



FAO/GOVERNMENT COOPERATIVE PROGRAMME

**UNITED KINGDOM SUPPORT TO:
TIMBER PRODUCTION FROM HARDWOOD
PLANTATIONS IN THE TROPICS AND SUB-TROPICS
(GCP/INT/628/UK)**

TERMINAL REPORT

June 2002

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

ROME

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Abstract

The importance of tropical and sub-tropical hardwoods in industrial wood production in relation to market opportunities are discussed. Forest plantation areas in 1995 are presented based on a comprehensive study made within the framework of UK/FAO Trust Fund Project. Reported gross plantation areas tended to be higher than the actual plantation resources and reduction factors were used to derive net plantation areas. Of the net area of 56.3 million hectares of forest plantations in the tropics and sub-tropics in 1995, 32.3 million hectares were hardwood species and 24.0 million hectares were softwoods. Special attention is given to the most valuable “luxury” hardwoods: teak, mahogany and rosewood. Indicative estimates of teak standing volume (industrial wood) annually available are presented showing Asia dominating production. According to five case studies, in Malaysia, the Melanesian Islands, Central America, Australia and Ghana, governments have a significant role in initiating hardwood plantation development. Recommendations are given for promoting the establishment of hardwood plantations in the tropics and sub-tropics. Demonstration plantations should be established, impediments for foreign investments should be minimised and reviews of legislation and regulations should be made, as necessary. A strategy of plantation development should be part of national forest programmes and plantation opportunities should be promoted. During the coming decades tropical hardwood plantations will produce an increasing volume of valuable timber. In the long term it is likely that the demand for tropical hardwood plantation grown industrial roundwood will exceed supply. There remains good market potential for valuable hardwood plantations, but if this potential is not realized the opportunity will be lost to substitute wood and non-wood products.

Introduction

The project was carried out under the UK/FAO Trust Fund *Timber Production from Hardwood Plantations in the Tropics and Sub-tropics* (GCP/INT/628/UK), funded by the Department for International Development (DFID) of the United Kingdom. Information gained from the various case studies has been extensively used. Data from the review of hardwood plantation areas was, for example, used in the Global Fibre Supply Model (FAO 1998), the Asia-Pacific Forestry Sector Study (FAO 1998), State of the World's Forests (SOFO) 1997 (FAO 1997), 1999 (FAO 1999), and 2001 (FAO 2001), as well as in a number of other papers and studies including Global Outlook for Future Wood Supply from Forest Plantations (FAO, 2000). The indicative volume figures and the case studies were also used in the preparation of an overview paper presented at a workshop on teak. The UK/FAO project, further, formed the basis for a review of recent developments in hardwood plantations in the tropics, one of the studies on trends in plantations for the Global Forest Resources Assessment 2000 (FAO 2001).

The project was originally conceived as a study focussed on the future standing volumes of hardwood likely to be available from forest plantations in the tropics and sub-tropics, as the title implies. The development objective was:

- *To contribute to regional and global planning of supplies from forest plantations in the medium-term.*

The immediate objectives were to:

- Obtain estimates of current and future plantation programmes in the tropics and sub-tropics, summarised by area, by species or groups of species, by age classes, by objectives and by expected outputs;
- Obtain and derive estimates of future (short- and medium-term) production of hardwood from tropical and sub-tropical plantations, as well as the prospects for the sustainable supply of products at the country and regional level; and
- Identify the common features of successful hardwood plantation programmes (incentives, organizational framework *etc.*) and recommend possible strategies for promoting the establishment of hardwood plantations in the tropics and sub-tropics.

The study was carried out in four main phases corresponding to the immediate objectives:

- Area estimates to base year 1995, mainly in October-November 1997, but with subsequent revisions as new data became available;
- Indicative estimates of future production of hardwood timber from tropical and sub-tropical plantations, through the development of a model (March-April 1998) and simulation studies using the model (October-November 1998);
- Case studies of hardwood plantation programmes in Malaysia; Ghana; New South Wales, Australia; Fiji, the Solomon Islands and Papua New Guinea; and Central America (June-December 1998); and

- Special studies on Markets for High Value Tropical Hardwoods in Europe (1999-2001); and Global Survey and Analytical Framework for Forestry Out-grower Arrangements (2000)

The project was operational from April 1997. It had originally been planned to complete the project within 15 months (i.e. by September 1998), but identification of special studies to supplement the knowledge on markets and forest plantation partnership agreements caused postponed completion of this project and final report.

The project produced working papers 11 and 18 - 24 printed in the Forest Plantations Working Paper series, Forest Resources Development Service and a further working paper under the Marketing series, Forest Products Division, FAO. These working papers were synthesized into a paper published in the International Forestry Review, July/August, 2002.

This terminal report is presented in the four main parts, each interlinked. Each major output has been published in technical working papers for wider dissemination by either the Forest Resources Development Service or the Forest Products Division as indicated below.

PART 1 PLANTATION DATA SET

Tropical forest plantation areas 1995 data set, by D. Pandey

The study, using the hardwood databases by J Leech with inputs from FAO personnel, Oxford Forestry Institute, CIRAD Forêt and World Bank (Heermans), covered the areas of forest plantations of all species in tropical and sub-tropical countries. The full report is published as Forest Resources Development Service *Forest Plantations Working Paper 18* (FAO, 2002).

PART 2 CASE STUDIES:

Teak (*Tectona grandis*) in Central America, by R. De Camino, M. Alfaro and L. Sage The full case study report is published as Forest Resources Development Service *Forest Plantations Working Paper 19* (FAO, 2002).

Melina (*Gmelina arborea*) in Central America by M. Alfaro and R. De Camino. The full case study report is published as Forest Resources Development Service *Forest Plantations Working Paper 20* (FAO, 2002).

Hardwood plantation programmes in Fiji, Solomon Islands and Papua New Guinea, by D. Hammond. The full case study report is published as Forest Resources Development Service *Forest Plantations Working Paper 21* (FAO, 2002).

Long rotation eucalypt plantations in New South Wales, by R. Heathcote The full case study report is published as Forest Resources Development Service *Forest Plantations Working Paper 22* (FAO, 2002).

Hardwood plantations in Malaysia, by D. Krishnapillay. The full case study report is published as Forest Resources Development Service *Forest Plantations Working Paper 23* (FAO, 2002).

Hardwood plantations in Ghana, by F. Odoom. The full case study report is published as Forest Resources Development Service *Forest Plantations Working Paper 24*, (FAO, 2002).

PART 3 SPECIAL STUDIES:

Global survey and analytical framework for forestry outgrower arrangements, by H. Desmond and D. Race. The report is published as Forest Resources Development Service *Forest Plantation Working Paper 11* (FAO, 2001).

Markets and marketing of high value (luxury) tropical hardwoods, by BioComposites Centre, Bangor, Wales. This report is published as Forest Products Division *Marketing Working Paper*, (FAO, 2001).

PART 4 SYNTHESIS

The importance of hardwood plantations in the tropics and sub-tropics – an Overview, by M. Varmola and J. Carle, (paper prepared for the *International Forestry Review* (FAO, June, 2002)

Lessons learned from the Case Studies

A summary of the common factors from the case studies

Conclusions and Recommendations

A summation of the lessons learned and potential uses for hardwood plantation development in the tropics and sub-tropics.

PART 1 DATA

1 TROPICAL FOREST PLANTATION AREAS 1995 DATA SET

(Available as FORM Working Paper FP/18)

1.1 Areas

The total gross area of plantations in 89 tropical and sub-tropical countries was estimated in 1995 at 70.85 million hectares, of which 42.1 million hectares (59.4%) were in the tropical and 28.8 million hectares (40.6%) in sub-tropical countries. Of the net area, 56.3 million hectares, 32.3 million hectares were hardwood plantations and 24.0 million hectares softwood plantations. The majority of forest plantations in tropical and sub-tropical countries were in Asia (76.3%). Plantations in South America (14.1%) and Africa (9.6%) comprised the remainder. More than 80 % of non-industrial plantations were in Asia.

1.2 Species and countries

Tropical and sub-tropical plantation areas were dominated by two genera: *Eucalyptus* and *Pinus*. *Eucalyptus* accounted for 31.9% of the hardwood plantation net area. Other important species included *Acacia* spp., *Tectona grandis*, and *Gmelina arborea*. There was a broad range (more than 100) of species utilised in plantations. The significance of minor species in total plantations was evidenced by the area of species classified as "Other hardwoods", which totalled 40.8%.

China has the largest plantation area of 21.4 million hectares. The second largest area reported was from India of 20.3 million hectares. The next largest forest plantation estates were Indonesia, Brazil and Viet Nam. There were around 6 million hectares of Chinese softwood plantings of *Cunninghamia lanceolata*. This species was not planted on a large scale elsewhere, but the widespread Chinese plantings made it one of the world's most extensively planted species. Among the softwood species the fast growing pines (*Pinus radiata*, *P. patula*, *P. caribaea*, *P. elliottii* and *P. oocarpa*) occupied about 25% of the area whereas other pines (*P. kesiya*, *P. massoniana*, *P. merkusii*, *P. roxburghii*, *P. halepensis*, *P. maritime*, *P. wallichiana*) covered about 36%. *Leucaena* spp. and similar multi-purpose and fodder species comprised a significant proportion of "Other hardwoods".

Eucalyptus species were planted extensively throughout the tropics and particularly in sub-tropical regions. The countries with the largest *Eucalyptus* plantation resources were India (3.1 million hectares), Brazil (2.7 million hectares), China (670,000 hectares), South Africa (557,000 hectares) and Viet Nam (483,000 hectares) and they accounted for 73% of the *Eucalyptus* resource.

Other species were less widely distributed. Acacias were planted mainly in Africa, Indonesia and the Indian subcontinent. Teak (*Tectona grandis*) was predominantly grown in South-East Asia, parts of Central America and the Caribbean, and in Africa, while Indonesia and Fiji had the largest introduced mahogany plantations (*Swietenia macrophylla*). About 95% of rosewood

plantations (*Dahlbergia sissoo*) are located in India and Pakistan while Nepal and Bangladesh made up an additional 4%. Small plantations of this species were found in tropical Africa, in Nigeria and Burkina Faso.

PART 2 CASE STUDIES

2 **TEAK (*TECTONA GRANDIS*) IN CENTRAL AMERICA**

(Available as FORM Working Paper FP/19)

2.1 *Introduction*

The first reported introduction of teak into Central America is from 1926, when it was planted in the Summit Botanical Garden, in the former-Channel Zone. The first commercial planting trials are believed to have been made in the early-1940s.

The total area of forest plantations in Central America is estimated to be 224,896 hectares, with teak plantations comprising 18.1%, or 40,815 hectares. Costa Rica has the largest area of teak plantations in the region with 23,475 hectares (57.5%), Panama has planted 13,135 hectares (32.2%), El Salvador has 2,488 hectares (6.1%), and Guatemala has 1,717 hectares (4.2%).

2.2 *Key issues*

Political, legal and institutional

Regional

A Central America Agreement for Management and Conservation of Natural Ecosystems and Development of Forest Plantations was ratified by Costa Rica in 1996. The convention seeks to conserve existing areas of natural forest, and to promote rehabilitation and reforestation of degraded agricultural lands. Similarly, the Central American Alliance for Sustainable Development seeks to “promote reforestation and productive forest activity”. These agreements are evidence of Central American States’ interest in reforestation as an important environmental measure.

Costa Rica

Forestry in Costa Rica is regulated by the Forestry Law (1996), No 7575. Several aspects of the law are specifically designed to encourage plantation forestry.

- The Law establishes an incentive scheme for plantations, “Payment for Environmental Services” (PES), which provides subsidiary payments (up to US\$600/year for 5 years) to plantation growers for the carbon sequestering, soil, water and biodiversity protection, and scenic services of forests;
- The Law provides plantation growers with exemption from real estate tax on planted areas, exemption on payment of uncultivated land tax, and exemption on asset taxes during the establishment, growing and thinning stages. If plantations have been established without government incentives then production is exempted from income taxes: and

- The Law specifies that plantation logs and other produce will not require permits for any of harvesting, transport, industrialisation or export.

Panama

Forestry in Panama is mainly regulated by the Forestry Law No. 1. The Law establishes a 30-year period during which private reforestation will receive priority and support. The primary incentive is that 100% of the costs of forestry investments (including land costs) are considered deductible expenses from income tax from all sources except those from forestry activities

El Salvador

Forestry in El Salvador is governed by the El Salvador Forestry Law 1973. The Law presently provides few specific concessions for plantation forestry, though a proposed amendment will exempt plantations from requiring authorization for establishment, maintenance and harvesting. A Forest Promotion Program provides loans for reforestation at concessionary terms (6% with a 10-year period of grace). Technical assistance in plantation establishment is provided by the Agriculture and Range Management Ministry.

Economic

International investment

Several foreign companies have invested in Costa Rican teak plantations, either establishing operations by themselves or subscribing contracts with local forest companies. International investors are generally perceived to be not interested in State incentives, but do inscribe their farms in the Forest Regime¹ so as to have land taxes exemption, and income tax exemption from sales of plantation products.

Funding comes from selling the forest stands in parcels to the general public in Europe and North America through two main modes:

- Sale of shares: share values set at a fraction of the value of the project: and
- Sale of planted areas that vary in size from ¼ hectares to one or more hectares. Some sell not only the stand and its maintenance, but also the land, while others only sell the stand, and include the leasing of the land.

In recent years some foreign companies have purchased established plantations from local growers who had claimed incentives granted by the Costa Rican government. In these cases, the purchasing company assumes the liabilities contracted by the seller with the State.

State incentives

The vast majority of the plantations established in Costa Rica have been totally, or partially, financed by State incentives. The first incentive scheme allowed landowners to deduct plantation expenses from income tax. The current scheme pays a tradable forest bonus (CAF), a credit used to offset Government taxes. A National Fund for Forest Financing (FONAFIFO) provides concessionary loans for plantation establishment and management. The PES provides direct compensatory payments to plantation growers.

