		299
	150X38	175.438	1.71		300
	200X38	131.578	2.28		300
	250X38	105.263	2.85		300
	300X38	87.719	3.42		300
					0
	50X50	400	0.75		300
	75X50	266.667	1.12		299
	100X50	200	1.50		300
	125X50	160	1.87		299
	150X50	133.333	2.25		300
	200X50	100	3.00		300
	250X50	80	3.75		300
	300X50	66.667	4.50		300
					0
	75X75	177.778	1.69		300
	100X75	133.333	2.25		300
	125X75	106.667	2.81		300
	150X75	88.889	3.37		300
	200X75	66.667	4.50		300
	250X75	53.333	5.62		300
	300X75	44.444	6.75		300
					0
	100X100	100	3.00		300

KWILA RST VANIMO MARCH,1993

50X 25	800		280
75X25	533.333		350
75X50	266.667		350
100X50	200		425
250X50	80		425
300X50	66.667		425
75X75	177.778		400
100X100	100		420
		AVERAGE	384

AVERAGE PRICES:

	K/M3
MIXED HARDWOOD/SOFTWOOD, RST	256
KWILA/ROSEWOOD, RST DOMESTIC	384
MIXED HARDWOODS, RST, DIFFUSION DIP	279
KWILA/ROSEWOOD, RST EXPORT	450

ASSUMED MIX:

GROUP	RATIO	CONTRIBUTION
MIXED HARDWOOD/SOFTWOOD, RST	53.00%	136
KWILA/ROSEWOOD, RST DOMESTIC	17.00%	65
MIXED HARDWOODS, RST, DIFFUSION DIP	25.00%	70
KWILA/ROSEWOOD, RST EXPORT	5.00%	23

AVERAGE NET MILL PRICE		294

APPENDIX 5 - C

PAPUA NEW GUINEA
CASH FLOW PROJECTION - 10 YEARS

PLYWOOD

VALUES IN '000$US

ITEM	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
OPERATING LEVEL	0.00%	40.00%	80.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
VOLUME OUTPUT (M3	0	12000	24000	30000	30000	30000	30000	30000	30000	30000
CAPITAL RESIDUAL	15160	13644	12279	11051	9946	8952	8057	7251	6526	5873
CAPITAL INPUT	16844									
RAW MATERIALS	0	3773	7546	9432	9432	9432	9432	9432	9432	9432
LABOR	91	683	911	911	911	911	911	911	911	911
SUPPLIES	0	529	1058	1322	1322	1322	1322	1322	1322	1322
POWER & FUELS	0	569	853	948	948	948	948	948	948	948
OVERHEAD	437	874	874	874	874	874	874	874	874	874
INTEREST 9.25%	779	701	631	568	511	460	414	373	335	302
D/E RATIO 50.00%										
DEPRECIATION 10.00%	1516	1364	1228	1105	995	895	806	725	653	587
REVENUE	0	8199	16398	20498	20498	20498	20498	20498	20498	20498
PROFIT/LOSS	-2823	-294	3298	5337	5505	5655	5791	5913	6022	6121
CASH FLO -16844	-1307	1070	4525	6442	6499	6550	6596	6638	6675	6709

RATE OF RETURN ESTIMATE (GUESS)	30.00%
INTERNAL RATE OF RETURN	18.90%

NOTE: DEBT CAPITAL IS REDUCED BY 10% OF RESIDUAL PER YEAR
DEPRECIATION IS ON DECLINING SCALE OF RESIDUAL

APPENDIX 5 - C

PAPUA NEW GUINEA
PRO-FORMA ANNUAL COST/REVENUE PROJECTION

PLYWOOD

		VALUES IN $US		
	UNITS	% OF TOTAL	NUMBER	$/UNIT
STATISTICS:				
OPERATING DAYS	DAYS		250	N/A
LOG INPUT	M3		62882	150.00
PLYWOOD PRODUCED	M3		30000	697.50
KILN DRIED	M3	0%	0	300.00
PLANED	M3	0%	0	350.00
RECOVERY FROM LOGS	%		47.71%	N/A
GREEN WASTE	M3	39.82%	25040	8.00
REVENUE:			000$	$/UNIT
PLYWOOD SALES			20925	697.50
KILNED WOOD SALES			0	300.00
PLANED WOOD SALES			0	350.00
GREEN WASTE SALES			200	8.00
LESS ADVERTISING/COMMISS.	3.00%		-628	-20.93
TOTAL SALES			20498	683.25
EXPENSES:	PLYWOOD			
LOG COST			9432	314.41
PRODUCTION LABOR			729	24.30
MAINTENANCE LABOR			182	6.08
PRODUCTION SUPPLIES			231	7.70
GLUE SUPPLIES			653	21.75
FINISHING SUPPLIES			59	1.97
MAINTENANCE SUPPLIES			312	10.40
SHIPPING SUPPLIES			68	2.25
ELECTRIC POWER			897	29.90
PROCESS FUELS			0	0.00
FUELS & LUBES.			51	1.70
PLANT O/H SALARIES			584	19.46
PLANT O/H EXPENSE			290	9.67
COST OF SALES			13487	449.57
OPERATING PROFIT			7010	233.68
DEPRECIATION			1684	56.15
OPERATING INCOME			5326	177.53

