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This issue's focus

Pitching For Plantation Wood

Making Timber Plantations Viable

• FRIM's Millennium Trees • Recalcitrant Seeds • Test-Tube Trees
• Developing A Cutting Edge • Delaying Teak Flowering
• Plantation Silviculture • Plantation Options • Scientist In Focus • Palm Paper
• The Russians Are Coming • The Grapevine • Saving Fraser's Hill

Overview / Policies

Carrots To Sprout Tree Farms

Promoting forest plantations

A ONE-STOP agency on plantation establishment for investors and planters must be in place if this sector is to take off.

Information such as available lands with potential for plantations, for example, and a good forestry extension service providing seedlings and advice on forest tree cultivation ought to be provided by the respective States.

"The R&D requirements for plantation development are mainly on line, with research streamlined to focus on the species with highest potential," said Dr Baskaran Krishnapillay, FRIM's Forest Plantation Division director.

The lands (inclusive of degraded, idle and logged-over State forest land and mainly in East Malaysia and the East Coast) are available, and this without sacrificing any of our Permanent Forest Estates (PFEs). There are, however, constraints in land acquisition and issues of land tenure that need to be addressed.

Over 430,000 ha of land in the Peninsula on a 15-year rotation period is projected to be the requirement for forest plantations. This is based on year 2000 log consumption levels, an average production level of 180m^3/ha/yr and an estimated,

More on page 2

From The Editor

A TIMBER deficit of eight million cubic metres is thought to be faced by our wood-based industries each year[1], as we cut back on harvests in sustainable practices and our total installed processing capacity exceeds supply.

However, this appears to mask the current reduced demand that is stalling many of our mills, and a timber shortfall of over a million cubic metres (for Peninsular Malaysia) would be closer to the mark[2]. To be sure, even with present demand levels, this deficit would rise in years to come, as supplies from natural forests is reduced (see cover story).

Forest plantations (and we're not talking rubber) are touted to be the solution, particularly for the ravenous pulp and paper industry, and for general utility timber.

Besides reducing pressure on natural forest conversions[3], plantations upgrade degraded forest lands, promote the productivity of idle lands, alleviate rural poverty with agroforestry schemes and bypass the issue of labour shortage in the agricultural sector with low labour-demanding timber plantations.

So have our plantations prospered? In this issue, we turn our attention to some of the problems and prospects faced in this sector before it can be the promised panacea of the timber industry: namely, species choice and silvicultural techniques, adequate, quality planting stock, disease control, and tree breeding and genetic improvement.

The non-technical, instrumental areas of government policy and incentives, and socio-economic aspects like planter profiles and forms of land tenure, must also be addressed since private sector investment must be the driving force in plantation establishment to attract the necessary funds and expertise.

Plantations make up some five percent of the world's forests, and although not a new practice, plantations as a source of industrial wood are relatively recent with half of the world's plantations less than 15 years old, and 62% of them in Asia[4].

Chile and New Zealand have managed to establish extensive plantations to meet all their domestic needs as well as support a significant export sector, and New Zealand, the Philippines and Thailand have withdrawn all, or most of their natural forests from timber production as a conservation strategy[4].

Indonesia, Myanmar and South Africa (rubberwood in the case of Malaysia) have begun to supplement their wood supplies with plantation wood, while Europe, China and the Far East are growing plantations to replenish and increase their forest estates[4]. FIF

[1] *2001 estimates from the Malaysian Timber Council*
[2] *Dr Woon Weng Chuen, FRIM Techno-Economics Division director*
[3] *Normally, forest plantations involve extensive alteration of the ecosystem, disrupting for a long time the complex closed nutrient cycle in tropical rainforests. Monocultures further destabilize the system, and require heavy use of fertilizers and pesticides. However, since plantations would be on degraded, logged-over forests or on idle lands, this would be a non-issue*
[4] *State of The World's Forests 2001, FAO*

From cover page

Rectifying Setbacks

anticipated timber deficit of 5.56 million cubic metres[1].

Technical issues such as procuring enough quality planting stock, improving silvicultural knowledge and disease control are constantly being addressed by research, and should pose no problem in the long run.

Inferior planting stock from unknown origins, the 'plant it and leave it' mis-silviculture, the problematic soils that forestry is confined to, and exaggerated profit claims by some planters impeded plantation development in the past.