¹ Forest Regime, a set of legal and technical dispositions published by the government for the landowners who want to take advantage of forest incentives.

2.3 Potential for increasing teak plantations

The situation regarding teak plantations varies from country by country. In some countries, teak planting is just beginning, while others have made important progress in the last decade. Globally, teak plantations are estimated to comprise 2.25 million hectares (1995). Teak is the only tropical species yielding fine dark wood that is being planted on a large scale. It should, consequently, command a broad market niche. All natural teak forests and 93% of teak plantations are located in Asia and the Pacific. 4.5% are in Africa and 2.2% in Latin America. Central America has 1.9% of the total teak plantation area. Teak prices (real) have shown an upward trend and this provides an economic incentive for further plantation establishment. Supplies from Asian natural forests are also expected to decline.

It has been estimated that there is at least 100,000 hectares of land suitable for further teak afforestation in Central America: 25% is located in Guatemala, 25% in Nicaragua, 20% in Costa Rica and 15% in each of El Salvador and Panama. With a rotation period of 25 years, these countries could produce approximately 1.43 million m³ of roundwood annually.

Costa Rica

Costa Rica has developed significant technical skills in teak plantation establishment and management. On the best sites and under intensive management, rotations of 20 to 25 years will yield an MAI of 20 to 25 m³/ha/year. On average, well-managed plantations should produce a total volume of 15 - 20 m³/ha/year, with 10 - 15 m³/ha/year of commercial industrial volume. These results have stimulated large-scale teak planting in Costa Rica.

Future expansion will depend from the availability of financial resources that originate from two sources:

- Payment for Environmental Services (PES); and
- Foreign Investment.

Several factors may affect foreign investments. First, the 1995 Bosques de Puerto Carrillo (a timber company) bankruptcy. The main reason for the bankruptcy was an overcommitment to processing investment before sufficient roundwood was available for the company's sawmill to operate at capacity. This failure brought some discouragement to the forestry sector. In 1996 Flor y Fauna was the subject of a strong international critique for data on growth and yield, and financial performance, reported to investors in the Netherlands. This generated considerable bad publicity for Costa Rican teak growing. During 1997 the European stock exchange market had an attractive performance, reducing European interest in reforestation projects. These factors have contributed to foreign companies reducing their expansion expectations to 2,000 - 3,000 hectares during the next 2 - 3 years.

The key determinant of future teak establishment will be market performance. If prices remain high, domestic demand is strong, and Costa Rican teak is competitive on international markets then teak establishment will continue.

Panama

Panama has the second largest area planted with teak in Central America. Three areas have further expansion potential: the South of Veraguas Province, the East of Panama Province (currently used for cattle-raising), and the south-west of the Darién Province (in national lands, or properties currently dedicated to cattle-raising). The principal problem for teak expansion is land price (US\$1,000/ha). A reforestation tax incentive, which covers 100% of expenses, including land, started a speculative land price spiral. At present there appear to be no forces likely to check this spiral.

El Salvador

El Salvador has good prospects for plantation expansion. Land is available and there is good domestic demand for wood. It is not guaranteed that plantation expansion will be with teak. Teak has been criticised species for being exotic and for its leafless appearance in the dry season. Little or no vegetation grows under closely grown teak canopies (plus large leaf water drip), may make plantations erosion prone on steep slopes. However, there are also good reasons to use teak widely in El Salvador's reforestation programs:

- It adapts very well to the climatic conditions of the country;
- There is an abundance of seeds;
- The greenhouses seedling production system is well known;
- It resists fire very well;
- It has an acceptable performance, even in low productivity sites; and
- It is easy to plant.

Guatemala

Guatemala has large resources of natural forests, which supply domestic market requirements and there is currently little incentive for plantation establishment. Changes to the Forest Law are expected, however, to provide incentives for tree planting. The only project that has anticipated the expansion of teak areas is ECOFOREST S.A., which has established plantations on the Atlantic Coast.

Nicaragua

Nicaragua's economic crisis does not favour reforestation as an economic land use alternative. Farmers do not have capital to invest in this long term and a lack of reforestation incentives does not favor the expansion of the planted areas in the near future. The Forest Law is currently being revised to include incentives for reforestation. The Exchange of Cattle-Raising Debt for Forests, a program of the Ministry for Agriculture, could stimulate reforestation. This program is just beginning, but it is a good opportunity to plant teak. Land prices and reforestation costs are lower than in other countries and opportunities to plant teak do exist.

Honduras

In Honduras reforestation is its infancy. Current experience is with plantations of *Pinus caribaea*. Broadleaf has been planted at experimental level. It is expected that, in the short and medium term, there will be little interest to plant with teak.

3 MELINA (*GMELENA ARBOREA*) IN CENTRAL AMERICA (Available as FORM Working Paper FP/20)

3.1 *Melina plantations in Central America*

In Central America there are a total of 225,000 ha of forestry plantations of which 52,000 hectares (23%) have been planted with Melina. Up until 1997, Costa Rica had a total of 49,300 hectares planted with Melina. This represented 94% of the total area that has been reforested with the species in Central America and 22% of the total reforested area in the region. Melina has been used in reforestation projects since 1979, however, it was not until 1986 that the species began to be used in large scale projects.

70% of the area established with Melina has been planted by national tree growers using State incentives. The remaining 30% of the area corresponds to projects established by tree growers or companies that use their own capital. Within this category, the most important project is the Ston Forestal Company which has established approximately 14,000 hectares to 1998.

3.2 Technical information

The species grows in the tropical life zones where the average annual precipitation is between 1,000 and 3,000 mm, from sea level to 500 m of elevation and with average temperatures between 24 and 35 C. In Costa Rica it has been observed growing well up to 600 m above sea level with average annual precipitation of up to 2,500 mm and 2 - 4 dry months per year. Two or three intermediate thinnings and three prunings are recommended.

The mean annual increment in total volume has been estimated between 7 and 30 m³/ha/year at 12 years of age for the lowest and highest site indexes, respectively. The experience generated in Costa Rica with the species show that higher volume increments can be achieved like 30 and 50 m³/ha/year in southern Costa Rica in plantations established with genetically improved seed with the appropriate fertilization and weed control programs. The profitability of a Melina plantation (internal return rate) has been calculated to be between 12% and 18% depending on the quality of the site and the price of the wood.

3.3 *Financial information*

Information on costs, yields and profitability presented refer to Costa Rica, since it is the only country in the region that has data and statistics for Melina. The costs of one full production cycle in Costa Rica were estimated at US\$1,287/ha in 1998. The figure does not include the land price, which oscillates between US\$1,000 and US\$1,500/ha.

Stumpage prices earned varied from US\$13.5/m³ in the first commercial thinning (at year 6) to US\$24.6/m³ for final cut (year 12). There is a price scale that can be applied according to log diameter. Sawn wood in the local market was sold for approximately US\$160/m³. There are reports of sawn, kiln dried Melina being sold for US\$225/m³.

The profitability of a Melina plantation was calculated with The Internal Return Rate IRR to be between 12% and 18% depending on the quality of the site and the price of the wood.

The first product made from Melina was pallets. In 1997 the Costa Rican Forestry Council (CCF) began promoting the use of Melina wood from forest plantations to make furniture and high price items for the export market.

3.4 Potential for Melina plantation expansion

Melina wood in Central America was earlier not been thought to be able to compete with native forest species. However, the increase in forest use restrictions has reduced the availability of native forest raw materials and has produced the need for seeking alternative wood sources.

All the experience generated in Costa Rica predicts that this species, along with teak, will have the most potential for expansion of planted areas. It is estimated that in 2020, the country could have 100,000 hectares planted with Melina, double what it has now. In addition, if more area is planted with the species, by the year 2010 the market could have up to 1.5 million m³ of roundwood annually, both for national consumption as well as for use in crafting furniture and high quality items for export.

4 CASE STUDY OF HARDWOOD PROGRAMMES IN FIJI, THE SOLOMON ISLANDS, AND PAPUA NEW GUINEA (Available as FORM Working Paper FP/21)

Fiji

4.1 Introduction

Commercial forest plantations in Fiji are divided into softwoods (dominated by *Pinus caribaea* covering 43,000 hectares in 1996) and commercial hardwoods, notably mahogany (*Swietenia macrophylla*). The development of hardwood plantations in Fiji has been carried out over 40 years and today an established, predominantly mahogany resource of close to 50,000 hectares exists. This has been almost exclusively developed by the Forestry Department, rather than the private sector.

As early as the 1930s there was recognition that Fiji could not continue to exploit its natural forest at past rates. Initially the solution was thought to be the management of natural species, but experience soon showed that their growth rates were too slow to make them an economic option. Between 1935 to the 1950s, a series of trials of mahogany (and other less suitable species) were established, paving the way for an expanded programme of reforestation in the 1960s.

Between 1972 and 1974 planting of mahogany was suspended and other hardwood species were again appraised. Up to 1983 the annual hardwood planting programme achieved between

1,000 and 2,000 hectares per annum but the target was increased to 5,000 ha/year (subsequently revised to 4,500 ha/year) in 1983. The relative success of mahogany compared with other species led to the cessation of planting of hardwood species other than mahogany by 1991.

In 1996 a study was commissioned to determine the feasibility of creating a hardwood plantation corporation (given the previous successful privatization of the softwood plantations). The study concluded that the conceptual justification for corporatisation was strong, and this became their recommendation. Currently (mid-1998) the Department of Public Enterprises is in the process of implementing the recommended corporatisation.

It has been recognized for some time that Fiji will be a major source of plantation grown mahogany for many years to come and as the natural forest supply of mahogany diminishes will be important in the overall supply of the species. Annual harvest from Fiji's mahogany plantations was 5000m³ in 1987. It is predicted to rise to 100,000m³ by 2010 and further to 135,000m³ by 2015.

4.2 Objectives

The objectives of the hardwood plantation programme are to:

- Meet local demand for timber and to develop and maintain an export trade;
- Develop timber resources as a basis of establishing further investment in processing;
- Provide additional sources of export income and hence broaden the country's economic base;
- Attempt income redistribution and stimulate the rural economy; and
- Reduce pressure on future exploitation of the remaining natural forests.

The plantations are thus expected to provide a combination of economic, social and environmental benefits. This range of objectives and anticipated benefits can make the implementation of the project rather difficult, and the outcome may become something of a compromise between conflicting objectives.

4.3 Key issues

Land tenure

The Fiji mahogany plantations are all established on customary land leased to the Forestry Department by a Government body, the Native Lands Trust Board, on behalf of the customary owners. The effect of this is to place a third independent party between the investor and the landowner with a mandate to manage the lands and to be responsible for leasing and negotiating such leases. The Board has a good record of safeguarding the interests of the owners and the land they represent. Equally the land is also well defined physically, reducing the opportunity for disputes.

For investors in forest plantations, security of tenure and security of use are among the most common and difficult issues to resolve when considering long term investment in the developing

world. In Fiji this is not a major issue. Ironically, in most developed countries, security of tenure is not a major threat, but security of use can be where there are a wide range of planning, environmental, and social constraints on land users

In Fiji one of the factors which may affect the mahogany plantation programme if it is privatized is conditions of the traditional agreements for use of the land. At present, land owned by Mataqali (traditional communities) is leased through the NLTB for the plantations for periods ranging from 10 to 99 years, with around 50% being held in 50-year leases. Since the mahogany rotation is 30 to 35 years, many of the leases do not translate into complete rotations so either land will be left idle for part of the rotation or new leases must be negotiated in order to complete a crop cycle. Neither of these alternatives would be attractive to a private investor. Furthermore, the present leases for the mahogany plantations do not contain rights of renewal, which to the private investor in a long-term crop this must be of concern.

Land quality and suitability

To obtain adequate economic returns from long rotation hardwood plantations there is a need to ensure that they are established on fertile soils with good access, and on sites that are not too difficult or expensive to initially establish and to subsequently harvest. But much of the Fiji mahogany has been established on steeplands which are difficult (and more costly) to harvest, and which have a lower value.

This also leads to the technical question of the suitability of the current sites when it comes to replanting following harvest. The existing crop was established in cutover natural forest. Following the harvest of the first mahogany crop, the site will be much more open than when the natural forest was harvested. These open conditions may be much less suitable for mahogany than the cutover natural forest.

Political situation

Long rotation plantations may be affected by political stability both in terms of investor confidence and the level of Government support. Political stability also affects investor confidence in local processing. Political instability in Fiji in the 1980s probably had little impact on the mahogany plantations. The effects of political instability may show up if the resource is privatised, or in the willingness of investors to establish processing facilities in Fiji.

Social issues

Plantation establishment has provided a significant source of employment and income for local communities. There has been, however, a period between establishment and harvest when if there is no further land to plant the community has no source of income. Once harvesting begins there is an expectation that the local community will again receive the employment opportunities offered and will once again prosper. Unfortunately this is often not the case, as the job of harvesting is a specialized one requiring skilled workers and often, capital-intensive plant. The topography and soil conditions will necessitate the use of some cable extraction systems, which are even more demanding of specialized equipment and workers. It has been estimated that one cable hauler unit will be sufficient for all the steeper areas of the mahogany plantations. This will

also mean that people not associated with a particular piece of land will be employed in the harvesting of that land. This may give rise to some inter-community issues.

Technical issues

Forest health

Mahogany was particularly attractive to Fiji because of the absence of the shoot borer (*Hypsipyla robusta*). The plantations have, however, been attacked by Ambrosia beetles and by termites.

Wood quality

A sawing study of Fijian mahogany showed a high level of hidden defects including decay and insect damage. This lowers the value recovered from a plantation and may discourage future investment.

Genetics and tree-breeding

Mahogany is not a highly researched plantation species and in Fiji seed collection is done from the forest floor, perpetuating the relatively poor form of most stands.