RATIOS:	CASH FLOW	OPERATING INCOME
R.O.I. (%)	41.62%	31.62%
PAYBACK (YEARS)	2.4	3.2

APPENDIX 5 - C

PAPUA NEW GUINEA
CAPITAL COST ESTIMATE
PLYWOOD

PLYWOOD — VALUES IN '000$US

ITEM	LOAD HP	CUBIC M3	COST '000$US
LAND			50
SITE PREPARATION			225
ACCESS ROADS			25
WATER SYSTEM	40		40
BUILDINGS	100		883
ELECTROGENERATION			
LOG INFEED	100	40	50
SLASHING DECK	50	10	60
DEBARKER	90	14	250
CONDITIONING VATS	15	5	350
OVERHEAD CRANE	20	0.5	20
LATHE INFEED	20	6	120
LATHE	650	60	1200
REELING SYSTEM/STORAGE	40	40	350
CLIPPERS	20	12	200
DRYERS	200	120	950
VENEER COMPOSITING	60	20	450
GLUE MIXER	20	2	60
GLUE SPREADERS	30	10	150
PRE-PRESS	100	12	160
HOT PRESS	300	80	1000
SAWLINE/GRADING	125	48	200
SANDER	450	24	550
BLOW LINES	300	40	350
WASTE SYSTEMS	250	40	300
HEATING PLANT	225	60	1200
MAINT. SHOP	60	10	250
LOG LOADER		45	350
FORKLIFTS		27	160
TOTALS	3265	726	9953

IMPORT DUTY/TAXES	10%	OF EQUIP.	995
ELECTRICAL INSTALLATION @$	360	/ HP	1175
MECHANICAL INSTALLATION @	17%	OF MECH	1605
OCEAN FREIGHT @$	140	/M3	102
INLAND FREIGHT (EST.)			20
SUBTOTAL			13851
ENGINEERING & P.M. @	0.08	OF EQUIP.	796
SUBTOTAL			14647
CONTINGENCY @	15%	OF PROJECT COST	2197
TOTAL ESTIMATED COST PLYWOOD			16844

APPENDIX 5 - C

PAPUA NEW GUINEA
MANNING AND LABOR COSTS
PLYWOOD

POSITION	RATE $/DAY	NUMBER PER SHIFT SHIFT 1	SHIFT 2	SHIFT 3	TOTAL	COST $/DAY
PRODUCTION LABOR						
YARD MACHINE OP.	16.67	1	1		2	33.34
YARD LABOR	13.34	1	1		2	26.68
DEBARKER OP.	15.33	1	1		2	30.66
DEBARKER LABOR	13.34	1	1		2	26.68
COND VAT OP.	15.33	1	1	1	3	45.99
DECKMAN	13.34	1	1	1	3	40.02
LATHE OP.	16.67	1	1	1	3	50.01
ASS'T. LATHE OP.	15.33	1	1	1	3	45.99
REELING LABOR	13.34	6	6	6	18	240.12
GREEEN CLIPPER OP.	15.33	1	1	1	3	45.99
GREEN CHAIN	13.34	4	4	4	12	160.08
DRY CLIPPER OP.	15.33	1	1	1	3	45.99
DRYCHAIN O/B	13.34	4	4	4	12	160.08
FORKLIFT OP.	15.33	1	1	1	3	45.99
VENEER PREP.	13.34	4	4	4	12	160.08
GLUE MIXER	14.21	1	1		2	28.42
FORKLIFT OP.	15.33	1	1		2	30.66
CORE FEEDER	13.34	2	2		4	53.36
CORE LAYER	13.34	6	6		12	160.08
PRESS OP.	15.33	1	1		2	30.66
ASS'T. PRESS OP.	14.21	1	1		2	28.42
FORKLIFT OP.	15.33	1	1		2	30.66
SAW FEEDERS	13.34	2	2		4	53.36
SAW OP.	14.21	1	1		2	28.42
SANDER OP.	15.33	1	1		2	30.66
GRADER	14.21	1	1		2	28.42
GRADE LABOR	13.34	3	3		6	80.04
PATCHERS	13.34	4	4		8	106.72
STRAPPERS	13.34	2	2		4	53.36
FORKLIFT OP.	15.33	1	1		2	30.66
CLEAN-UP	12.57	4	4	4	12	150.84
TOTAL		61	61	29	151	2082.44
PLUS FRINGE BENEFITS @			40.00%			832.98
TOTAL OPERATING LABOR/DAY						2915.42
MAINTENANCE & TECHNICAL						
MILLWRIGHTS	19.00	3	2	2	7	133.00
ELECTRICIANS	19.00	2	1	1	4	76.00
TECHNICAL	19.00	1	1	1	3	57.00
GRINDERMAN	15.50	1			1	15.50
BOILERHOUSE	16.67	2	2	2	6	100.02
TRAINEES	15.50	3	3	3	9	139.50
TOTAL		12	9	9	30	521.02
PLUS FRINGE BENEFITS @			40.00%			208.41
TOTAL MAINTENANCE LABOR/DAY						729.43
TOTAL MANNING			181			

APPENDIX 5 - C

PAPUA NEW GUINEA
PLANT OVERHEAD

PLYWOOD

WAGES:

POSITION	RATE $/ANNUM	NUMBER	COST $/YEAR
PLANT MANAGER	100000	1	100000
SHIFT SUPERVISORS	45000	3	135000
CONTROLLER	55000	1	55000
RECEPT/ADMIN	12000	6	72000
PAROLL/SHIP.	21000	1	21000
GUARDS	14000	6	84000
	TOTAL WAGES	18	467000
	PLUS FRINGES @	25.00%	116750
	TOTAL PAYROLL COST		583750

EXPENSES:	$/ANNUM	
SUPPLIES	5000	EST.
TEL & TEL.	6000	EST.
INSURANCE	134753	0.80 / $100 OF CAPITAL
AUDIT/LEGAL	30000	EST.
TAXES	84221	0.50 / $100 OF CAPITAL
TRAVEL	30000	EST.
TOTAL	289974	

TOTAL MANNING INC. O/H 199

APPENDIX 5 - C

PAPUA NEW GUINEA

OPERATING/MAINTENANCE SUPPLIES & CONSUMABLES

PLYWOOD

PRODUCTION SUPPLIES

BASED ON INDUSTRY RANGE OF $US4.75 - $US7.70/CUBIC METER, A
COST OF $ 7.70 /M3 HAS BEEN USED.