To rectify setbacks suffered from these earlier forays into the sector, Government incentives should be stepped up to lure the private sector back into plantations. The estimated projected total capital investment needed for the sector is RM2.37 billion[1].

Already in place is tax exemption from corporate tax of 100% for 10 years on all statutory income (pioneer status), or an investment tax allowance (ITA) at the rate of 100% of the statutory income for five years.

However these incentives cannot be used as it does not address the long gestation period (at least 15 years) in this sector and the cash flow problems that follow as a result.

Techno-Economics Division director Dr Woon Weng Chuen[2] suggests how these incentives can be improved:

More on next page

ONG TAI HOCK

Cover photo: Four-year-old sentang trees in a fertiliser trial plot at a plantation in Kg Tasoh, Perlis

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The Chairman,
FRIM In Focus
Forest Research Institute Malaysia,
Kepong, 52109 Kuala Lumpur,
Malaysia

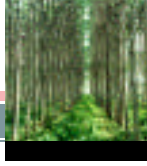
Telephone
603-62797501

Facsimile
603-62797878

E-mail
razak@frim.gov.my
veron@frim.gov.my

Website
www.frim.gov.my

Design & Printing
Langkawi I.D Sdn Bhd



From previous page

Cultivating The Right Conditions

- the qualifying capital expenditure for tax relief under the ITA be extended to 15 years and allowed to be carried forward to be used during the harvesting period,
- that such expenditure includes costs such as those for timber certification, surveys, silviculture, pest and disease control and fire management,
- pioneer status to start from the production (harvesting) date for 10 years,
- group relief be given which allows companies with other business ventures taking up plantation forestry to offset losses incurred in forest plantation in the initial years against profits of their other ventures, and
- such group relief shall not be mutually exclusive from pioneer status or ITA.

Plantation forestry funds that offer soft loans or subsidies for new forest plantations and their management costs has also been suggested to offset the high initial capital investments and long gestation periods.

The provision of market intelligence on potential markets fetching profitable prices would be ideal. But predicting markets for such long-term ventures as plantations can be tricky. A preference for darker-coloured timber 15 years down the road, for instance, might adversely affect the demand for rubberwood sawntimber.

Dr Baskaran said the volume of timber from mature plantations can vary from 95 to 300m^3/ha depending upon the species planted. The total hectarage under plantations (of which 60% are located in Sabah) currently stands at some 250,000 ha, representing about one percent of total forested land.

Forest plantations need a large area of land to be commercially viable. Plantations for the sawmilling and furniture industry need between 15,000 and 20,000 ha, while chip/pulp and paper mills require from 90,000 to 200,000 ha.

ASMAR HASSAN

Dr Woon... *Incentive package tailored for the long-gestation plantation sector needed*

Single, contiguous areas are ideal, or at least in the form of two or three nearby parcels to facilitate easy and efficient management of activities, with the land being close to basic amenities, road networks and processing mills and markets.

Lands stretching across State borders would be dicey, as firms would have to deal with different procedures adopted by the various State governments. A coordinating agency, said Dr Baskaran, would help overcome this and make for the easier establishment of plantations.

Small and isolated stands and holdings could be developed via agroforestry, mixing high quality timber and timber-yielding fruit trees with cash crops.

Cash crop plantations by FELDA and other schemes can develop their marginal land for high quality timber species, and native customary lands, if found in concentrations, are suitable for high quality timber species like teak and sentang. 'Pulp and paper plantations' would be suitable in the vast expanses of Sabah and Sarawak.

Another issue of concern is competing for labour in an economy where working conditions in other industries are usually more conducive.

One option is increased mechanization. "Machines developed in countries like Finland and Canada, for example, are environmental-friendly and highly flexible in their plantation operations," said Dr Baskaran.

Quality seeds and trees selected for their superior timber characteristics and then reproduced via various means are not enough to meet current and projected needs. While efforts are being stepped up to overcome this problem (see 'Stubborn Seeds That Go To Seed', 'Test-Tube Trees' and 'Developing A Cutting Edge' on pages 10 & 11), fly-by-night nurseries are providing planting material of unknown genetic sources.

Dr Baskaran said FRIM has signed MOUs with four nurseries to step up production of quality planting materials of the required species while the Forestry Department Of Peninsular Malaysia, with FRIM's help, has set up the National Seed And Planting Material Procurement Centre in Pahang.