Growth rates

There is wide variation in productivity depending both on site and stocking. Well-stocked plantations on good sites may yield 11 m³/ha/year, while the average mean annual increment is generally 4 - 5 m³/ha/year.

Climate

Fiji is susceptible to cyclones with a periodicity of 20 years. Thus, there is a high probability that trees will suffer wind damage during a rotation. Mahogany is one of the most wind-firm species.

Management

Funding uncertainties can create difficulties in on going plantation programmes. In the early 1970s a temporary suspension of mahogany planting has created a dip in the level of sustainable yield from Fijian mahogany plantations. This may create temporary shortages of supply in the future.

Papua New Guinea

4.4 Introduction

Efforts to establish plantations in PNG have occurred since 1955. The most extensive plantation programmes have been carried out during the late-1960s and 1970s, with teak (*Tectona grandis*) and *Eucalyptus grandis* and *E. robusta*, the favoured species. The case study focuses on the 1,986-hectare Brown River teak plantations. The government established Brown River plantations, but in the 1980s two of the three Brown River plantations passed to local landowners as a result of a land claim. The third Brown River plantation has remained on government land.

Nonetheless, PNG has a variety of different plantation ownership structures, including ownership by the national government, provincial governments, private companies and communities.

4.5 Key issues

Economic

Landowner issues

Landowners in PNG have a reputation for expedient behaviour, resulting in insecure tenure and perceived high risk for business ventures. The PNG Forest Authority plays a mediation role between investors and landowners to reduce this risk, to ensure the legitimacy of the landowner, and to negotiate fair arrangements. It is not possible to purchase freehold land in PNG, instead an investor may ask the government to purchase land and then lease from the Government. The tenurial system appears relatively complex and this is likely to be a significant disincentive to investment.

Tenure and security

Securing a standing resource on which to base commercial plantation activity is the key to this case study. Challenges posed by landowners, costs associated with taxes and duties, and difficulties with working in a developing country are all justifiable if there is an economic base from which to expand further investment.

Incentives

A number of government incentives (e.g. a 10 year tax holiday) are available for enterprises setting up in rural areas, and for industries that will be involved in exporting (e.g. a seven year export sales incentive).

Laws protecting local processing

The Government has adopted stringent laws to encourage onshore processing of both indigenous logs, and of high quality exotic species such as teak. The target is to eliminate log exports by 2000. Log and flitch exports incur a duty of 45%, making log exports of plantation-grown teak an uneconomic option.

Legal

Legally binding agreements are alien to PNG culture, so agreements are always viewed as negotiable. Indigenous people also struggle to comprehend value changes over time. "Worthless" land leased at low prices in the past may increase in value as a result of afforestation. The landowner may then feel cheated and seek to renegotiate the land deal.

Technical

Experience

Plantation expertise has been sourced by the PNGFA from Australasian foresters. National foresters also have good technical competence, but this does not extend to the landowners. For example, following the take-over of the Brown River plantations silvicultural management was not continued. Stands remained heavily stocked with minimal diameter increment.

Fire and disease

Fire is considered the greatest risk to PNG plantations. Large populations of hunter-gatherer societies use fire as a means of clearing undergrowth for hunting access and to reduce snake populations. Teak is less affected than most other hardwood species.

Solomon Islands

4.6 Introduction

Plantation forestry in the Solomon Islands commenced in 1967 and since that time around 20,000 hectares of hardwood plantations have been established. The government established almost all of the plantations, but some have subsequently been privatised, or incorporated in government joint ventures with the private sector. The primary hardwood species planted are *Cedrela odorata*, *Gmelina arborea*, *Tectona grandis* and *Swietenia macrophylla*. The case study focuses on Saenaua plantation on Malaita Island.

Saenaua was established under New Zealand's ODA programme on customary land. At present, Saenaua is 100% owned by the landowners but will need ongoing investment to continue effective management, and to acquire harvesting and marketing expertise.

4.7 Key issues

Economic

Investment

Perceptions of investment in countries like the Solomon Islands are that the risks are higher than in developed countries, so the expected return on investment also needs to be higher. Current analysis suggests an IRR of 15% but perceived risk means it is still difficult to find investors. Worries about political and legislative stability discourage investors. In general, the concept of forestry, as an investment, is foreign to most locals including local Forestry Division staff.

Costs/Prices

Actual prices realized for Solomon Islands hardwoods will be dependent on buyer confidence. Prices could well be lower than the international norm – particularly for small shipments, or where there may be concerns about quality. Operational costs for Saenaua plantation have certainly been higher than for a normal commercial plantation. This is because ODA funds were used with an emphasis on timeliness and high quality in all operations.

Incentives

The Solomon Islands' Government provides several direct incentives to investment such as accelerated depreciation allowances and possible exemption of some profits from taxes. Corporate tax in the Solomon Islands is relatively low (15%).

Export duties

The Solomon Islands' Government wants to encourage investment in timber processing and charges a duty on log and timber exports from natural forests. There is potential that, in the future, export duties will distinguish between plantation-grown timber and natural forest timber.

Land

Land ownership in the Solomon Islands is very complex and can involve several layers of customary ownership. Landowners must be dealt with in any forestry investment because the land will not be sold. Land-related disincentives to investment include:

- Land title on customary area does not exist;
- Boundaries are not mapped – merely “known” by the local land guardian;
- Land leases must be acquired through government;
- Complex ownership system, which differs across the country; and
- Need to involve and consult stakeholders.

Common Factors in Melanesian Case Studies

The case study identifies eight key common factors for plantation forestry in the South Pacific.

- *Involvement of Government agencies*: Government agencies are seen as crucial to the establishment of long rotation plantations in the South Pacific, both as a catalyst for the development of a plantation growing industry, and as a facilitator over difficulties such as land tenure. Government involvement is generally directly in establishment of plantations. Notably, little private sector investment has followed the government lead.
- *Land tenure issues and perceptions*: The use of customary land is seen as a major disincentive to private sector investment. Concerns over long run security of lease arrangements are cited as the major problem.
- *Involvement of local people in the decision making and employment opportunities*: The terms of any lease must reflect the needs of the local community and landowners (often the same people), as well as the investor. Involving local communities in the making of decisions has helped ensure a reasonably smooth existence for forests established with community liaison groups, such as some of the Fijian plantations.
- *Quality and consistency of forest management*: Plantations require clear objectives, consistency of management aims, and these need to be achieved through the life of the project. In all three countries examples exist of either blurred objectives or management failures.
- *Expectations created by the development of cash economies in areas where these did not previously exist*: Plantation provide employment through the establishment and tending phases enabling the development of cash economies. A fall-off in employment after the local people have grown accustomed to a wage and the associated social structures causes dislocation and may encourage antipathy towards the project in particular and forestry in general.
- *The apparent need for tax concessions or similar incentives from governments to make the initial plantation establishment attractive as an investment option*: There has been little private sector uptake of incentives, where they have been offered. This indicates the incentives were not high enough, or the risks were perceived as too great. The private sector has shown greater willingness to become involved as plantations have approached maturity, thus perceived long-run risks may be the primary disincentive to investment. The challenge for governments may be to successfully establish plantations with a view to exiting them once they are approaching maturity.

- *There appears to be almost unconstrained market potential for high value hardwood logs:* Supplies of natural forest tropical hardwood logs is declining, however, it is unlikely demand will follow suit.
- *Funding uncertainties, which can lead to inconsistent, forest establishment and tending:* The need to ensure (as far as possible) secure funding is a key point.

The case study concludes that investing in “bare land” plantation establishment in these countries is generally not an attractive option to the private investor. There is an apparent preference to purchase an established resource so that establishment of processing facilities and possibly further planting can occur without the long initial wait for cashflow, and without dealing with many of the difficulties inherent in greenfields investment. Private investors appear more willing to buy assets that have been established by the government, and the most productive government’s role may be to initiate these assets with a view to selling them to private enterprise at some future date. That is, the government supplies the seed capital to establish projects, private enterprise then generates processing operations and the capital required for that phase where cashflows can be generated rather more quickly and with considerably greater certainty.

5 CASE STUDY OF LONG ROTATION EUCALYPT PLANTATIONS IN NEW SOUTH WALES (Available as FORM Working Paper FP/22)

5.1 Introduction

Eucalyptus species dominate Australian natural forests and historically have been the principal species supplied to the domestic sawmilling industry. Extensive areas of natural eucalypt forest remain in Australia. A reduced supply of large logs allied with conversion of timber producing areas into conservation areas and community concerns over the harvesting of natural forests is, however, driving a move to source more wood from eucalypt plantations.

Australian eucalypt plantations currently total around 170,000 hectares, with annual new planting estimated at 25,000 hectares. Pulpwood plantations predominate, with 120,000 hectares being ostensibly grown for pulpwood.

State Forests of New South Wales (SFNSW) has been planting eucalypts for more than 50 years and currently manages a eucalypt plantation estate of about 45,000 hectares. Contrary to the general trend in Australia, SFNSW has pursued an integrated management regime based on sawlog production. The main species planted is *Eucalyptus pilularis* (blackbutt). Since 1994, around one-third (5,000) of planting has been done under a joint venture scheme between SFNSW and private landowners. The intention is to establish plantation critical mass, with Government funding for plantation establishment is being phased out as private investment arises.

5.2 Factors influencing investment in NSW long rotation eucalypt plantations

Technical factors

Technical factors are principally biological factors that influence the scale, risks and returns of a plantation investment. The most significant limiting factor is the absence of large contiguous clear

sites to establish economic-scale plantations. This is a combination of varying soil types and, particularly, the widespread occurrence of native vegetation, clearing of which is stringently regulated.

Eucalypts, as a native species is vulnerable to a range of native pests and diseases, though conversely, there is generally sufficient natural control of pests and resistance to disease to eliminate the need for broad scale artificial control.

Planting of non-standard species, such as *E. pilularis* (as opposed to standard plantation species such as *E. grandis*), is a deterrent to investors until growth performance is proven. *E. pilularis* now has a proven record but new species, such as *Corymbia maculata*, presently suffer from this problem.

Typical biological constraints listed in the study include soils, rainfall, frosts, pests and disease, remnant vegetation, weeds, and fires.

Economic factors

The economic factors that influence investment are those that impact on costs and returns in a direct way. Pre-tax real returns on the north coast of NSW have typically ranged from 1 to 4% per annum. In recent years, higher prices and better yields have boosted IRR's to between 3 and 7%. Some costs of growing eucalypts tend to be high relative to other species: at establishment because of their sensitivity to weed competition; later because of fire protection costs; and at harvest, because eucalypts' open crowns encourage development of a substantial understorey.

Several major distorting factors are present in NSW/Australian log markets:

- SFNSW dominance of local log markets means that prices are largely determined by Government decree rather than market forces;
- Long supply contracts at fixed prices has established a system of "quota" pricing;
- Native forest log prices are significantly below the growing costs for plantation logs of similar size; and
- Small growers have sometimes been excluded from the market in government/industry wood supply deals.

Australia's political history, stable currency and low inflation environment are attractive to investors.

Social factors

Community support for native species plantations is high. Concern over natural forest logging allied with perceived returns from forestry promotes the establishment of plantations. Plantations role in carbon sequestration is also viewed positively.

Policy factors

Government dominance of the forest resource has meant policy has played a major role in log supply. SFNSW has assumed responsibility for providing a future resource for the sawmilling

industry – possibly crowding out private sector investment. NSW has a comprehensive legislative framework

5.3 Major impediments to investment in Australian plantations

Five factors were identified as being key impediments to private sector plantation investment in Australia.

Dominant role of government

State Governments own, manage and market more than 70% of the Australian plantation resource and compete directly with the private sector. It is believed that this dominant role of government may “crowd-out” some private sector investment. Additionally some government regulation has discouraged plantation investment. For example, the recently removed export controls on plantation logs and wood chips, local government regulations that favour traditional agricultural land uses, and tariff protection of agricultural products that distort land use.

Lack of transparent and competitive markets

The detrimental effects of dominant Government wood suppliers have been exacerbated uncompetitive market behaviour and cost advantages conferred to Government. Uncompetitive practices have included setting artificially low rates of return (i.e. selling logs at below “market return” prices). Cost advantages include exemption from some taxes and levies such as local government rates and sales tax on vehicles. Government growers probably also benefit from a lower cost of capital and a lower risk premium on borrowing relative to private growers.

Unsympathetic tax regime

Australia’s forest taxation regime is relatively unattractive compared to many other countries. For example, Australia has a relatively high rate of corporate taxation (36%); harvest income is not allowed to be spread across the rotation for taxation purposes; plantation costs are deductible only against income earned in the year they accrue.

Uncertainty with regard to land availability, yields and other risks

Long rotations mean that unquantified risks and uncertainties may assume greater significance than in short-run investments. Land availability, yields and costs are specified as particular variables of concern.

Relatively poor track record of past investment

Many plantation investments in Australia in the past 30 years have been driven by tax concessions with gains appropriated on establishment. A lack of subsequent management and indifferent markets have tainted forestry in the eyes of many potential investors. Government incentive schemes have similarly had limited success due to the absence of effective, on-going management (after establishment).

5.4 Potential changes to promote plantation investment

There are a number of significant improvements that could further enhance investment in long rotation hardwood plantations:

- Log pricing should be publicized and price setting mechanisms made transparent;

- Ensuring competitive markets for the whole tree;
- Removal of planning discriminations against plantation forestry versus other rural land uses;
- Removal of imbalances between public and private forest growers;
- Separation of government forest growing activities from government policy and regulatory functions; and
- Changes to the taxation environment to provide greater incentives toward plantation investment.

6 CASE STUDY OF HARDWOOD PLANTATIONS IN MALAYSIA (Available as FORM Working Paper FP/23)

6.1 Background and objectives

Malaysian timber supplies have traditionally come from natural forests where the timber industry is a major contributor to foreign exchange earnings, bringing in some RM13 billion/year and employing over 200,000 people. However, concern for natural forest conservation and the sustainability of their management has become a major public issue. If sustainable practices were adopted in the natural forests, the total amount of timber would decline. Since Malaysia is committed to preserving natural forests for perpetuity, this implies that more timber has to be obtained from other sources. If the mills are to remain in operation then alternative sources of the raw material to the natural forests have to be explored. Plantations offer a promising source of timber.