GLUE SUPPLIES

BASED ON AN INDUSTRY COST OF $US14.50 - $US21.75/CUBIC METER, A
COST OF $ 21.75 /M3 HAS BEEN USED

FINISHING SUPPLIES

BASED ON AN INDUSTRY RANGE OF $US1.80 - $US 1.97/CUBIC METER, A
COST OF $ 1.97 HAS BEEN USED.

MAINTENANCE SUPPLIES

BASED ON AN INDUSTRY RANGE OF $US7.40 - $US10.40/CUBIC METER, A
COST OF $ 10.40 /M3 HAS BEEN USED.

SHIPPING SUPPLIES

BASED ON an INDUSTRY RANGE OF $US1.75 - $US2.25/CUBIC METER, A
COST OF $ 2.25 /MSF HAS BEEN USED

ELECTRIC POWER

THE PLYWOOD PLANT IS ESTIMATED TO HAVE A CONNECTED LOAD OF
2432 KW. THIS HAS BEEN CALCULATED AT 20 HOURS PER DAY,
250 DAYS PER YEAR, 80% DEMAND FACTOR AND 60% LOAD FACTOR.
A RATE OF $0.0923 /KWH, AND DEMAND RATE OF $11.56
PER KVA HAS BEEN APPLIED
ANNUAL COST= $ 896898

PROCESS FUELS

THE PLYWOOD PLANT IS EXPECTED TO BE SELF SUFFICIENT IN
FUEL SUPPLY FROM BARK, SAWDUST, SANDERDUST AND OTHER WOOD WASTE
SOURCES.
A COST OF $ 0.00 HAS BEEN APPLIED

FUELS AND LUBRICANTS:

BASED ON an INDUSTRY RANGE OF $US1.60 - $US1.70/CUBIC METER, A
COST OF $ 1.70 /MSF HAS BEEN USED

APPENDIX 5 - C

PAPUA NEW GUINEA
RECOVERY TO PLYWOOD FROM ROUNDWOOD

PLYWOOD

BLOCK LENGTH	2640 mm				
SPUR LENGTH	2540 mm				
TAPER	10 mm/BLOCK				
CORE DIAMETER	150 mm				
	TOP DIAMETER INSIDE BARK - mm				
	500	600	700	800	900
DISTRIBUTION BY POP. (%)	15.00%	20.00%	30.00%	20.00%	15.00%
TOTAL = 100.00%					
GROSS VOLUME - M3	0.529	0.759	1.031	1.344	1.698
LESS:					
CORE LOSS - M3	0.047	0.047	0.047	0.047	0.047
SPUR LOSS - M3	0.018	0.027	0.037	0.049	0.063
ROUND-UP - M3	0.005	0.006	0.007	0.008	0.009
GROSS GREEN PEEL - M3	0.459	0.679	0.940	1.240	1.580
CLIPPING LOSS - M3	0.161	0.238	0.329	0.434	0.553
35.00%					
DRY LOSS - M3	0.024	0.035	0.049	0.064	0.082
8.00%					
TRIM LOSS - M3	0.023	0.035	0.048	0.063	0.080
8.50%					
RECOVERED FROM BLOCKS - M3	0.251	0.372	0.514	0.678	0.865
PERCENT REC. FROM BLOCKS	47.48%	48.97%	49.89%	50.49%	50.91%
LESS:					
LOG TRIM ALLOWANCE	0.021	0.030	0.041	0.054	0.068
4.00%					
NET RECOVERY FROM LOGS	45.65%	47.09%	47.97%	48.55%	48.95%
AVERAGE RECOVERY FROM MIX	47.71%				
RECOVERABLE GREEN WASTE	0.231	0.317	0.420	0.538	0.671
USABLE GREEN WASTE	41.92%	40.21%	39.17%	38.48%	38.01%
GREEN WASTE FROM MIX =	39.82%				

APPENDIX 5 - C

PAPUA NEW GUINEA
CONVERSION FACTORS EMPLOYED, SELLING PRICES
PLYWOOD

INTERIOR: THICKNES mm	PANELS /M3	PRICE/PANEL BY GRADE: K/PANEL COMMONS	MERCH	PRUPLY	PRICE/M3 BY GRADE: K/PANEL COMMONS	MERCH	PRUFPLY
3	112.0	7.12	7.88	7.91	797.28	882.38	885.74
4	84.0	8.45	9.38	9.70	709.65	787.76	814.63
6	56.0	10.48	11.52	11.79	586.76	644.99	660.10
6	56.0				0.00	0.00	0.00
9	37.3	18.63	19.68	20.30	695.38	734.57	757.71
12	28.0	23.04	24.14	24.97	644.99	675.78	699.02
15	22.4	24.44	29.08	29.98	547.34	651.26	671.41
18	18.7	38.19	39.95	40.96	712.73	745.58	764.43
25	13.4	46.59	49.00	50.57	626.04	658.43	679.52
			AVERAGE		665.02	722.59	741.57
			AVERAGE INTERIOR			709.73	

WATERPROOF EXTERIOR:

		EXTERIOR	MARINE	EXTERIOR	MARINE
3	112.0	12.36	15.71	1384.04	1759.16
4	84.0	13.90	17.26	1167.36	1449.54
6	56.0	16.52	20.06	924.93	1123.13
6	56.0	23.01	26.22	1288.30	1468.02
9	37.3	27.24	32.24	1016.75	1203.53
12	28.0	32.24	38.07	902.54	1065.74
15	22.4	38.76	45.84	868.05	1026.61
18	18.7	52.86	61.50	986.52	1147.76
25	13.4	65.97	0.00	886.46	0.00
			AVERAGE	1047.21	1280.44
			AVERAGE EXTERIOR		1163.83

DOOR SKINS: (2052 X 832)

		HMR	EXT	HMR	EXT
3	195.2	5.32	8.35	1038.70	1630.29
4	146.4	6.34	9.38	928.39	1373.54
6	97.6	7.36	10.41	718.50	1016.25
			AVERAGE	895.19	1340.03
			AVERAGE DOORSKIN		1117.61

ASSUMED MIX:

GRADE	RATIO	CONTRIBUTION
INTERIOR	40.00%	283.89
EXTERIOR	55.00%	640.10
DOORSKIN	5.00%	55.88
AVERAGE MIX PRICE:		979.88

LESS REJECT AT 10.00% = 881.89

SOURCE: PNG FOREST PRODUCTS PTY LIMITED
PRICE LIST: FEB. 1/93

AVERAGE EXPORT PRICE FOR TROPICAL HARDWOOD PLYWOOD (FEB. 1993)
IS REPORTED AT $775.00 /CUBIC METER. TO THIS A FACTOR OF
10.00% REJECT HAS BEEN APPLIED. EXPORT PRICE: $697.50 /M3

APPENDIX 5 - D

PAPUA NEW GUINEA
CASH FLOW PROJECTION - 10 YEAR

MEDIUM DENSITY FIBREBOARD (MDF)

VALUES IN '000$US

ITEM	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
OPERATING LEVEL	0.00%	50.00%	75.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
VOLUME OUTPUT (M3	0	15000	22500	30000	30000	30000	30000	30000	30000	30000
CAPITAL RESIDUAL	19722	17750	15975	14377	12940	11646	10481	9433	8490	7641
CAPITAL INPUT	21914									
RAW MATERIALS	0	225	338	451	451	451	451	451	451	451
LABOR	0	290	436	484	484	484	484	484	484	484
SUPPLIES	0	908	1362	1816	1816	1816	1816	1816	1816	1816
POWER & FUELS	0	754	1358	1509	1509	1509	1509	1509	1509	1509
OVERHEAD	187	562	749	749	749	749	749	749	749	749
INTEREST 9.25%	1014	912	821	739	665	598	539	485	436	393
D/E RATIO 50.00%										
DEPRECIATION 10.00%	2191	1972	1775	1597	1438	1294	1165	1048	943	849
REVENUE	0	5166	7749	10333	10333	10333	10333	10333	10333	10333
PROFIT/LOSS	-3392	-458	911	2988	3221	3432	3621	3791	3945	4082
CASH FLO -21914	-2379	454	1732	3727	3886	4030	4160	4276	4381	4475

RATE OF RETURN ESTIMATE (GUESS) 30.00%

APPENDIX 5 - D

PAPUA NEW GUINEA
PRO-FORMA ANNUAL COST/REVENUE PROJECTION

MEDIUM DENSITY FIBREBOARD (MDF)

	VALUES IN '000$US			
	UNITS	% OF TOTAL	NUMBER	$/UNIT
STATISTICS:				
OPERATING DAYS	DAYS		250	N/A
FIBRE INPUT, SWE	M3		56320	8.00
MDF PRODUCED	M3		30000	351.45
VENEER O/L SALES	M3	0%	0	300.00
HIGH DEN. O/L SALES	M3	0%	0	350.00
GREEN RECOVERY	%		53%	N/A
FUELWOOD	M3		0	8.00
BOARD DENSITY	KG/CUBIC METER		760	N/A
REVENUE:			000$	$/UNIT
MDF SALES			10544	351.45
VENEER O/L SALES			0	0.00
HIGH DEN. O/L SALES			0	0.00
FUELWOOD SALES			0	0.00
LESS ADVERTISING/COMMISS.	0.02		-211	-7.03
TOTAL SALES			10333	344.42
EXPENSES:	MDF			
FIBRE INPUT			451	15.02
PRODUCTION LABOR			309	10.28
MAINTENANCE LABOR			176	5.85
PRODUCTION SUPPLIES			195	6.50
GLUE SUPPLIES			1426	47.52
FINISHING SUPPLIES			0	0.00
MAINTENANCE SUPPLIES			135	4.50
SHIPPING SUPPLIES			60	2.00
ELECTRIC POWER			1464	48.80
PROCESS FUELS			0	0.00
FUELS & LUBES.			45	1.50
PLANT O/H SALARIES			393	13.11
PLANT O/H EXPENSE			356	11.86
COST OF SALES			5009	166.95
OPERATING PROFIT			5324	177.47
DEPRECIATION			2191	73.05
OPERATING INCOME			3133	104.42

RATIOS:	CASH FLOW	OPERATING INCOME
R.O.I. (%)	24.30%	14.30%
PAYBACK (YEARS)	4.1	7.0

APPENDIX 5 - D PAPUA NEW GUINEA
CAPITAL COST ESTIMATE
MDF VALUES IN '000$US

ITEM	LOAD HP	CUBIC M3	COST '000$US
LAND	0	0	30
SITE PREPARATION	0	0	169
ACCESS ROADS	0	0	20
WATER SYSTEM	30	0	40
BUILDINGS & FOUNDATIONS	150	0	1074
ENERGY SYSTEM	175	80	1200
LOG INFEED	75	80	350
DEBARKER	350	20	450
CHIPPER	450	20	750
CHIP RECLAIM/WASHER	50	20	250
INFEED CONVEYORS	50	40	125
DEFIBRATOR	2500	20	1500
BLOW LINE DRYER	400	120	350
RESIN/WAX SYSTEMS	20	20	95
METERING BIN	15	10	125
BLOW LINES AND CYCLONES	120	40	300
INFEED CONVEYORS	20	20	75
FORMING LINE	300	120	2250
PRESS SYSTEM	550	220	2800
COOLER	75	80	130
SANDING LINE	450	60	350
SAWLINE/GRADELINE	125	60	250
BLOW LINES	75	40	100
WASTE SYSTEMS	75	20	100
AIR SYSTEM	150	3	100
MAINT. SHOP	40	5	125
LOG LOADER	0	0	350
FORKLIFTS	0	0	90
TOTALS	6245	1098	13548