Meanwhile, species choice and the silvicultural concerns of species-site matching, planting distance and density, rotation age, planting requirements and manuring, et cetera are being addressed (see 'Getting It Right'and 'Seeing The Trees For The Wood'on pages 6 & 7).

Over the years, species trial plots (for over 150 species, of which 55 are dipterocarps) have been conducted mainly in FRIM. "It's a vital body of work that will provide data for plantation development well into the future," said Dr Baskaran.

ASMAR HASSAN

Dr Baskaran... *R&D requirements for forest plantations on line*

The problem of smaller logs that form the bulk of plantation wood has been solved somewhat with wood-based industries adjusting to short lengths and offcuts to form products with gluing and finger-jointing technology. Also, there are more efforts to make use of reconstituted wood.

Apart from improvements in timber yield through high quality planting materials and better silvicultural practices, the financial viability of plantations can be enhanced through integration with processing capacities to produce value-added products.

In the past, (with the exception of Sabah, the premier 'plantation state' in terms of the number of species and total hectarage planted) the position for plantations was rather hazy, and the commitment somewhat lacklustre.

But with consistent policies, forthcoming funds and technical back-up, plantation development should start to paint a rosier picture from now on.

Plantations in Peninsular Malaysia will be privatised, those in Sabah will continue to be accelerated where 745,080 ha of land have been identified as suitable for forest plantations, while plantations are taking off for Sarawak with one million ha of land planned for fast-growing species during the next 15-20 years, and the State enacting legislation for the orderly establishment, maintenance and harvesting of plantation forests[3]. FIF

Information obtained from Dr Baskaran Krishnapillay (baskaran@frim.gov.my)

[1] *Plantation Forests – Future Timber Supply: A Technical And Economic Perspective, paper presented by Dr Woon Weng Chuen at the National Workshop On The Use Of Timber In Construction-Prefabricated Timber Roof Truss in July*

[2] *Commercial Tree Plantation From A Private Sector Perspective, paper by Dr Woon Weng Chuen and KTS Resources Sdn Bhd Projects And Special Functions General Manager Lim Choon Yang at the Seminar On Forestry And Forest-Based Industries – Socio-Economic And Policy Issues in June*

[3] *Report On Malaysia's Primary Commodities, Ministry of Primary Industries, December 2001*

Collaborations

The Russians Are Coming

Russian know-how and Malaysian resources are set to boost biotechnology in the country; FRIM to start its own herbal processing plant by year's end

FRIM is one of 13 local varsities and research institutions that will be working with Russian scientists in a Malaysia-Russia bilateral collaboration set to jumpstart our biotechnology to new heights with 'quantum leap' findings in several critical areas of research.

Targeted research goals include the production of phytomedicines from *Phyllanthus amarus* (dukung anak) for use in cancer therapy and prevention, an area where FRIM's Medicinal Plant Division deputy-director Dr Rasadah Mat Ali is involved together with scientists from UPM, MARDI, UTM and UNIMAS.

Other targeted areas include the production of pharmaceutical proteins (recombinant human growth hormones and recombinant antibodies) from rubber latex and high-value fatty acids from palm oil, development of protein and DNA biochip (nanotechnology) for the diagnosis of infectious diseases, development of anti-viral drugs against dengue and technology acquisition in state-of-the-art diagnostics and gene therapy.

The collaboration will have 'Russia's MIT', the Shemyakin-Ovchinnikov Institute Of Bioorganic Chemistry, provide training to local scientists via research attachments and graduate training in Moscow, and when Russian scientists come here for joint research.

The MOA signed when Prime Minister Datuk Seri Dr Mahathir Mohamad visited Russia in March, is between Akademi Sains Malaysia and the Russian Academy Of Sciences, with the overall project costing some RM15 million that is expected to come from Government sources.

Meanwhile, FRIM has identified 11 herbs in the country used by local herbal manufacturers – among them hempedu bumi, mengkudu, misai kucing and pegaga, besides the popular aphrodisiacs and health tonics tongkat ali and kacip fatimah, – as targets for upgrading the sector in terms of the safety, efficacy and efficient production of herbal products.

Towards this end, FRIM is starting its herbal processing plant by year's end.

The local herbal health industry, estimated to be worth RM1.2 billion in 1998 and growing at the rate of 15 to 20 percent every year, is still vastly untapped. The current market price of tongkat ali is about RM40 per kg.

Rural backyard processing plants (forming the majority of herbal product producers), with their unsatisfactory hygiene and scientifically unsound methods, pose a health hazard. For instance, tongkat ali must be processed within three days before bacteria proliferation sets in.