The biggest demand will be for general utility timber that can be raised cheaply over short to medium term rotations. There is also a growing internal and external demand for pulp and paper, which Malaysia is importing at present. One paper mill is in operation while others are planned. The need for pulpwood is enormous and the government has to assist the private sector in developing this sector of plantations.

Due to the rapid growth in the economy and labour shortages, there has been neglect of much agricultural land and there are now considerable areas of degraded or under-utilized land in the country. In Sabah and Sarawak, shifting cultivation has resulted in the degradation of a significant area of former agricultural land. One solution to these two issues is plantation development, which is a low labour intensive industry, uses the land productively and has the added benefit of bringing social and economic benefits to the rural people.

Based on the above considerations, the objectives of the plantation programme include:

- To supplement the increasing timber requirement in Malaysia;
- To increase productivity of degraded forestlands;
- To alleviate rural poverty through implementation of social forest plantation programmes;
- To reduce excessive loss of foreign exchange by increasing production of raw material for the timber industry;
- With the increasing shortage of labour in the country, there is a need to diversify into low-labour demanding crops, and timber plantations offer an excellent opportunity; and

- To introduce timber plantations, which with their higher productivity would reduce pressure on the PFE, so the latter can be managed on a sustainable basis.

6.2 Current status of plantation development

Species

Most of the plantations lie in Peninsular Malaysia and Sabah; Sarawak, with large areas of natural forest still intact has not yet established plantations to a great extent. The total area of plantations in Peninsula Malaysia in 1998 is estimated at 89,758 hectares; plantations in Sabah total 77,400 hectares; in Sarawak 12,897 hectares. Malaysia's total plantation estate is 180,055 hectares, of which 96% comprise hardwood species. In addition to the hardwoods there are 6 573 hectares of pines (nearly all *Pinus caribaea*, mainly in Peninsular Malaysia).

Acacia mangium is the main hardwood species planted, comprising 123,904 hectares or 71 percent of the hardwood plantation area. Most of this has been planted for the provision of pulpwood since Malaysian experience with the species has shown that it develops heart rot and is not suitable for sawntimber rotations. Under the Compensatory Forest Plantation Scheme about 64,000 hectares were planted for sawntimber.

Paraserianthes falcateria has been planted over 13 755 hectares, *Gmelina arborea* over 10 872 hectares, teak over 4 260 hectares and sentang (*Azadirachta excelsa*) over 1 743 hectares. A large number of species trials have been established over a long period; at present there is particular interest in the dipterocarps, which may provide alternative plantation species for the future.

Establishment mechanisms

Each of the three States has followed a different path in plantation establishment.

Peninsula Malaysia

The bulk of forest plantations in Peninsula Malaysia were planted in the 1980s under the Government's Compensatory Forest Plantation Scheme, mainly funded by an Asian Development Bank loan. The scheme originally planned to plant 188,000 hectares, but was scaled down when *Acacia mangium*, the principal species, was found to suffer from heart-rot, and due to a lack of poor or degraded forest land, suitable for conversion to plantation, within the Permanent Forest Estate. Private sector plantation initiatives in Peninsula Malaysia have been relatively insignificant.

Sabah

Plantations in Sabah were initiated by a private sector joint venture. About 60,000 hectares of *Pinus caribaea* and *P. oocarpa* were planted as a commercial venture in the mid-1970s. Shortly after the Sabah Forestry Development Authority (SAFODA) was established, with a view to reforest 200,000 hectares of degraded lands. More recently a variety of commercial investments in plantation forestry have been made. The success of plantation forestry in Sabah is attributed mainly to the role played by the private sector.

Sarawak

Sarawak has established a relatively small area of plantations and the majority of planting has been done by the Forest Department. Private companies have commenced planting rattan.

Government support

Government support to forest plantations schemes in Malaysia includes:

- Pioneer status, tax exemption from corporate tax of 100 percent on statutory income for 10 years;
- Investment tax allowance, at the rate of 100 percent on statutory income for 5 years.

6.3 Rubberwood

Malaysia has attracted attention in recent years through its use of rubberwood derived from rubber trees being cleared to make way for new clones giving higher yields of latex.

The rubber plantations, originally established for latex production, are now regarded as an important source of timber for wood based industries. It is estimated that annually around 2 million m³ of heveawood logs are harvested and utilized for the production for the production of furniture and furniture components. In terms of plantation area about 30,000 to 40,000 hectares are cleared yearly and the rubberwood products are exported to well over 20 countries. The value accelerated from a mere RM4.5 million in 1980 to RM1.4 billion in 1995. Exports in 1997 are expected to in the region of RM2 billion.

With the rapid expansion of the rubberwood-based industry, there appears now to be a short supply of wood and this is expected to be serious as more rubber plantations are converted into other land use such as oil palm. Research and development are thus being intensified to increase rubberwood productivity from existing plantations and efforts are also initiated to develop clones that yield more wood as well as latex.

The total area of land under rubber plantations in Malaysia is about 1.6 million ha, mostly consisting of smallholdings. About 700 000 hectares are felled each year and the logs are used for timber, but some of that is being replanted with oil palm, which gives a better economic return.

6.4 Constraints and challenges

Constraints to the expansion of the forest plantation scheme include:

- Shortage of large blocks of unencumbered land, contiguous to the processing site;
- Where suitable large blocks of land occur, problems of dealing with the different land or state regulations and authorities if it crosses State or other borders;
- Ban on the establishment of agricultural crops with tree crops, on forest reserve land. This means agr-forestry-type approaches designed to generate early cashflow are not viable;

- Claims established under customary rights to land by natives residing in affected logged over forestlands. In Sabah for example, although these lands belong to the State and are untitled, under the provision of the Land Ordinance a native can claim customary rights on them as long as he or she has been living in it for at least 3 years;
- Inadequate supplies of good quality planting material;
- Labour shortages; and
- Financial issues, including shortages of capital, high interest rates, the long period to obtain a return on the investment, perceived high economic or natural risks, and unattractive or inappropriate government incentives.

Land availability

The results of a recent survey jointly carried out by the Forest Research Institute Malaysia and The Forest Department of Peninsular Malaysia (1996) on land area with potential for forest plantation development estimate that, besides forest reserves, Malaysia has more than 1 million hectares of idle lands. Such lands include tin tailings, BRIS (sandy) soils and ex-shifting cultivation and abandoned paddy lands. There is estimated to be 153 900 hectares of degraded forest land in Malaysia. There is, however, a shortage of large blocks of unencumbered land with access to necessary infrastructure.

6.5 Economic comparison of some Malaysian plantation options

The case study concludes with a comparison of six plantation options, involving four species (rubber (heveawood), teak, sentang and acacia):

- Rubber plantation for timber and latex production;
- Rubber plantation for timber production;
- Sentang plantation;
- Teak Plantation;
- Acacia plantation; and
- Mixed plantation: rubber-sentang and rubber-teak.

For a 2000 hectare plantation estate, the paper concludes that the best internal rate of return is made on teak (17.3%), followed by sentang (16.4%), heveawood-latex (15%), Acacia (14.5%), and heveawood-timber (11.1%).

7 HARDWOOD PLANTATIONS IN GHANA

(Available as FORM Working Paper FP/24)

7.1 Introduction

Records of modern plantation establishment in Ghana date back to the early 1950s, although teak was trialed as early as 1905. A large number of exotic species were trialed in 1951, but the general policy was to concentrate on planting indigenous species in the High Forest Zone (HFZ). This included implementation of the "Tropical Shelterwood System" (TSS), an attempt to convert the forest from a complex multi-species/age structure to a simpler structure comprising preferred economic species of similar age in any compartment. The TSS included enrichment

planting. Around the same time, line planting was implemented in the poorly stocked wet evergreen forest reserves. Both TSS and line-planting were abandoned due to a variety of problems or undesirable effects. Taungya agroforestry systems were also experimented with through the late-1960s to 1987. Problems in the management and application of the Taungya system, particularly in conflicts of interest between the Forestry Department and farmers, led to its abandonment. The technical and economic difficulties found in all enrichment operations in Ghana have led to a preference for total replacement.

7.2 Experience with hardwood plantations

Forestry Department

It is estimated that approximately 50,000 hectares of plantations were established by the state in the HFZ in 88 forest reserves between 1963 and 1987. Of these, only 15,000 hectares (33 percent) were assessed (by the Forestry Department) to have been successful in 1991. More than 80% of the stands have stocking of less than 300 stems/hectare and only a third have basal areas in excess of 18m²/hectare. About 2,500 hectares of teak plantations were established in the productive forest reserves in the Volta Region. The successful area was assessed to be about 1,300 hectares (52%) with a mean stocking of about 330 stems/hectare. The current status of most of the FD plantations is generally a mixture of natural forest re-growth/bushes and the plantation species. Most of the fully stocked teak stands have very little undergrowth and erosion has occurred under those on moderate to steep slopes. The plantations were neither pruned nor thinned until recently when a market was established for teak poles and *Cedrela* logs.

Community forestry

In 1990, a six-year Forestry Department programme was developed based on the establishment of tree nurseries at central, subsidiary and village levels. By 1995 - 1996 it was planned that 112 nurseries would be producing 1.9 million seedlings annually. Evaluation of progress up to the third year of the programme recorded that there were 52 nurseries established producing 1.4 million seedlings in 1993. However, it was also concluded that 50 percent of the nurseries were 'very substandard' and only 11% were 'good' in terms of condition, appropriateness of species and demonstration value. The major concern however was that seedlings were being produced with little subsequent community or individual planting. Of the planting that did take place, woodlots accounted for about 90 percent of the seedlings while the remaining 10% were aimed at agro-forestry, boundary planting, wind breaks and home gardens. The programme's stated aim was to support private sector planting to the tune of 10 - 15 million seedlings per annum by the year 2000.

Deliberate tree-planting is not a traditional part of Ghanaian culture and impetus for community forestry projects is generally external. Rural communities can be reluctant tree planters for a number of reasons: shortage of land or ambiguous tenure over trees planted, limited availability of labour and capital, and previous bad experience of the Taungya system where the FD failed to provide seedlings or appropriate advice.

The RFD and some NGOs have given out free seedlings. The provision of free seedlings has made some farmers make wrong decisions. Examples include farmers having grown large tracts of plantations for which they did not have the requisite financial capacity to maintain.

Private sector

The case study documents 7 corporate plantation projects:

- BonsuVonberg Farms Ltd;
- Subri Industrial Plantation Ltd;
- Swiss Lumber Co. Ltd;
- Pioneer Tobacco Co. Ltd;
- Ashanti Goldfields Co. Ltd;
- Smartex Afforestation Projects; and
- Joint Forest Management Project, Gwira Bansa.

BonsuVonberg Farms Ltd. (BVFL) is a typical example of an investment company. The project was initiated in 1993 and planting commenced in 1994. BVFL is owned jointly by Dutch and Ghanaian investors. The investors have been assured of reasonable returns on their investments by a guarantee of the revenues from the sale of the wood by an independent international accounting firm.

The main objective of the BVFL is sawlog production. The total area of the Somanya plantation is about 700 hectares. Of this about 500 hectares has been planted with teak. The remaining area is composed of wetlands and natural vegetation. A further 3,000 hectares of plantable land has been identified in the Brong Ahafo Region. The overall objective is to plant a total of 10,000 hectares in Ghana.

BVFL has established an out-grower scheme that is supposed to be used to educate the inhabitants of the area on how to assist with the amelioration of the environment through tree planting. The extent of the individual areas involved is about 0.4 hectare to 1 hectare each. An Extension Officer visits each out-grower about 2 to 3 times in a month. Free seedlings and technical advice is given. Advice has been given to the farmers involved to plant mainly marginal land, farm boundaries or a proportion of the farmland. The condition attached to the offer of support by BVFL to the farmers is that the mature crop would be sold to the company at the prevailing market rates.

Management models

There are various relationships that have been used for the establishment of tree crops – especially rubber and oil palm – in the country for several years. These are normally between companies and individual farmers. The relationships include:

- *The Small Holder system*: The individual planter or small farmer does not own the land. A nucleus company arranges for credit and provides extension services and planting material for the establishment and maintenance of the tree crop.
- *The Out-grower scheme*: The main difference is that the farmer owns his own land. All inputs except land and labour are provided by the company and seedlings may be sold at cost to the farmer as is the case with the small holder scheme. The services include extension and farmer loan account services.
- *The Lease-back system*: The farmer who owns the land does not want or is unable to make any investment towards the establishment of the crop. The nucleus company is

granted use of the land. The farmer may or may not provide paid labour to the company but usually takes a share of the final value of the harvest.

7.3 *Promotion of tree plantations*

Markets and economics

- Generally demand for wood in Ghana exceeds supply. Industrial processing capacity is around 3.7 million m³ per annum, compared with an annual allowable cut of 1 million m³;
- Log prices are artificially depressed due to the suspension of log exports in 1995. Illegal trade in timber also contributes towards distortions in the domestic wood market;
- National electrification programme will require around 100,000 wood poles per year, for 30 years. Thinnings from the FD teak plantations have been the main source raw material for the wood pole treatment industry in Ghana;
- Ghanaian sawmills generally not equipped to process small diameter plantation logs. Will generally require re-tooling and upgrading to process plantation logs;
- Meeting domestic demand for wood will require an estimated 1,255,000 hectares of plantations. Fuelwood plantations comprise 840,000 hectares of this estimate (derived by case study author); and
- FAO cost-benefit analyses (10% discount rate) indicate teak is generally the most profitable plantation species in Ghana.