IMPORT DUTY/TAXES	0% OF EQUIPT.	0
ELECTRICAL INSTALLATION @	$360.00 / HP	2248
MECHANICAL INSTALLATION @	17.00% OF MECH	2002
OCEAN FREIGHT @	$140.00 /M3	154
INLAND FREIGHT (EST.)		20
SUBTOTAL		17971
ENGINEERING & P.M. @	8.00% OF EQUIP.	1084
SUBTOTAL		19055
CONTINGENCY @	15.00% OF PROJECT COST	2858
TOTAL ESTIMATED COST MDF		21914

TABLE (CONTINUED)

DEPRECIATION: 10 YEAR STRAIGHT LINE ON TOTAL INSTALLED COST

= 10% 21914 = 2191

					$US
LAND AREA :		3	HECTARES		
LAND VALUE :		$10,000	PER HECTARE =		30000
SITE PREP @		$25,000	PER HECTARE =		75000
GRAVEL	15000 M2 @		$6.25	PER SQUARE METER =	93750
		SITE PREPARATION			168750
BUILDING	6140 M2 @		$60.00	PER SQUARE METER =	368400
FLOORS	6140 M2 @		$90.00	PER SQUARE METER =	552600
FOUND.	170 M3 @		$900.00	PER CUBIC METER =	153000
		BUILDINGS, FLOORS AND FOUNDATIONS			1074000

APPENDIX 5 - D

PAPUA NEW GUINEA
MANNING AND LABOR COSTS
3 SHIFT OPERATION, 5 DAYS/WEEK = 250 DAYS/YEA
MDF

POSITION	RATE $/DAY	NUMBER PER SHIFT SHIFT 1	SHIFT 2	SHIFT 3	TOTAL	COST $/YEAR
PRODUCTION LABOR		COSTS IN $US				
LOG LOADER	13.44	1	1		2	6720
DEBARKER OPERATO	13.44	1	1		2	6720
ASS'T DEBARKER	12.30	1	1		2	6150
RECLAIM OPERATOR	13.44	1	1	1	3	10080
DEFIBRATOR OP.	16.67	1	1	1	3	12503
ASS'T DEF. OP.	15.33	1	1	1	3	11498
FORMING/PRESS OP.	16.67	1	1	1	3	12503
ASS'T FORM OP.	15.33	1	1	1	3	11498
SANDER OP.	16.67	1	1		2	8335
ASS'T SANDER OP.	15.33	1	1		2	7665
FORKLIFT OP.	13.44	1	1		2	6720
SAWLINE OP.	15.33	1	1		2	7665
ASS'T SAWLINE OP.	14.21	1	1		2	7105
STRAPPERS	12.57	6	4		10	31425
LOADING F/L OP.	13.44	1	1		2	6720
UTILITY	12.57	6	6		12	37710
GUARDS	12.57	2	2	2	6	18855
TOTAL		28	26	7	61	209870
PLUS OVERTIME @		5%				10494
PLUS FRINGE BENEFITS @			40.00%			88145
TOTAL OPERATING LABOR/YEAR						308509
MAINTENANCE & TECHNICAL						
MILLWRIGHTS	19.36	2	2	2	6	29040
ELECTRICIANS	19.36	2	2	2	6	29040
TECHNICAL	19.36	2	1	1	4	19360
GRINDERMAN	18.01	1			1	4503
HEATING PLT OP.	18.01	1	1	1	3	13508
HEATING PLT. ASST.	14.21	1	1	1	3	10658
UTILITY	12.57	2	1	1	4	12570
TOTAL		11	8	8	27	118678
PLUS OVERTIME @			8.00%			9494
PLUS FRINGE BENEFITS @			40.00%			47471
TOTAL MAINTENANCE LABOR/YEAR						175643
TOTAL HOURLY LABOR			88			

APPENDIX 5 - D

PAPUA NEW GUINEA
PLANT OVERHEAD

MDF

WAGES: COSTS IN $US

POSITION	RATE $/ANNUM	NUMBER	COST $/YEAR
PLANT MANAGER	100000	1	100000
SHIFT SUPERVISORS	37000	3	111000
CONTROLER	37000	1	37000
RECEPT/ADMIN	5000	3	15000
PAYROLL	3000	1	3000
SHIPPER	15000	1	15000
	TOTAL WAGES	10	281000
	PLUS FRINGES @	40.00%	112400
	TOTAL PAYROLL COST		393400

EXPENSES:	$/ANNUM	BASIS
SUPPLIES	5000	EST.
TEL & TEL.	6000	EST.
INSURANCE	175308	$0.80 / $100 OF CAPITAL
AUDIT/LEGAL	30000	EST.
TAXES	109568	$0.50 / $100 OF CAPITAL
TRAVEL	30000	EST.
TOTAL	355876	