Another worry is the fast-depleting herbs that are being harvested from forests without proper cultivation of these plants. Supplies of tongkat ali are reaching critically low levels. "We must start growing the herb now because five years is all it takes to start being harvestable. The plant is easy to grow – farmers can cultivate it with oil palm, coconut or sentang trees," said Dr Rasadah. FIF

Information obtained from Dr Rasadah Mat Ali (rasadah@frim.gov.my)

Collaborations

Palm Paper And It's No Pulp Fiction

Paper from oil palm by 2004 and what's more, we can be a major pulp and paper player

GRATIFYING what a little query can do. In our pr evious issue in June , we hinted at an oil palm pulp and paper mill in the works, in response to a reader's question.Things mo ved apace after that,and we were ready to call a press conference on July 2.This is an edited version of what appeared in the New Straits Times the next day:

THE world's first pulp and paper mill that uses oil palm biomass as feedstock is expected to start operating in the country by 2004.

The pilot plant at the Ulu Sebol Palm Oil Mill in Kulai, Johor, has an initial capacity to process 20 tonnes of empty fresh fruit bunches (EFB) a day from the RM30 million mill, which will also make other products such as medium density fibreboard, fibre mats and particleboards.

Future commercial production of pulp by a full-fledged mill costing between RM80 million and RM100 million to build is expected to be in the region of at least 100,000 tonnes of pulp a year.

Primary Industries Minister Datuk Seri Dr Lim Keng Yaik said Malaysia can emerge as a major pulp and paper player as the country produces some 30 million tonnes of oil palm biomass a year.

The Minister was speaking on the occasion of the signing of a MOU between the Malaysian Forestry Research And Development Board and OP Biomass Technologies (OPBT) Sdn Bhd to develop a new pulping method, using ethanol as the main solvent.

The US-based 'organosolv process' uses clean technology, thus preserving the environment. Malaysia's 351 palm oil mills produce 30 million tonnes of EFB, not including the trunks and fronds, which are either thrown away, used as fertilisers, animal feed or burned to generate energy.

The new pulping process can produce one tonne of pulp with five tonnes of EFB, which means the country can produce three million tonnes of pulp per year from EFB alone. At the current pulp price of some US$500 a tonne, the extra income will amount to US$1.5 billion.

Each year, the country imports over RM2.7 billion worth of printing and writing paper, kraft and medium weight packaging materials, and other related products.

There are currently 19 paper manufacturing companies and one pulp and paper mill in the country. The only kraft pulp operation in Sabah has the capacity to produce 150,000 tonnes of pulp a year. FIF

MITI

Datuk Seri Dr Lim... *His Ministry might coax the Chinese pulp and paper manufacturers to forge joint ventures with their Malaysian counterparts. China needs about seven million tonnes of pulp per year*

FRIM Services

Fiery Trials

FRIM's fire protection lab tests doors and walls for their fire rating

TEMPERATURES can soar up to 1,100ºC within 40 minutes in the event of a fire with an accompanying build-up in air pressure within a building.

Doors and walls, being the main conduit through which fires spread, must be built to withstand such onslaughts.

A full-scale fire resistance furnace at FRIM's fire protection laboratory has, since 1986, been testing doors and walls for their integrity (fire containment) and thermal transmittance (insulation).

The LPG-fired furnace is used to determine the fire rating of doors and walls, as required by building by-laws enforced by the Fire And Rescue Department Malaysia and SIRIM QAS Sdn Bhd, based on the Malaysian standard, MS 1073: Part 2&3: 1996.

Doors would be deemed to have failed the integrity test should cracks or other openings develop through which flames or hot gases flare forth.

Also, should obstructed gap gauges or fissures exceeding 6mm in diameter by 150mm in length, or 12mm in diameter by 25mm in length develop in the door assembly, this constitutes failure. So, too, sustained flaming of more than 10 seconds on the unexposed face (the side of the door not directly exposed to fire).

Doors fail the insulation test when the mean temperature of themocouples (gadgets used to detect temperatures at specific points on unexposed surfaces) register temperature increases of more than 140ºC above the initial temperature (for five, specific standard points), or more than 180ºC above the initial temperature at any point on the unexposed surface.