Legal and policy issues

The Forest Development Master Plan (FDMP) 1996 - 2020 has been prepared by the Ministry of Lands and Forestry. The objectives of the plan include the mobilization of a wide range of Ghanaians, mainly from the private sector, to undertake tree growing ventures within each district of the country. Accordingly, a series of incentive packages will be designed to ensure widespread appeal and positive response across the nation. The plan envisages a 10% increase in the forest and tree cover of Ghana. A nation-wide planting target of 200,000 hectares has been proposed with annual plantings of 7,000 to 10,000 hectares over the next 20 years. In this respect, the forest industry would also be encouraged to modernize and also to re-tool to be able to process small logs and plantation products in the future.

The Natural Resources Management Programme has been developed to implement the FDMP. The Government plans to establish a Forest Plantations Development Centre to promote and encourage private forest plantation development. The project is meant to support all those who are planting or wish to plant timber trees commercially within the HFZ. Institutions and facilities necessary to encourage private investment in plantation forestry would be developed. A Forest Plantations Development Fund, for instance, would be set up. Details of a practical and feasible incentive scheme for investors in plantation forestry are yet to be worked out.

Land and tree tenure

A key point is that ownership of planted trees is not clearly defined. The following points may impact on plantation establishment and rights to harvest:

- *Traditionally land is deemed to include things on and under the soil, but does not necessarily include things attached to it such as houses and trees;*

- *The right to economic trees is generally vested in the owner of the paramount interest to the land on which they grow, even where the land has been leased out;*
- *Individuals cannot harvest economic trees on unallocated communal land even if they have been planted by them;*
- *In traditional land agreements, when the tenant changes the land use, which was agreed upon during the land acquisition, the landowner's consent must be sought. Investors wishing to invest in plantations on degraded forest reserve lands will need to consult with the owners – even though management of the lands is vested in the Government;*
- *In other regulations no particular exemption is made for planted timber from legal requirements applicable to natural timber;*
- *Multiplicity of interests and rights in land which may vary in different parts of the country leading to conflicting claims to ownership;*
- *Lack of reliable maps indicating stool/skin land boundaries which can give rise to disputes; and*
- *Cumbersome land disposal and documentation procedures.*

7.4 Conclusions

The main constraints to plantation formation in Ghana can be summarized as follows:

- Limited experience with successful commercial forest plantations formation. Hence no proven technical packages;
- No information on available land and site typing even though there is no shortage of gross area;
- Lack of adequate and genetically improved planting material;
- Security of land and tree tenure;
- Fire in the Transition Zone;
- Illegal timber markets and the sale of plantation timber below the market price by the Forestry Department, and
- Timber industry not adapted to small diameter milling.

There is, however, considerable scope for successful commercial plantations in Ghana when the following are compared with those in other tropical countries:

- Favourable conditions for tree growth and quality wood development including climate, topography, and soils;
- Political stability;
- Reasonable local infrastructure and access to ports;
- Strong domestic markets for wood products and good access to major ECOWAS and European markets;
- Favourable labour market in terms of skills, price and availability;
- Existing processing capacity; and
- Extensive areas of degraded forests within forest reserves suitable for tree planting, and by statute dedicated to permanent forest status.

The Government of Ghana is committed to the facilitation of the formation of commercial plantations in the country for economic, environmental and sociological reasons. It is also the

intention of the government that most of the commercial forestry activities should be the province of the private sector. The necessary political will exists to boost tree plantation formation. What are required are the necessary incentives and policy reforms to pave the way for increased investments in commercial tree plantations by both the local and foreign investors

PART 3 SPECIAL STUDIES

8 GLOBAL SURVEY AND ANALYTICAL FRAMEWORK FOR FORESTRY OUT-GROWER ARRANGEMENTS (Available as FORM Working Paper FP/11)

8.1 Background

Out-grower schemes are an emerging feature of forestry development in many countries, yet the socio-economic value of such schemes is still to be fully assessed. The main aims of the study were to assess the extent and main characteristics of forestry out-grower schemes globally, with an emphasis on developing countries, and develop an analytical framework to assist the comparative analysis and development of existing and future out-grower schemes.

The study provides a broad overview of forestry out-grower schemes in operation around the world. A major component of the study was to survey forest industry staff who manager out-grower schemes, with a response rate of 21% received for the study's questionnaire – covering 17 schemes. Given the limitations of the study, it is not presented as a comprehensive review of all forestry out-grower schemes in operation.

8.2 Key issues

Based on the information derived from the out-grower schemes reviewed by the study, the key issues that contribute to the success of schemes include the extent:

- Arrangements are appropriate (e.g. partners should have a reasonable likelihood of deriving benefits, contribute to the strengthening of the socio-cultural and economic context of local communities);
- Contributions (e.g. land tenure, business viability) and partnerships are secure;
- Production and market risks are accurately calculated and shared;
- Partners have the social and technical expertise to genuinely negotiate arrangements;
- Partners are informed of realistic prospects and opportunities (e.g. flexibility of options);
- Arrangements and forestry practices are consistent with sustainable forest management principles – at the local and regional levels; and
- Arrangements contribute to wider community well-being.

Drawing on published literature and the results of this study, a set of principles and criteria or an analytical framework has been developed as a tool for assessing the implications of forestry out-grower schemes. This framework outlines the characteristics that appear to have a major influence on the extent out-grower arrangements are fair and beneficial for each partner (or potential partner).

8.3 Framework for assessing forestry out-grower schemes

Principles

- Mutual acceptance of each partner's aims under the arrangement;
- Fair negotiation process where all partners can make informed and free decisions – including allowance for a third party to negotiate on their behalf;
- Realistic prospect of all partners being able to derive benefits proportional to their contributions and risks; and
- Long-term viability and commitment of partners to optimize the returns from the arrangement – in terms of commercial, socio-cultural and environmental attributes.

Criteria

- Positive local socio-cultural, policy, economic and environmental context for all the principles (noted above) to develop;
- Partners have a willingness and capacity to contribute to arrangements within the socio-economic and environmental parameters of their household/business over the contractual period – with opportunities for re-negotiation or inherent flexibility within contracts (i.e. partners need to avoid high risk arrangements);
- Arrangements are formalized (i.e. have legal status) with clear details of when and how multiple benefits can be arranged (e.g. collection of NTFPs, grazing, inter-cropping), contracts can be nullified, and compensation would be forthcoming. It would also appear useful for a credible and independent third party to be nominated to arbitrate if disagreement arises;
- Partners have access to accurate, in-depth and independent information on the:
 - Likely short- and long-term prospects – with contingency scenarios explored if arrangements are nullified;
 - Current and likely long-term viability of prospective partners; and
 - Likely long-term context for local forestry development (e.g. market trends – product volumes and competitiveness, necessary infrastructure, government policy, code of practices, local SFM practices, landholder/grower participation, wider community support).

How these principles and criteria translate to any given local context will vary depending on the extent:

- Entering into out-grower arrangements out-weighs the opportunity costs for both partners;
- Partners are informed of the commercial prospects and wider implications;
- Regional markets provide positive commercial returns for both partners;
- Partners remain motivated to contribute to arrangements – reflecting the importance of schemes to the viability of the household/business;
- Government has a willingness and capacity to develop encouraging policies and procedures;
- Community perceptions of out-grower schemes and potential partners are favourable; and

- Institutional support is available for providing market information and a fair negotiating context.

9 MARKETS FOR HIGH-VALUE TROPICAL HARDWOODS IN EUROPE (Available as FOP Marketing Working Paper)

9.1 Objectives

The objective of the study was to provide an up-to-date, quantified, description of the current and future markets of high-value tropical sawnwood, veneer and plywood in Europe, with a rough comparison to the markets in North America and Japan. Further objectives were to provide a comprehensive description of the main marketing factors for accessing the markets and to identify important attributes that can be used in the marketing of tropical hardwoods, in particular, to various end-use segments.

9.2 Certification and markets

Although traders and industrial buyers offer certified forest products in Northern Europe (the United Kingdom, Germany and the Netherlands), it is not a requirement of buyers, nor are they generally prepared to pay a price premium, unless it is a specialist niche market. Although desirable for buyers groups and stakeholders to have mutual recognition of certification schemes (Forest Stewardship Council [FSC], Pan European Forest Certification [PEFC] Scheme and others), this is not currently the situation. Mediterranean countries and France (like Japan and the United States of America) are less likely to require certification of forest products.

Conservatism about the use of plantation teak comes primarily from the merchants, importers and manufacturers rather than the final consumers or end users who often appreciate the aesthetic natural qualities of the wood. Overall the opportunities for plantation grown teak in Europe are considered to be good. However, the marketing of plantation and lesser-known species was reported by the industry as being difficult. In these instances, introduction is more appropriate through use in value added products where design, quality and service are considered more important than the tradition of using certain species in a particular country for a given end use.

9.3 Constraints for tropical hardwood markets

The European tropical hardwood industry, over recent years, has suffered from a loss of markets. There are many reasons for this loss; however, some of the main factors include:

- Negative public perception of tropical timber products arising from campaigns by non-governmental organizations (NGOs) linking tropical timber consumption with tropical forest depletion;
- Change in fashion from dark coloured species to lighter coloured species;
- Increased competition from other wood, as well as non-wood, substitute materials (e.g. plastics in window manufacture); and
- Reduced margins within the timber industry 'squeezing' tropical timber profitability;

- Policy changes by exporting countries (especially Southeast Asia), shifting export emphasis from primary products (logs, sawnwood, plywood and veneers) to secondary processed products.

9.4 Opportunities

There are now, however, some signs of optimism regarding the future of tropical timber products. These result from:

- Public perception of timber is changing: wood, in general, is seen by many to be a 'green' material;
- Mounting concern over the environmental credentials of substitute materials, particularly plastics; and
- Fashion: some evidence suggests that there is a reversal in the trend for lighter coloured species, with darker woods gaining popularity in some areas.

In general, the future markets for tropical timbers are seen to be predominantly in the maintenance of existing, 'traditional' markets (joinery, furniture) with the possible regaining of market share lost in recent years. It is unlikely that significant 'new' markets will open up for tropical timbers, with the possible exception of indoor flooring and outdoor decking material.

9.5 Future trends

There has been a general decline in the importation of tropical primary products into Europe over the past ten years, whilst the regions of supply have changed markedly. Over the same period, the level of imports of secondary processed products have increased rapidly and in 1998 accounted for a third of the value of all tropical products imported into Europe. This trend seems likely to continue.

The supply of plantation (and lesser-known) species is likely to increase in the future. The opportunities of these materials would appear to lie in product development and by adding value through the manufacture of secondary processed products in the exporting countries.

In terms of how primary tropical timber products compete against alternative materials, in general, the 'natural' or technical properties are perceived to be their strongest attributes. However, product specifications and particularly issues of supply are seen to be weaknesses of tropical timbers.

With regard to the supply chain, traditional importers and traders are those still, in the main, dealing with exporters. There is, however, a trend to shorten the supply chains and 'e-commerce' is likely to affect this still further.

Price is a key factor influencing purchasing decisions, but is not the sole buying criterion.

A comparison with other economic regions reveals that, as in Europe, Japanese imports of primary products are falling. In North America, tropical primary product imports only form a

small fraction of the total. The situation with secondary products is different; in Europe and North America the value of these is rising, however, in Japan levels have not changed over the past five years.

The environmental perceptions surrounding the use of tropical timbers are likely to be key issues in the future. The adverse image of tropical timber, associated with deforestation in tropical countries may, in part at least, be countered by the utilization of certified timber products. In order to achieve this, it may be necessary to secure mutual recognition of local certification systems operating in countries like Malaysia and Indonesia. In general, the market is unlikely to accept any price premium for certified timber, except in niche applications. There is some evidence, however, which suggests that the ultimate end user may be willing to pay more for certified material.

9.6 Recommendations

Based on the findings of this report, the following are the key recommendations for maintaining and promoting markets for tropical hardwoods in the future:

- Limited data on end uses are available. Research should, therefore, be undertaken to elucidate key areas at a European level. This would enable more effective, targeted promotional campaigns to be undertaken.
- Contacts with key personnel within industry, prepared to give regular feedback on the market situation, should be developed and maintained.
- Traditional markets are seen as the key continuing markets for tropical timbers. Promotional campaigns aimed at maintaining or increasing market shares in these sectors are recommended. Any problems associated with such promotion should be elucidated and strategies for dealing with these issues developed.
- Education campaigns, highlighting the benefits of tropical timbers, which target architects and builders' merchants (and any others involved in recommending/specifying materials) should be instigated.
- Tropical timber is considered to be synonymous with 'quality'. The development of value added markets for tropical hardwoods, particularly plantation grown species, is thought to be one way of gaining market share.
- Research should be conducted into end user requirements in terms of tropical timber product appearance (i.e. the presence of natural defects such as knots) since there is some evidence to suggest that this contradicts what the industry believes consumers require. This may be of particular relevance to the introduction of plantation or lesser known species.
- Measures should be taken to ensure the quality, regularity and dependability of tropical timber supply.

PART 4 SYNTHESIS

10 SYNTHESIS OF STUDIES

10.1 Lessons learned from Case Studies

The case studies examined plantation forest establishment on a range of scales and by a variety of participants, most notably large-scale government planting, large-scale private sector corporate establishment, and small scale private landowner planting. It is evident that there is considerable diversity among the groups of countries selected for case studies. Nonetheless, there is a surprising degree of commonality in the issues governing establishment of plantations. At the same time there are subtle differences in the mechanics of these issues, interactions between various factors, and the manner in which challenges are being addressed.

The issues raised in the case studies can be distilled into nine key lessons:

- *Governments appear to have a significant direct role to play in establishing an initial critical mass of forest plantations;*
- *Perceptions of political and economic stability are at the core of plantation investment decisions by the international private sector;*
- *Land tenure issues can be a major constraint on investment, and also reflect “cultural uncertainty” – a disincentive to international investment;*
- *Legislative and institutional factors can create significant impediments to investment.*
- *Cashflow problems are major impediment;*
- *Market conditions must be conducive to profitability;*
- *Shifting from large-scale to small-scale operations;*
- *Local people’s participation – socio-economic issues important; and*
- *Need for continuous improvement in technical factors of production.*

Many of these issues are well known to the forestry community, however, there are some interesting lessons to be learned by comparing the relative experiences of the Case Study countries in addressing the challenges. Each of these issues is discussed in greater depth below.