TOTAL MANNING INCLUDING OVERHEAD 98

APPENDIX 5 - D

PAPUA NEW GUINEA

OPERATING/MAINTENANCE SUPPLIES & CONSUMABLES

MDF

COSTS IN $US

PRODUCTION SUPPLIES

PRODUCTION SUPPLY INCLUDES ALL ITEMS OF PRODUCTION CONSUMABLE INCLUDING SUCH ITEMS AS REFINER DISCS, SANDINGS SUPPLIES, SAWS ETC. BASED ON GLOBAL EXPERIENCE OF $6.25-6.50/M3
A FIGURE OF $US 6.50 / CUBIC METER HAS BEEN APPLIED

GLUE AND WAX SUPPLIES

THE PLANT WILL CONSUME 2197214 KG/ANNUM UREA FORMALDEHY RESIN @ $0.64 /KG PLUS 60882 KG WAX $0.32 /KG.
ANNUAL RESIN/WAX COSTS WILL BE $US 1425699

FINISHING SUPPLIES

NO SECONDARY FINISHING WILL BE UNDERTAKEN AT THE PLANT IN INITIAL YEARS, THEREFORE A FIGURE OF $US 0.00 /M3 HAS BEEN APPLIED

MAINTENANCE SUPPLIES:

BASED ON INDUSTRY RANGE OF $4.20 - $4.50/MSF (3/8" BASIS) A COST OF 4.50 /MSF HAS BEEN USED

SHIPPING SUPPLIES

BASED ON INDUSTRY RANGE OF $1.95 - $1.99/MSF (3/8" BASIS) A COST OF 2.00 /MSF HAS BEEN USED

ELECTRICITY

THE MDF PLANT IS ESTIMATED TO HAVE A CONNECTED LOAD OF 4653 KILLOWATTS. THIS HAS BEEN CALCULATED AT 24 HOURS PER DAY, 250 DAYS PER YEAR, 80% DEMAND FACTOR AND 60% LOAD FACTOR.
A RATE OF $US 0.0923 /KWH HAS BEEN APPLIED PLUS A DEMAND CHARGE OF $US 11.56 /KVA OF DEMAND
ANNUAL COST= $ 1463852

PROCESS FUELS

THE MDF PLANT WILL CONSUME ALL OF ITS OWN WOOD WASTE PLUS THAT OF ASSOCIATED PLANTS IN THE PRODUCTION OF ENERGY FOR FIBRE DRYING AND PANEL CURING. THEREFORE A FIGURE OF $US 0.00 PER ANNUM HAS BEEN APPLIED

APPENDIX 5 - D PAPUA NEW GUINEA

FIBRE BALANCE, MEDIUM DENSITY FIBREBOARD

MIXED HARDWOOD SPECIES

	ASSUMPTIONS:		
	BOARD DENSITY	760	KG/M3
	RAW MAT'L DEN (GREEN)	800	KG/M3
	RAW MAT'L DEN (O.D.)	500	KG/M3
	MOISTURE CONTENT (GREEN)	60.00%	
	RECOVERY	53.27%	M3/M3

	RATIO	000KG/ANNUM	M3/ANNU
INPUT		45056	56320
LESS MOISTURE CONTENT	60.00%	16896	
		28160	
LESS SCREEN LOSS	8.00%	2253	
		25907	
LESS REFINER LOSS	6.00%	1554	
		24353	
PLUS WAX	0.25%	61	
		24413	
PLUS RESIN	9.00%	2197	
		26611	
LESS CYCLONE LOSS	0.01%	3	
		26608	
LESS TRIM LOSS	12.50%	3326	
		23282	
LESS SANDING LOSS	6.50%	1513	
		21769	
LESS REJECT LOSS	0.25%	54	
		21714	
PLUS MOISTURE	5.00%	1086	
		22800	30000

APPENDIX 5 - D

PAPUA NEW GUINEA
CONVERSION FACTORS EMPLOYED, SELLING PRICES

MDF
PRICES IN $US

SELLING PRICE:

CURRENT (FEBRUARY 1993) SELLING PRICE FOR MDF IS REPORTED AT $355.00 U.S.DOLLARS PER CUBIC METER. TO THIS PRICE A 1.00% FACTOR HAS BEEN APPLIED FOR REJECT/FALLDOWN PRODUCT FOR SALE TO LOCAL MARKETS.

FOB MILL NET MILL RETURN: $351.45 /CUBIC METER

APPENDIX 5 - E

PAPUA NEW GUINEA
CASH FLOW PROJECTION

"WOKABAUT" SAWMILL

ITEM		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
VOLUME		100	400	500	500	500
CAPITAL RESIDUAL		47	33	23	16	11
RAW MATERIALS		17	67	83	83	83
LABOR		21	41	41	41	41
SUPPLIES		1	3	4	4	4
POWER & FUELS		2	6	6	6	6
OVERHEAD		22	45	45	45	45
INTEREST	9.25%	2	2	1	1	1
D/E RATIO	50.00%					
DEPRECIATION		5	5	5	5	5
REVENUE		25	101	127	127	127
PROFIT/LOSS		-44	-66	-58	-58	-58
CASH FLO	-47	-39	-62	-53	-53	-53