Doorsets must also pass the cyclic movement endurance test when they are subjected to 100,000 cycles of continuous opening and closing. Doors would be deemed durable after this test if they can still close properly, maintain all clearances between door leaf, door frame and the floor, and show no signs of wear and tear.

The furnace, upgraded in 1999 for four hours of fire testing and computerised for accurate data analysis, is made up of calcium silicate, fire-insulating bricks.

The furnace consists of six burners which control fire temperatures according to the standard temperature time curve.

The hardiest doors to withstand fires are solid timber ones made from heavy hardwood, but these are costly and limited in supply. Most doors today are cheaper composites made of non-combustible substances as the door core, combined with timber and plywood finishes.

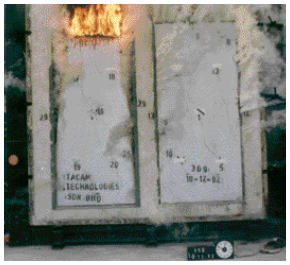
Doors must be subjected to at least one hour of firing to test their fire-resistance capacities, while roller shutters (the kinds that shops use) undergo four-hour tests. Concrete walls are normally tested for two hours.

The laboratory's indicative furnace also tests smaller items such as panel boards, lock-set accessories, safe deposit boxes, beams, flooring and ceilings. The lab aims to acquire the ISO: 17025 certification by year's end. EIF

Information obtained from Zaihan Jalaludin (zaihan@frim.gov.my) and Nor Azian Mohd Kasby (azain@frim.gov.my)

ZAIHAN JALALUDIN

Bringing the house down... *Preliminary work to calibrate temperature rise in a timber house fire. It was undertaken by FRIM in 1990 on a house already slotted for demolition*



This one failed... *A metal door bursts into flames and billows heavy smoke in the furnace*

Closer encounters... *A worker using a diameter gauge to closer inspect integrity failure*

FN WAN RAHMAH WAN A. RAOF

FRIM Happenings

"Let's Be Friends & Work Together"

SARAWAK Chief Minister Tan Sri Datuk Patinggi Haji Abdul Taib Mahmud **(right)** receives Malaysian Forestry Research And Development Board Chairman Datuk Seri Lim Cheong Keat in Kuching when the latter came a-calling recently. Looking on is FRIM Deputy Director-General Dato Dr Wan Razali Mohd. The purpose of the visit was to foster closer ties and support for future FRIM undertakings. EIF

Plantation Silviculture

Getting It Right

On designing successful plantations

IDEALLY, to placate environmentalists, mixed species planting is advocated to mimic (however poorly) the biodiversity of original forests, and help curb pest and disease outbreaks.

But silviculturists would balk at the difficulty (and expense) of managing such plantations with the spectrum of varying tending needs demanded by the different species[1].

Species choice is one of a host of criteria for forest plantations, if they are to be profitable ventures.

Good germination ability and high percentage of survival on out-planting must be considered, as well as fast height growth in the early stages.

Additionally, the species must be tolerant of shade and side competition, have good natural bole form, be naturally self-pruning and exhibit a low crown diameter/diameter at breast height ratio. More marks if the species display rapid growth and is a fast volume producer.

Being insect and fungal resistant, a producer of quality poles in thinning and a yielder of high economic value timber positively endears the species to growers. If they also demonstrate low site specificity, prolific seed production, natural regeneration and suitability for cutting propagation – well, they are practically the Chosen Ones.

Easier said than done, naturally (or even artificially, for that matter).

Exotics have been preferred because adequate knowledge in the propagation and silvicultural management of indigenous species is lacking. Plus exotics are generally fast-growing and high-yielding with a plentiful supply of seeds.

However, some fast-growing exotics yield poorer quality timber while patience is demanded of planters opting for the slow-growing, but higher-valued native species.

Current research focus is on indigenous trees to produce better quality timber. This begins with the search for 'Plus' trees: candle-like trees with the high economic value traits of long, straight, large, cylindrical and branchless trunks (or clear boles, as they're called in the industry).

"To date we have identified and successfully completed profiles of 15 species with these traits and are propagating via seeds, cuttings and tissue culture those trees with proven superior growth and yield performance. These are also trees that constitute viable populations with sufficient genetic variation," said Forest Plantations Division deputy director Dr Abdul Rasip Abdul Ghani, who also heads the Tree Breeding And Improvement Unit at the division.

But the quest for quality is a never-ceasing pursuit with the regular development of new clones and varieties with ever-improving traits, and for this purpose FRIM has set up several seed orchards to allow superior trees to cross-breed.