10.2 Governments appear to have a significant direct role to play in establishing an initial critical mass of forest plantations

A common theme through four of the five case studies is the major role played by governments in initiating plantation forestry in countries. In Malaysia, New South Wales, Ghana, Fiji, Solomon Islands and Papua New Guinea the government has played the primary role in initiating species and provenance trials, initiating larger-scale planting and providing a body of knowledge, expertise and research that can be tapped by private sector successors. A similar role for government can be observed in a many other countries with significant plantation estates.

The case studies suggest a number of reasons for this government role. Probably the most significant factor is the risk involved in initiating national plantation programmes. In Australia, Heathcote (1998) notes that:

Government plantation programs have often pioneered new plantation resources where an individual grower would not have taken the initial risk.... With their large plantation base and public funding, government growers have probably taken bigger risks and have

been prepared to accept more uncertainty than many private growers.... Governments have played a major role reducing these uncertainties and risks.

Government in Peninsula Malaysia played a similar role. The Forestry Department was responsible for most of the initial planting trials. Government recognition of impending declines in natural forest wood supplies led to plantation establishment under the Compensatory Plantation Project supported by the ADB. That this programme was less than entirely successful, due to deficiencies in *Acacia mangium*'s suitability for sawmilling, serves to highlight the risks involved in initiating plantation programmes. Nonetheless, in the case of Malaysia, the experience from government initiatives has successfully translated into private sector plantation enterprises, particularly in Sabah.

This translation has been less successful in the Melanesian Islands. A major part of the reason for this probably relates to limitations on local private sector access to capital and difficulties in attracting international investor interest. Perceived risks relating to issues such as land tenure, economic stability and user rights appear to outweigh the potential for high rates of return from investing in relatively low cost environments. Hammond (1998) goes as far as to suggest the role for government in these countries may be one of assuming establishment and management risks associated with plantation investment by:

successfully establishing forests with a view to exiting them once they approach maturity.

The exception to direct government-led plantation development is in Central America. Here, the private sector has played a much more important role in initiating plantation establishment, albeit with the help of significant government incentives. The initial government incentive in Costa Rica enabled unlimited plantation expenses to be deducted from income tax. The incentive appears to have been sufficient to encourage private landowners to experiment with teak growing. Projects directed by international aid agencies also helped to establish the viability of teak plantations and provide evidence of good financial returns.

10.3 Perceptions of political and economic stability are at the core of plantation investment decisions by the international private sector

For many developing countries, large-scale plantation development requires either direct government involvement in planting, or attracting international investment. Major obstacles in many developing countries are perceptions of economic or political instability. As a consequence, risk factors applied to plantation investment decisions tend to outweigh the benefits of investing in low-cost economies.

For example, Hammond (1998) notes that in Fiji, investor confidence is likely to have been affected by the political turmoil created by the outcome of the 1987 election and subsequent coups.

The perception that there can be political instability brings about uncertainty, which in turn is a most difficult factor to overcome if trying to encourage investment.

Hammond also highlights the fact that economic stability is important in enhancing confidence that investment conditions will not vary markedly over the long life of a plantation investment:

A further issue associated with incentives is highlighted by the Solomon situation and even more so with recent events in Asia and in particular in Indonesia. While the current government in a given country may have certain incentives or tax breaks in place, can they afford to maintain them for the life of the plantation – say 30 years? For investors, this matter of confidence about the economic environment they will be operating in, in the future tends to encourage them to locate in economies that are less liable to change dramatically in the future.

Using the Solomon Islands as an example, Hammond (1998) cites important disincentives to investment as:

- *Lack of political focus on management of economic matters;*
- *Problems in the national economy limiting the government's room to move;*
- *Perceived political interference – legal and illegal – in resource allocation and the investment process.*

Heathcote (1998) emphasises the point from a different angle in noting:

Despite the relatively high cost environment, Australia is perceived as one of the most attractive countries for overseas plantation investment. A history of political certainty, stable exchange rates and low inflation are significant attractive features to investors.

10.4 Land tenure issues can be a major constraint on investment, and also reflect “cultural uncertainty” – a disincentive to international investment

Land accessibility and security of tenure are probably the most widely emphasised issues across the case studies. Land security comes from having well-defined and enforceable property rights.

Customary systems of land tenure often fail to display sufficient security of tenure to encourage developed country investment. In part, this reflects the uncertainties (and often discomfort) inherent in attempting to invest in an unfamiliar, and sometimes incomprehensible, cultural environment. Different perceptions of the nature, validity and enforceability of contractual arrangements can be a major source of uncertainty.

For example, Odoom (1998) notes that a potential investor in Ghana would have to deal with the following land-related issues:

- *Multiplicity of interests and rights to land...leading to conflicting claims to ownership;*
- *Lack of reliable maps indicating stool/skin land boundaries;*
- *Cumbersome land disposal and documentation procedures; and*
- *Potential conflict concerning tenurial and management arrangements for plantations within forest reserves.*

Hammond (1998) notes similar obstacles in the Melanesian Islands. Land ownership is not always clear, legal title to land may not be defined, formal mapping and boundaries may be non-existent (in the Solomon Islands, for example, title is defined by the local land guardian who “knows” the boundaries), contractual arrangements may be viewed as renegotiable by landowners (particularly in Papua New Guinea).

Issues associated with native claims on customary land are becoming important in Malaysia. Krishapillay notes:

Another concern that is slowing down the commercial sectors’ participation in forest plantation investments, either as joint venture partners or outright investments, is the issue of claims for customary rights by natives residing in affected logged over forest lands where plantations are to be established. In Sabah for example, although these lands belong to the State and are untitled, under the provision of the Land Ordinance a native can claim customary rights on them as long as he or she has been living in it for at least 3 years. Such issues need to be resolved before investors would consider investing in forest plantations.

In Ghana, and in Melanesia, Governments have attempted to overcome difficulties posed by customary land ownership, and cultural difficulties in negotiations, by acting as intermediaries between investors and landowners. In Papua New Guinea, for example, partially as a protection against corruption, customary land may only be purchased by the government and then leased to a foreign investor.

Even in developed countries, land and security can be a major issue. Hammond (1998) suggests security of rights to utilise plantations is likely to be a bigger issue than security of land tenure:

Ironically, in most developed countries, security of tenure is not a major threat, but security of use can be. Most developed countries impose a wide range of planning, environmental, and social constraints on land users, but do not threaten ownership. In much of the developing world where customary land is a common phenomenon, tenure is often rather confusing to outsiders, but the right to use land in any way without government intervention is much more accepted.

A slightly different issue may arise in Australia, where communities may be sensitive to large land purchases for forestry or associated with privatisation of plantations – especially by overseas investors. Forestry rights, purchasing the forests but not the land, may both facilitate investment and reduce community unease.

10.5 Legislative and institutional factors can create significant impediments to investment

Where plantation investment is desired, legislation may need to be adjusted to ensure it enables, rather than constrains, investment. Legislative constraints often relate to specific controls,

designed to govern aspects of land-use or forestry, but irrelevant or inappropriate for plantation development or sale of plantation-grown products. Several broad categories can be noted:

- Insufficient differentiation between natural forest practices and plantation practices;
- Land-use and planning regulations that specifically favour agriculture over forestry;
- Subsidy policies that favour other land-uses over forestry;
- Export levies and bans designed to protect natural forests, also affecting plantations;
- Poorly designed plantation incentive policies; and
- Absence of a coherent forest policy.

Government encouragement of plantations often requires considerable political will, and a need to capture the attention and focus of legislators and decision-makers. A common difficulty is that forestry legislation is designed to govern natural forest activities, but in the absence of other specific legislation, coverage extends across planted trees and forests, to constrain desirable activities. For example, in Ghana, the Timber Resources Management Act 1998 does not explicitly exempt planted timber from the requirement of a Timber Utilisation Contract (TUC) for harvesting. And TUC's may not be held by individuals. In Australia, some of these issues have been dealt with in a specific Timber Plantations (Harvest Guarantee) Act 1995, which seeks to remove impediments to harvesting plantation timber by replacing environmental and development consents with a compliance code of practice.

Heathcote (1998) notes that, in Australia, local planning regulations forestry tends to be discriminated against compared to traditional land-uses (though this is contrary to the National Forest Policy Statement). Some of these inequities are exacerbated by subsidies accruing to other land-uses, for example, tariff protection on agricultural products. Governments need to consider their incentive policies on a cross-sectoral basis. Occasionally, forestry incentives may introduce the major distortion. For example, the reforestation incentive in Panama gives tax deductibility to 100 percent of expenses, including land. This has started a speculative land price spiral.

In Papua New Guinea, Solomon Islands and, until recently, Australia, export duties or export bans have been applied to unprocessed logs from both plantations and natural forest. Part of the justification for these is environmental protection in the natural forest, part of the motivation is to encourage development of local processing, but a direct effect is to lower the returns to forest growers, and hence the attractiveness of plantation investments.

The absence of a coherent forest policy generally leaves a forestry department with no clear mandate and leads to weak administration. Odoom (1998) in Ghana notes:

Prior to the Fourth Republic, the forestry sector lacked an updated and clearly defined forest policy spelling out goals, objectives and strategies for development of forest resources and the future direction of the timber industry. As a result, administration by the relevant sector institutions was weak and this led to widespread trade malpractice including failure to pay forest fees, speculative felling, illegal trading in forest products and unauthorised subletting of concessions to illicit timber operators. In force at the time were ridiculously low fines and outdated legal sanctions that served as stimuli, rather than

as deterrents, to the rampant commission of forest offences. These deficiencies led to excessive depletion of the most marketable timber species causing severe forest degradation and an escalated rate of deforestation by agricultural encroachment. Also, a lack of local community involvement in forest resource protection and an absence of comprehensive and co-ordinated medium to long-term plans further aggravated the situation.

The key issues that militated against good forest management were therefore inconsistent financing of the forest sector operations, ill-motivated civil service personnel, and weak legislation coupled with lack of co-operation from the law enforcement agencies.

10.6 Cashflow problems are major impediment

The classic problem for forestry plantation investment is the long time horizon between incurring the costs of establishment and receipt of the returns from harvest. Absence of cashflow is a complete disincentive for any company or individual without recourse to other income. Not surprisingly, several case studies identify cashflows as a major impediment.

Two responses are of particular interest.

1. In Malaysia, several companies have requested that they be allowed to allocate a portion of land leased for plantation establishment to the raising of agricultural cash crops. This is considered a necessary activity to cushion the long waiting period before plantation harvests. If the land is inside forest reserves, however, it must be strictly planted with forest trees. The policy aims to favour the forest and environment, but where plantations might otherwise be established on degraded lands, it could be counter-productive. Consideration of a case-by-case approach might be desirable.
2. In Australia, Heathcote (1998) notes:
Convincing landowners to participate in long rotation (up to 40 years) joint ventures has been a major challenge particularly when the returns from the joint venture are not received until each harvest. This has been easier for landowners with non-farm income to accept as they are better able to afford to set land aside for at least ten years. In recognition of this, State Forests has introduced another joint venture agreement that makes annual payments to landowners as "rent" for the first ten years of the rotation. After this time the stand is thinned and an increase in cattle grazing is possible.

The suggestion is that plantations can be encouraged if it is possible to integrate tree-planting into existing land-uses or portfolios. A related impediment is a general lack of availability of long and medium term loan finance, packaged appropriately for forestry cashflows.

A major problem, once plantations are established, is if cashflows (and hence ability to finance management) become squeezed. This can be a problem, regardless of whether the plantations are funded by the government, large-scale private sector, or small grower. Optimal silviculture requires that interventions be timely, and effectively carried out. Often, however, there is a

temptation to defer treatments, thereby affecting the quality of the timber and reducing final returns to a project. These management issues are noted in all case studies. Aid projects may be particularly susceptible to deteriorating project quality, particularly when many have a limited lifespan and success is measured in terms of trees-in-the-ground.

10.7 Market conditions must be conducive to profitability

A perception that plantations will be profitable is the central motivation for plantation establishment. The case studies identify, however, a number of factors that act to reduce profitability in countries.

A primary issue is pricing, particularly where stumpage rates in natural forests or from government supplies are kept artificially low. This can occur through a number of mechanisms. These include:

- Intentional underpricing of natural forest wood;
- Long-run concessions or quotas without appropriate price adjustment for inflation;
- Restricting exports and thereby creating an oversupply in local markets;
- Illegal harvesting and trade in timber; and
- Inappropriate government market behaviour and “crowding out” of private sector.

In Ghana, for instance, Odoom (1998) describes local log prices as being artificially depressed due to the 1995 suspension of the log export trade, and illegal logging, particularly by low cost chainsaw mills. Forest growers consequently receive lower prices for their log production. Similar problems have occurred in Australia where, until recently, exports of unprocessed logs were effectively banned, while governments set an artificially low rate of return on their forest production, undermining private sector investments. In Malaysia, PNG and the Solomon Islands, abundant supplies of cheap wood from extensive natural forests until recently provided little incentive for plantation investment.

In these instances profitability can be enhanced by the payment of incentives to tree planting. Hammond (1998) argues that there are very few instances in the world where plantations have not been established without recourse to subsidies, incentives, or tax concessions – except where plantations have been directly established by the government. The use of incentive payments to encourage the establishment and maintenance of tree plantations, especially by out-growers, has been reported in several of the case studies.