RATE OF RETURN ESTIMATE (GUESS) 1.00%

INTERNAL RATE OF RETURN: ERR

APPENDIX 5 - E

PAPUA NEW GUINEA
PRO-FORMA ANNUAL COST/REVENUE PROJECTION

"WOKABAUT" SAWMILL

		UNITS	% OF TOTAL	NUMBER	$/UNIT
STATISTICS:					
OPERATING DAYS		DAYS		250	N/A
LOG INPUT		M3		1667	50.00
SAWNWOOD PRODUCED		M3		500	256.00
KILN DRIED		M3	0%	0	300.00
PLANED		M3	0%	0	350.00
GREEN RECOVERY		%		30.00%	N/A
FUELWOOD		M3		333	8.00
REVENUE:				000$	$/UNIT
SAWNWOOD SALES (RST)				128	256.00
KILNED WOOD SALES				0	300.00
PLANED WOOD SALES				0	350.00
FUELWOOD SALES				3	8.00
LESS ADVERTISING/COMMISS.		(3%)		-4	-7.68
TOTAL SALES				127	253.65
EXPENSES:	SAWMILL				
LOG COST				83	166.67
PRODUCTION LABOR				35	70.00
MAINTENANCE LABOR				6	12.83
PRODUCTION SUPPLIES				1	1.97
MAINTENANCE SUPPLIES				2	4.50
SHIPPING SUPPLIES				1	2.00
PLANT POWER				5	9.53
PROCESS FUELS				0	0.00
FUELS & LUBES.				1	1.50
PLANT O/H SALARIES				42	84.00
PLANT O/H EXPENSE				3	5.50
COST OF SALES				179	358.49
OPERATING PROFIT				-52	-104.83
DEPRECIATION	(@ 30%)			14	27.95
OPERATING INCOME				-66	-132.78

RATIOS:	CASH FLOW	OPERATING INCOME
R.O.I. (%)	-112.52%	-142.52%
PAYBACK (YEARS)	-0.9	-0.7

APPENDIX 5 - E

PAPUA NEW GUINEA
CAPITAL COST ESTIMATE

"WOKABAUT" SAWMILL

SAWMILL

ITEM	LOAD HP	CUBIC M3	COST $US
LAND			
SITE PREPARATION			
ACCESS ROADS			
WATER SYSTEM			
BUILDINGS			
ELECTROGENERATION			
LOG INFEED			
LOG TURNER			
HEADRIG		10	35
OUTFEED CONVEYOR			
EDGER INFEED			
EDGER			
RESAW INFEED			
RESAW			
OUTFEED CONVEYORS			
TRIMSAW INFEED			
TRIMSAW			
GREEN CHAIN			
DIP TANK			
WASTE CONVEYORS			
BLOW SYSTEM			
SHIPPING			
GRINDING ROOM			
MAINT. SHOP			
LOG LOADER			
FORKLIFTS			
TOTALS	0	10	35
ELECTRICAL INSTALLATION @ 360 / HP			0
MECHANICAL INSTALLATION @ 17.00% OF MECH			6
OCEAN FREIGHT @ 140 /M3			1
INLAND FREIGHT (EST.)			0
SUBTOTAL			42
ENGINEERING & P.M. @ 0.00% OF EQUIP.			0
SUBTOTAL			42
CONTINGENCY @ 10.00% OF PROJECT COST			4
TOTAL ESTIMATED COST SAWMILL			47

NOTE: DEPRECIATION CALCULATED AT 30.00% PER ANNUM

APPENDIX 5 - E

PAPUA NEW GUINEA
MANNING AND LABOR COSTS

"WOKABAUT" SAWMILL

POSITION	RATE $/DAY	NUMBER PER SHIFT SHIFT 1	SHIFT 2	SHIFT 3	TOTAL	COST $/DAY
PRODUCTION LABOR						
	15.00	0			0	0.00
	15.00	0			0	0.00
	14.50	0			0	0.00
	12.50	0			0	0.00
LABOUR	13.50	6			6	81.00
LOADER	15.00	1			1	15.00
SAWYER	16.00	1			1	16.00
	15.00	0			0	0.00
	13.00	0			0	0.00
	13.50	0			0	0.00
	13.50	0			0	0.00
	10.50	0			0	0.00
	12.00	0			0	0.00
					0	0.00
TOTAL		8	0	0	8	112.00
PLUS FRINGE BENEFITS @			25.00%			28.00
TOTAL OPERATING LABOR/DAY						140.00
MAINTENANCE & TECHNICAL						
MILLWRIGHTS	19.00	1			1	19.00
ELECTRICIANS	19.00				0	0.00
TECHNICAL	19.00				0	0.00
GRINDERMAN	15.50				0	0.00
					0	0.00
TOTAL		1	0	0	1	19.00
PLUS FRINGE BENEFITS @			35.00%			6.65
TOTAL MAINTENANCE LABOR/DAY						25.65
TOTAL MANNING			9			

APPENDIX 5 - E

PAPUA NEW GUINEA
PLANT OVERHEAD

"WOKABAUT" SAWMILL

WAGES:

POSITION	RATE $/ANNUM	NUMBER	COST $/YEAR
PLANT MANAGER	30000	1	30000
SHIFT SUPERVISORS	15000	0	0
CONTROLLER	30000	0	0
RECEPT/ADMIN	12000	0	0
PAROLL/SHIP.	14000	0	0
			0
	TOTAL WAGES	1	30000
	PLUS FRINGES @	40.00%	12000
	TOTAL PAYROLL COST		42000

EXPENSES:	$/ANNUM
SUPPLIES	100
TEL & TEL.	500
INSURANCE	400
AUDIT/LEGAL	500
TAXES	250
TRAVEL	1000
TOTAL	2750

TOTAL MANNING INCLUDING OVERHEAD 10

APPENDIX 5 - E

PAPUA NEW GUINEA
OPERATING/MAINTENANCE SUPPLIES & CONSUMABLES

"WOKABAUT" SAWMILL

MAINTENANCE SUPPLIES:
BASED ON INDUSTRY RANGE OF $4.20 - $4.70/MSF (3/8" BASIS) A
COST OF $ 4.50 /MSF HAS BEEN USED

OPERATING SUPPLIES AND SAWS:
BASED ON INDUSTRY RANGE OF $1.87 - $1.97/MSF (3/8" BASIS) A
COST OF $ 1.97 /MSF HAS BEEN USED