Several Central American countries have had incentive schemes in place for several years, but have recently refined the systems, which have led to greatly increased planting rates (de Camino and Alfaro 1998). In Costa Rica the incentive system is specifically related to the provision of environmental services financed by a selective consumption tax on hydrocarbon fuels. It includes exemption from various taxes as well as access to credit and payment of a subsidy in the first five years of the plantation’s life. Teak now constitutes 17% of the plantation area established between 1979 (the system was first introduced in 1969, but has been considerably modified over time) and 1996. Much of the expansion has been on the land of smallholders. In Panama investment in forestry is fully deductible for income tax purposes, while import duties are waived on equipment and machinery used in plantation activities.

Ghana has initiated a Forest Plantations Development Fund, which is intended to provide subsidies for the establishment and maintenance of plantations. Malaysia has recently offered

“pioneer status” to investors in forest plantations, consisting of full exemption from corporation tax for 10 years, and an investment tax allowance on all income for 5 years; nevertheless these may not be sufficient to attract private sector investment to meet the country’s ambitious plantation targets and other incentives may be required as well, such as access to credit or soft loans. Both Papua New Guinea and the Solomon Islands offer “tax holidays” to plantation investors.

In Australia, many plantation investment schemes have been tax-driven, with the major gains realised on establishment. A subsequent lack of management has meant these neglected stands have often yielded low returns and created a bad perception of plantation forestry.

In general, Odoom (1998) concludes that a “business principles” approach to plantation investment needs to be encouraged. In essence this requires that investors make an acceptable rate of profit – and, in Ghana, Odoom argues will require incentives. Direct participation of the private sector is held to be good evidence that a business principles approach is being followed and is succeeding.

10.8 Shifting from large-scale to small-scale operations

The private sector has become more involved in the establishment of forest plantations than ten or twenty years ago, and the direct role of the public sector has diminished. Within the private sector there is a trend towards increasing numbers of small scale farmers acting as “out-growers”, who incorporate trees into farming systems, or as small blocks, and who grow trees to supply large-scale industries. Examples are the growing of eucalypts by farmers for pulpwood in Brazil, India or Thailand or of poplars for peeler logs for matches and plywood in India. The same trend is apparent in teak, for example in Thailand, Costa Rica, and Ghana. Labour shortages in rural areas in Peninsular Malaysia have made the traditional labour-intensive crops such as rubber less economically attractive and have led to a dramatic increase in the involvement of small farmers in the growing of teak (Krishnapillay, 1998). Associations of growers have been reported in Central American countries, to represent the private sector and to help small growers obtain fair prices for their produce. The favourable economic returns on investment to small-scale growers have already been reported above) for Ghana.

Odoom (1998) described the three management models used for private tree crops such as oil palm and rubber in Ghana. They are:

- The smallholder system, where the smallholder does not own the land but is allotted it by a large company, which owns the land and which provides a guaranteed market, a loan, advice and inputs of planting material, fertiliser etc
- The outgrower scheme, which is similar to the smallholder system, but the farmer owns, leases or share-crops the land; and
- The leaseback system, in which a farmer owns the land but does not farm it, leasing it instead to a private company

All of these systems are being tested in Ghana for small, private teak plantations

10.9 Local people's participation – socio-economic issues important

In almost every country, forestry is moving to embrace, and integrate, social dimensions of forestry into the predominant economic-environmental paradigm. The importance of having support of local communities in establishing plantations will often be paramount to their success.

In Ghana, for instance, efforts to ensure people's participation by implementing Taungya systems (agro-forestry using block plantations with intercropping) largely failed, due to inadequate management and application of the system. As a joint venture between the Forestry Department and local farmers, there was a marked conflict between the objectives of each group. Farmers wanted to utilise land for cropping or grazing as long as possible, while the Department wanted to ensure trees were established quickly and with little damage. In some areas the system was sabotaged as fears of land shortages arose.

In the Melanesian Islands, Hammond (1998) notes:

The terms of any lease must reflect the needs of the local community and the landowners (often the same people), as well as the needs of the investor. The impact of the proposal must be considered from an environmental, economic and social perspective to ensure each benefit is maximised and equitably shared. Failure to observe these requirements is almost certain to result in difficulties at some point in the future, with the worst case being the failure of the plantation to ultimately deliver returns to either the investor or the community, or both.

Throughout the tropics, many of the problems registered by plantations have been related to social or environmental issues. Social conflicts have been mainly due to land claims by local communities, or to the lack of sensitivity to the needs and preferences of surrounding populations. Environmental conflicts have been related to poor matching of species to the conditions or soils, or susceptibility to fire pests and diseases.

Involving local communities in the making of decisions has helped to ensure a reasonably smooth existence for forests established with community liaison groups, such as some of the Fijian forests.

Community issues may be equally important in developed countries where educated, and potentially vocal, populations can easily disrupt a plantation project. In Australia, there is generally strong support for native species (*Eucalyptus*) plantations, due to concern over natural forest harvesting, because of the employment opportunities generated, and the benefits of improved soil and water protection. In some instances though, the expectations of local communities, for ongoing employment and income, are not always met. This can cause disaffection with plantation projects – particularly in developing countries, where cash economies may have been initiated by implementation of a plantation project.

Often it will be necessary to educate local communities on the benefits of tree planting. In Ghana, for example, tree planting is not part of the culture. Consequently, development needs external

motivation and technical support, as well as efforts to increase awareness and education. Often these objectives have been approached by giving free seedlings to landowners, and where extension has been properly followed up this appears to have worked well. However, in some instances free seedling programmes have caused some poor decision making, with farmers planting large plantations without the requisite capital to manage.

10.10 Need for continuous improvement in technical factors of production

One of the conclusions of several recent studies of plantation economics is that competitive advantage in forestry is moving away from countries that possess(ed) large tracts of natural forests, and towards countries that can grow trees fastest. Thus, continuous improvement in the technical factors of production is likely to be important in maintaining market competitiveness for plantation grown hardwoods. Key factors of production discussed in the Case Studies include:

- Seeds;
- Research;
- Management;
- Infrastructure; and
- Wood properties.

Seeds

One of the primary impediments to improving plantation productivity in developing countries is the availability of adequate and/or genetically-improved seeds or seeds of appropriate species. Generally, developing countries tend to favour exotic species in plantations, because these have been well researched and are known to grow quickly. Problems in accessing good planting material were noted for Ghana, Malaysia and the Melanesian Islands.

Research

Often significant research trials have been established in developing countries, but then the trials have been abandoned or lost, the results have been lost or destroyed, or the results have not been carried through to the field. For example, Krishnapillay (1998) describes the 1920s as the “plant and forget” era in Malaysia. Nonetheless, both the Malaysian and Ghanaian Case Studies believe that much useful information can still be retrieved from past experiments and experience.

Experience in developed countries suggests research is crucial to maintaining competitive advantage. In Australia, much of the skills and knowledge base of the Australian plantation industry has been developed by government and flowed into private industry.

Management

Most developing countries have limited experience with successful commercial forest plantation formation. Hence, there are no proven technical packages and this makes the concept difficult to sell to the private sector.

Infrastructure

Significant infrastructural advantages are generally conferred to developed countries, in terms of transportation, clusters of supporting industries and skilled labour. Developing countries are generally reliant on low cost economies to maintain competitiveness.

Wood properties

Converting industries from processing natural forest logs to plantation-grown logs may be a costly and difficult exercise. Generally, plantation logs are grown at shorter rotations than natural forest timber and logs are likely to be both smaller and have different fibre properties. In Ghana, for example, Odoom (1998) notes there is no ready market for small diameter, plantation-grown logs. Sawmills require re-tooling and upgrading before these can be processed. A similar challenge was overcome in Australia by tying some future wood supply and grant money to re-tooling sawmills in order to ease the transition away from “old growth” logs.

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

Wood and fibre from plantation forests constitutes an important part of global supplies. FAO estimates that around 24 percent of global industrial roundwood production is presently sourced from plantation forests. Given physical and political pressures on future wood supplies from natural forests, it is probably that if demand for wood continues to increase then this will need to be met by increasing production from plantations.

Tropical hardwoods are likely to be particularly affected compared to current levels of production from natural forests. Most Asian countries, and notably Indonesia and Malaysia, are expected (or have already) to reduce production of tropical hardwood timber from natural forests. As a consequence, the opportunities for plantation-grown hardwoods, particularly “luxury” hardwood species such as teak, should be highly favourable.

There are several caveats to this generalisation:

1. Information on future demand for tropical luxury hardwoods is imprecise. In 1996, ITTO estimates production of tropical hardwood saw and veneer logs by its member countries to have been 174.5 million cubic metres. Thus, tropical hardwood industrial roundwood production comprises around 12 percent of global industrial roundwood production. The highest value markets for tropical hardwood products are likely to be for solidwood products in developed countries. However, the size of these markets can be gauged by exports of logs in 1996 totalling 14 million cubic metres, and exports of sawn timber totalling 8 million cubic metres. ITTO estimates the roundwood equivalent of all tropical wood exports to be 58 million cubic metres, around 4 percent of global industrial roundwood production.

In the past, a significant amount of relatively high quality timber has been used in the manufacture of plywood – and often this plywood has been used in relatively low value applications. Similarly, significant volumes of tropical hardwoods are used in the production of fibre-based products – paper and panels – including whole logs, and residues.

Consequently, in looking at the future opportunities for plantation-grown tropical hardwood products, the size of the high-value “luxury” end of the market should not be overstated.

2. Information on substitute products and their relative competitiveness/market acceptability is not readily available or comprehended in the marketplace. Particularly weak is aggregated information on consumer preferences, information (in the forestry industry) on non-wood substitutes, and understanding of the likely impacts of engineered wood products in specific market segments. Note that it is not argued that information does not exist – rather that information is inaccessible or not adequately communicated to forest-growers, particularly in developing countries.

Mainly, this suggests that better analysis of market demand, and assessments of future market conditions need to be made available in the public domain. At the same time, forest growers need to be clear about the objectives and expected future markets for their produce. This should dictate choice of species, silvicultural treatments and management. A common mistake in plantation establishment is to plant species that grow quickly, but without any clear idea about the end-purpose of production. For example, Malaysia’s planting of *Acacia mangium* under the Compensatory Plantation Programme were planned to produce “general utility timber” and were funded by loans from the Asian Development Bank. The species proved unsuitable for sawing and consequently returns have been well below initial expectation.

All this begs the question as to what are appropriate responses by countries? What are the common features of successful hardwood plantation programmes? In general there appear to be (have been) three distinct phases in national plantation establishment programmes.

In the initial phase of establishing a national plantation estate, a strong government effort presence seems almost a prerequisite to success. In many instances, both those described in the case studies, and around the world, government forestry departments have directly initiated planting, carried the research effort, and even installed initial processing capacity. In general, the costs and risks associated with starting a plantation-growing industry appear to be unattractive to the private sector.

Given an initial direct impetus by government, a second common phase appears to government-assisted development. In this phase, governments move to devolve plantation establishment responsibilities to the private sector, though this phase still generally requires a level government encouragement and nurturing through incentives. Governments may still be directly involved in planting, but the key to this phase is encouraging private sector involvement.

A final phase is reached when a plantation industry is self-sustaining. In this phase governments have exited developmental involvement in what should be a mature industry. In some instances governments may exit the industry completely through privatisation. In any event, the private sector will have been weaned from incentives

An important question is whether, and by how much, it is possible to deviate from this model. Several experiences show that under some circumstances private sector plantation development

may commence without any direct government precursor. For example, in Sabah, the private sector led plantation development, although planting leaned heavily on prior experience in Peninsula Malaysia. Similarly, several countries in Central America appear to be successfully initiating teak plantations utilising the successful development in Costa Rica as a catalyst. In this instance, incentive payments may be necessary to successfully compete against incentives offered by neighbouring governments.

The type, and extent, of government involvement should be dependent on the structure envisaged for a national plantation growing industry. For example, a government's strategy will vary markedly depending on whether it wishes to encourage small-scale out-grower planting, or whether it hopes to attract large-scale foreign direct investment.

Where a government is seeking overseas investment in plantations, careful analysis of cultural obstacles (and means of circumventing these) needs to be carried out. The case studies note land tenure issues as potentially being important impediments to FDI, but cultural issues stretch across a broader set of possible disincentives to investment. Forestry departments can play a strong facilitatory role in matching overseas investors with landowners, but the departments need to clearly understand the objectives of the investors, and the aspirations of the landowners – and be able to anticipate areas of potential discomfort or conflict.

Economic, legislative and institutional issues will vary on a case-by-case basis. The key message is that governments need to create a “climate of enterprise”. This encompasses a need for countries to provide a stable economic and political basis to encourage investment (generally beyond the control of the forestry sector); it involves the removal of unnecessary institutional or regulatory obstacles to investment; and it requires that investors can clearly see opportunities for rewards to outweigh risks. Issues relating to security of use (i.e. that the forest grower will be able to harvest and sell a plantation) are of particular importance.

For community-based plantation projects it is important that a cross-sectoral approach, recognising that long-term forestry projects need to be integrated with means of generating short-run cash-flows, be taken. The Ghanaian experience with Taungya planting appears to illustrate a situation where afforestation objectives were allowed to override the real needs of local communities. Close community consultation, and a broad view of community land-use issues – particularly, noting that forestry is not the “be-all and end-all” of land-uses is required.

For plantation end-users a number of issues need to be resolved in terms of uncertainty over the technical properties of hardwood timber from plantations and small dimensions. For example, an emphasis on shortening rotations may have significant impacts on the qualities of log out-turns, and considerable thought needs to be given, by the entire forestry sector, as to how the entire forest processing industry should be structured (i.e. how processing facilities should integrate) to ensure that value is maximised. In many instances there may be major costs of converting and re-tooling mills to process small dimension plantation logs, especially where a processing industry has previously dealt with large-dimension natural forest species.

From a global information perspective, several informational deficiencies should also be highlighted. In general, plantation inventory data remains weak in most countries, with considerable doubt over such basic statistics as area and species data. The greatest lack of information appears to be in terms of translating trial growth rates to the field. In many countries, margins of error for estimates of plantation production remain very high, due to great uncertainty over growth rates. A related, and similarly little documented, issue is the extent and effect (on wood production) of mortality.

11.2 Recommendations

The following recommendations for promoting the establishment of hardwood plantations in the tropics and sub-tropics are based on two key principles. Firstly, that the evidence collected suggests that governments need to take a central role in initiating plantation establishment. Secondly, that forestry is a long-run business. Commitment to the success of a national plantation programme needs to extend over decades rather than years. Strategies for promoting plantation establishment should consequently extend over a long time-horizon, with an acceptance that development of a successful plantation industry will not be instantaneous, but will be an extended and incremental process.

Recommendation 1: Establishment of demonstration model plantations

The over-riding message from the case studies is that the most important promotional tool for plantations is demonstrable success. It is recommended that governments examine opportunities to establish modest areas of plantation forest with a view to using these as a promotional vehicle for plantation establishment. The demonstration plantations should be structured according to the type of plantation scheme the government intends promoting. Several key points are suggested:

- The model plantations should focus on quality rather than quantity. The core of the schemes should be to demonstrate the viability of producing financially viable, well managed plantations;
- The model plantations should have a strong research foundation. They should be founded on well-documented research trials and retain an experimental/research focus;
- The financial and business side of the plantations must be well-documented. A potential investor should be able to “open the books” to determine a project’s financial viability; and
- A demonstration forest should be founded on sound business principles, with well-defined market objectives and a detailed business plan.

Recommendation 2: Facilitating foreign investment

Government forestry departments should extensively review potential impediments to attracting foreign investment, with a focus on likely “cultural barriers” to investment. Strategies to minimise these obstacles, including possible means of forestry departments, or government investment agencies, having a direct facilitatory role, should be developed.

Recommendation 3: Regulatory review

Government departments need to carry out detailed reviews of legislation and regulations (including sub-national and local body regulation, and of customary law or practices) to identify impediments and constraints to plantation establishment.

Recommendation 4: Forestry planning, infrastructural reviews and sector strategy development

Strategies for the development of forest plantations should be part of an overall and integrated strategy for the forest industry. Countries should be encouraged to prepare National Forestry Plans (NFPs) encompassing objectives and strategies for the development of the forestry sector as a whole. Preparation of an infrastructural review should be part of this development process and should endeavour to identify physical and systemic impediments to plantation development. These may include factors such as shortages of appropriate land, water, absence of adequate transport systems, distances to markets, lack of skilled labour, lack of nursery facilities, lack of quality seed, absence of processing facilities.

Recommendation 5: Direct promotion of plantation opportunities

An important impediment to attracting foreign direct investment is the general lack of awareness of opportunities in many countries. Often information is non-existent and there is no vehicle to spark investor interest in a particular country. Forestry departments and national investment agencies should seek means of directly promoting plantation investment opportunities to foreign investors. This could be done by preparing and distributing booklets describing available investment opportunities as well as providing details of the local investment environment (regulations, key contacts, incentives, etc). If this is done in conjunction with the development of model forests, then there is an opportunity to promote tangible success.

Recommendation 6: Establishment of “turn-key” plantation forests

Hammond (1998) notes that in some instances (e.g. Fiji) the private sector has failed to follow a strong government lead in plantation establishment. In these instances it may be appropriate for government to continue the establishment of large-scale plantations with a view to selling these to the private sector, as the plantations approach maturity (a “turn-key” operation). Governments may wish to, at least, examine this option.

Appendix 1
Delivery with respect to the Objectives, Outputs and Activities detailed in the Project Document

Immediate Objective	Output	Activity	Delivery
<p>1. Obtain estimates of current and future forest plantation programmes in the tropics and sub-tropics by area, species or groups of species, by age classes and by purpose</p>	<p>1.1 Overview report on existing and planned forest plantations in the tropics and sub-tropics</p>	<p>1.1.1 Review existing planned forest plantations in the tropics and sub-tropics from literature available at FAO HQ</p> <p>1.1.2 Review existing planned forest plantations in the tropics and sub-tropics from literature available at Oxford Forestry Institute (English/Portuguese)</p> <p>1.1.3 Review existing planned forest plantations in the tropics and sub-tropics from literature available at CIRAD Forêt (French/Spanish)</p> <p>1.1.4 Develop supplementary survey format on existing and planned forest plantations and distribute to selected countries</p> <p>1.1.6 Publication of report on forest plantations data and distribution to users</p>	<p>Analysis by D Pandey and J Leech under contract. Supplementary information by J Heermans in collaboration with the World Bank, June 1997</p> <p>Analysis of English and Portuguese literature by Oxford Forestry Institute under contract, May 1997/ May 1998</p> <p>Analysis of French and Spanish literature by CIRAD Forêt under contract, May 1997</p> <p>In accordance with advisory team guide, a questionnaire and standard reporting format was derived, 1997/98.</p> <p>D Pandey report Tropical Forest Plantation Areas, 1995 Data Set; Nov'97</p>

Immediate Objective	Output	Activity	Delivery
<p>2 Obtain and derive estimates of future (short and medium term) outturn of hardwood timber from tropical and sub-tropical plantations</p>	<p>2.1 Report on short and medium term (2000-2010) annual wood outputs from hardwood plantations in the tropics and sub-tropics</p>	<p>2.1.1 Summarise data on present and predicted hardwood outturn from 1.1.1-4 (above)</p> <p>2.1.2 Develop indicative hardwood plantation growth and yield models for the main species and site types in the tropics and sub-tropics</p> <p>2.1.3 Develop an accounting system for following plantation growth and volume production from given programmes of hardwood plantation species and age class, allowing for harvesting and using alternative assumptions regarding growth rates, end uses and losses due to fire, pests etc</p> <p>2.1.4 Derive estimates of present and predicted hardwood production, where lacking from 1.1.1-4 (above), using the area and species figures from 1.1.1-4, the growth and yield models from 2.1.2 and the accounting system of 2.1.3 above</p> <p>2.1.5 Summarise estimates of present and predicted plantation hardwood outturn, derived from activities 2.1.1 and 2.1.4</p> <p>2.1.6 Publication of report on present and predicted hardwood plantation production</p>	<p>D Pandey and J Leech, data base and growth models, Nov 1997, unpublished provided critical inputs for formal FAO publications disseminated widely to users internationally (CDs, reports, papers in international journals, web access):</p> <ol style="list-style-type: none"> 1 Global Fibre Supply Model, FAO 1998 2 The potential role of forest plantations in meeting future demands for industrial wood products, A. Whiteman and C. Brown, 1999. 3 Global Overview of Teak Plantations, J. Ball, C. Brown, S. Hirai, 1999 4 Modelling global forest products supply and demand A Whiteman and C. Brown, 2000. 5 World View of plantation grown wood, C. Brown and J. Ball, 2000. 6 Current trends and development of plantation forestry in the Asia Pacific countries, C. Brown and P. Durst, 2000. 7 The importance of hardwood plantations in the tropics and sub-tropics, M. Varmola and J.

		and disseminate to users	Carle, 2002
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Immediate Objective	Output	Activity	Delivery
<p>3. Identify strategies for promoting the establishment of hardwood plantations in the tropics and sub-tropics and make recommendations</p>	<p>3.1 Scenarios for sustainable hardwood timber production under different levels of plantation programme, species substitution and growth rates</p> <p>3.2 Review of factors contributing to the success of hardwood plantations in the tropics and sub-tropics</p> <p>3.3 Report and recommendations for strategies to promote the establishment of hardwood plantations in the tropics and sub-tropics</p>	<p>3.1.1 Identify and develop scenarios, based upon production of goods and services</p> <p>3.1.2 Input data and test effects</p> <p>3.1.3 Review results under different scenarios</p> <p>3.2.1 Obtain and review qualitative and quantitative information on successful hardwood plantations in selected countries</p> <p>3.2.2 Analyse factors contributing to the success of hardwood plantations in the tropics and sub-tropics, including profitability of different species grown under different conditions and at present and predicted costs and benefits</p> <p>3.3.1 Combine Outputs 3.1 and 3.2</p> <p>3.3.2 Meeting of Specialists to review results from 3.3.1</p> <p>3.3.3 Revise report in light of comments from 3.3.2, publish and distribute report</p>	<p>D Pandey and J Leech, data base and growth models, Nov 1997, unpublished provided critical inputs for the working paper proposing different scenarios:</p> <ol style="list-style-type: none"> 1 Global outlook for future wood supply from forest plantations, FAO, 1998 (C. Brown) <p>Case studies were completed for selected countries:</p> <ol style="list-style-type: none"> 1 Hardwood plantations in Malaysia, FRIM (Krishnapillay), 1998. 2 Long Rotation Eucalyptus Plantations in NSW, Australia, Forestry Commission (Heathcote), 1998. 3 Hardwood Programmes in Fiji, Solomon Islands, PNG, Hammond Resources Ltd (Hammond), 1998 4 Teak and Gmelina (2 reports) n Central America, Recursos Naturales Tropicales (Camino, Alfaro, Sage), 1998 5 Hardwood Plantations in Ghana, Arbor Nova Ltd (Odoom), 1998 <p>Specialist meeting (Ball, Evans, Ugalde, Pandey, Vigneron, July 1998 to review objectives, data, study results, recommend use and supplementary</p>

Immediate Objective	Output	Activity	Delivery
<p>3, Continued</p>	<p>3.3 Continued</p>	<p>3.3.3 Continued</p>	<p>studies to complement the existing work</p> <p>Special Studies Recommended and completed:</p> <ol style="list-style-type: none"> 1 Forestry Outgrower Schemes: A global view, D. Race and H. Desmond, March, 2001 2 Markets for high value tropical hardwoods in Europe, Biocomposites Centre, 2001 <p>The data base and reports were recognized by the advisory team as being critical inputs for hardwood plantation development in the tropics and sub-tropics for:</p> <ol style="list-style-type: none"> 1 State of the Worlds Forests, 1999; FAO, 1999 2 State of the World's Forests; 2001, FAO, 2001 3 Global Forest Resources Assessment 2000 (FRA 2000), FAO, October, 2001. <p>Overview paper to synthesise the main findings, conclusions and recommendations</p> <ol style="list-style-type: none"> 1 Importance of hardwood plantations in the tropics and sub-tropics, M. Varmola & J. Carle 2002

Appendix 2

Published Documents and Reports as Direct and Indirect Outputs

The following documents were formal outputs of the project:

Forest Resources Development Service FAO Working Papers under the Forest Plantations Series

- FP/11: *Forestry Out-Grower Schemes: A Global View*. Race D. and Desmond H. March 2001.
- FP/13: *Future Production from Forest Plantations*. Brown C. March 2001.
- FP/18 *Tropical forest plantation areas 1995 data set*. Pandey D. May 2002.
- FP/19 *Teak (Tectona grandis) in Central America*. De Camino, R.V., Alfaro, M.M. and Sage, L.F.M. May 2002.
- FP/20 *Melina (Gmelina arborea) in Central America*. Alfaro, M.M. and De Camino, R. May 2002.
- FP/21 *Case study of hardwood programmes in Fiji, Solomon Islands and Papua New Guinea*. Hammond, D. May 2002.
- FP/22 *Case study of long rotation eucalypt plantations in New South Wales*. Heathcote, R. June 2002.
- FP/23 *Case study of the tropical forest plantations of Malaysia*. Krishnapillay, D.B. June 2002.
- FP/24 *Hardwood plantations in Ghana*. Odoom, F. June 2002.

Forest Products Division working papers under the Marketing Series

- NA *Markets for high value tropical hardwoods in Europe, BioComposites Centre, 2001*

Formal papers published using databases and results of the project include:

State of the World's Forests, FAO, 1997

Global Fibre Supply Model, FAO, 1998

Global Overview of Teak Plantations, Ball, J., Pandey, D., Hirai, S., 1999. Paper presented to the Regional Seminar, Site, Technology and Productivity of Teak Plantations, Chiang Mai, Thailand, 26-29 January, 1999.

State of the World's Forests, FAO, 1999

Asia Pacific Forestry Sector Outlook Study, FAO, 1998

The potential role of forest plantations in meeting future demands for industrial wood products, Whiteman, A. and Brown, C., 1999. Published in *International Forestry Review*, Vol 1 (3), September, 1999, pp 143-152

Role of planted trees and forest plantations in low forest cover countries, FAO, October, 1999. Background issues paper for the international meeting on special needs and requirements of developing countries with low forest cover and unique types of forests.

Modelling global forest products supply and demand: recent results from FAO and their potential implications for New Zealand, Whiteman, A. and Brown, C., 2000. Published in *New Zealand Journal of Forestry* – Vol 44 (4), February 2000, pp 6-9.

World View of Plantation Grown Wood, Brown, C. and Ball, J., 2000. Paper presented at the IUFRO XXI World Congress, Kuala Lumpur, Malaysia, August, 2000.

Current Trends and Development of Plantation Forestry in the Asia Pacific Countries, Brown, C. and Durst, P. 2000. Paper presented at the ITTO/FAO/DENR International Conference on Timber Plantation Development, Manila, Philippines, November, 2000.

GFPOS/WP/03 *The global outlook for future wood supply from forest plantations*, FAO, 1998. Forest Planning and Statistics Branch working paper prepared for the 1999 Global Forest Products Outlook Study, published December 2000.

State of the World's Forests, FAO, 2001

Global Forest Resources Assessment, 2000. FAO, October, 2001

FP/14 *Forest plantation resources, FAO data sets 1980, 1990, 1995 and 2000*, Del Lungo, A., edited by Carle, J., December, 2001. . Forest Resources Development Service Working Paper under the plantation series.

FP/15

Global Forest Plantation Development, FRA, 2000. Vuorinen, P. and Carle, J., December, 2001. Forest Resources Development Service Working Paper under the plantation series.

The importance of hardwood plantations in the tropics and sub-tropics, Varmola, M. and Carle, J.B., 2002. To be published in International Forestry Review, July/August, 2002.