FUELS AND LUBRICANTS:
BASED ON INDUSTRY RANGE OF $1.42 - $1.50/MSF (3/8" BASIS) A
COST OF $ 1.50 /MSF HAS BEEN USED

STRAPPING AND DUNNAGE:
BASED ON INDUSTRY RANGE OF $1.95 - $1.99/MSF (3/8" BASIS) A
COST OF $ 2.00 /MSF HAS BEEN USED

NATURAL GAS:
THE VENEER PLANT IS ESTIMATED TO CONSUME A MAXIMUM OF 20MMBTU/HR.
THIS HAS BEEN CALCULATED FOR 250 DAYS/YEAR AT 60% LOAD ,16 HRS/DAY
AND A COST OF $ $0.00 /GIGAJOULE

ANNUAL COST= $ 0

POWER COSTS
THE SAWMILL WILL OPERATE ON A DEISEL ENGINE DRIVE, AND WILL
CONSUME FUEL AT A RATE OF 50 LITRES PER DAY
250 DAYS PER YEAR AT A COST OF $0.38 PER LITRE

ANNUAL COST= $ 4763

APPENDIX 6

SENSITIVITY ANALYSIS

APPENDIX 6

SENSITIVITY ANALYSIS

A: SAWMILL COMPLEX (SAWMILL, KILNS/TREATMENT, PLANER/MOULDER)

	BASE CASE	COST UP SALES DOW	10.00% 10.00%	COST DOWN SALES UP	10.00% 10.00%
CAPITAL COST	15833	15833		15833	
TOTAL SALES	100957	90861		111053	
COST OF SALES	88127	82900		93353	
OPERATING PROFIT	12830	7961		17699	
DEPRECIATION	1583	1583		1583	
OPERATING INCOME	11247	6377		16116	
CASH FLOW	12830	7961		17699	
R.O.I.- OP. INCOME	71.03%	40.28%		101.78%	
R.O.I.- CASH FLOW	81.03%	50.28%		111.78%	
PAYBACK - OP. INC.	1.4 YR	2.5 YRS		1.0 YRS	
PAYBACK - CASH FL.	1.2 YR	2.0 YRS		0.9 YRS	

B: SATELLITE SAWMILL

	BASE CASE	COST UP SALES DOW	10.00% 10.00%	COST DOWN SALES UP	10.00% 10.00%
CAPITAL COST	1043	1043		1043	
TOTAL SALES	2592	2333		2851	
COST OF SALES	2015	2216		1813	
OPERATING PROFIT	578	117		1038	
DEPRECIATION	104	104		104	
OPERATING INCOME	473	13		934	
CASH FLOW	578	117		1038	
R.O.I.- OP. INCOME	45.41%	1.23%		89.59%	
R.O.I.- CASH FLOW	55.41%	11.23%		99.59%	
PAYBACK - OP. INC.	2.2 YR	81.6 YRS		1.1 YRS	
PAYBACK - CASH FL.	1.8 YR	8.9 YRS		1.0 YRS	

APPENDIX 6 (CONTINUED)

SENSITIVITY ANALYSIS

C: PLYWOOD PLANT

	BASE CASE	COST UP 10.00% SALES DOW 10.00%	COST DOWN 10.00% SALES UP 10.00%
CAPITAL COST	16844	16844	16844
TOTAL SALES	20498	18448	22547
COST OF SALES	13487	14836	12139
OPERATING PROFIT	7010	3612	10409
DEPRECIATION	1684	1684	1684
OPERATING INCOME	5326	1927	8724
CASH FLOW	7010	3612	10409
R.O.I.- OP. INCOME	31.62%	11.44%	51.79%
R.O.I.- CASH FLOW	41.62%	21.44%	61.79%
PAYBACK - OP. INC.	3.2 YR	8.7 YRS	1.9 YRS
PAYBACK - CASH FL.	2.4 YR	4.7 YRS	1.6 YRS

D: MEDIUM DENSITY FIBREBOARD PLANT

	BASE CASE	COST UP 10.00% SALES DOW 10.00%	COST DOWN 10.00% SALES UP 10.00%
CAPITAL COST	21914	21914	21914
TOTAL SALES	10333	9299	11366
COST OF SALES	5009	5509	4508
OPERATING PROFIT	5324	3790	6858
DEPRECIATION	2191	2191	2191
OPERATING INCOME	3133	1599	4667
CASH FLOW	5324	3790	6858
R.O.I.- OP. INCOME	14.30%	7.30%	21.30%
R.O.I.- CASH FLOW	24.30%	17.30%	31.30%
PAYBACK - OP. INC.	7.0 YR	13.7 YRS	4.7 YRS
PAYBACK - CASH FL.	4.1 YR	5.8 YRS	3.2 YRS

APPENDIX 6 (CONTINUED)

SENSITIVITY ANALYSIS

E: "WOKABAUT" SAWMILL

	BASE CASE	COST UP 10.00% SALES DOW 10.00%	COST DOWN 10.00% SALES UP 10.00%
CAPITAL COST	47	47	47
TOTAL SALES	127	114	140
COST OF SALES	179	197	161
OPERATING PROFIT	-52	-83	-22
DEPRECIATION	14	15	13
OPERATING INCOME	-66	-98	-34
CASH FLOW	-52	-83	-22
R.O.I.- OP. INCOME	-142.52%	-211.22%	-73.82%
R.O.I.- CASH FLOW	-112.52%	-178.22%	-46.82%
PAYBACK - OP. INC.	-0.7 YR	-0.5 YRS	-1.4 YRS
PAYBACK - CASH FL.	-0.9 YR	-0.6 YRS	-2.1 YRS