After the species choice is decided, there must be species-site matching where the species scheduled for planting are compatible with the site. This can pose a problem for the heterogeneous area of large plantations.

Next, site management must ensure field operations are carried out with as little site disturbance as possible. Proper

Candle trees... *Long, straight and branchless trunks make ideal timber*

stand treatment follows, with plants given the space and stand density they need for satisfactory growth and good development.

Objectives and regimes must be clearly set in the management of forest operations, and adequate forest protection against diseases, pests and fire must be considered.

To meet the timber deficit, rubberwood (used mainly for furniture) does not suffice. Now timber-latex clones are used in replanting activities. These are latex producers that will also maximize timber production.

Teak and sentang, (currently about 5,000 ha each) are the star trees at the moment, providing high quality timber. The other specialty species that can yield high value timber for veneers, paneling and furniture are *Khaya* spp, *Swietenia* spp., *Dyera costulata*, and *Araucaria* spp. that can be grown in plantation conditions or in smallholdings mostly in State lands and private holdings in 15- to 20-year rotations.

Species for general utility timber such as plywood cores, fibreboards, particleboards, interior construction wood and other low grade use timber of 15- to 20-year rotations are *Endospermum malaccense, Acacia* hybrids and *Paraserienthes fulcataria.* They are suitable to be grown in reforestation schemes and as enrichment planting (although the track record for the latter has been dismal).

Shorea spp., *Hopea* spp. and *Dryobalanops* spp. grown for longer rotations of between 30 and 35 years yield high-value timber for furniture.

Finally, there is the pulp species of *Acacia mangium*, grown large-scale in one site in short rotations of six to eight years in State lands. (For more information on potential plantation species, see 'FRIM's Millennium Trees' on pages 8 and 9) FIF

Information obtained from Dr Baskaran Krishnapillay (baskaran@frim.gov.my), Dr Abdul Rasip Abdul Ghani (rasip@frim.gov.my) and from the paper, Availability And Utilisation of Plantation Species by Dr Abdul Rasip, Mohd Noor Mahat (mohdnoor@frim.gov.my),Dr Ahmad Shakri Mat Seman (shakri@frim.gov.my) and Mohd Zaki Abdullah (zaky@frim.gov.my)

[1]Block planting has been suggested as one method of compromise

Species Viability

Seeing The Trees For The Wood

Various options for forest plantations exist for would-be planters

TEAK is the pick of the lot when it comes to monoculture for wood extraction. At the projected price of RM 600/m^3, it provides the highest return among plantation options.

Sentang fetches RM 450/m^3, while it's RM 150/m^3 and RM 95/m^3 for *Acacia* and *Hevea* (rubber) respectively.

The establishment of *Hevea* solely for log extraction must be integrated with at least sawntimber or fibrewood processing activities to benefit from the lucrative value added.

For the smallholding sector, as these growers could ill-afford the long gestation period before realising income from wood, planting for timber must be integrated with agricultural cash and/or food crops.

In 1999, there were some 3.47 million ha of rubber and oil palm land. As much as five percent of such land are void and unproductive (steep hills, plantation borders, roadsides, river banks, and spaces around offices, factories and living quarters). These areas can be planted with high quality timber species such as khaya, sentang, mahogany and meranti tembaga during replanting.

To begin with, model agroforestry plantations are being set up in rubber and oil palm estates nationwide, involving FELDA, FELCRA, RISDA and private plantations.

"These would serve as demonstration plots as well as adaptive research sites and become the reference centres through which potential investors can obtain first-hand information," said Dr Najib Lotfy Arshad at FRIM's Agroforestry Unit.

Heart rot-plagued *Acacia mangium* plantations (some 56,000 ha in Peninsular Malaysia that were planted in the 1990s) have yet to yield profits with low quality yields and low log prices, downgrading it as the main plantation species (because of its fast growth rates and adaptability to poor soils).

While good for pulp and paper needs at shorter rotations, feasibility can be enhanced if the plantations are integrated with processing facilities such as integrated timber complexes, and pulp and paper mills.

But there is now renewed interest in this wood for general utility timber with the development of *Acacia* hybrids. Also, efforts to increase the productivity of these *A. mangium* plantations in Peninsular Malaysia are being done in trial underplant/line planting with high quality dipterocarps *(Shorea parvifolia, Shorea leprosula* and *Neobalanocarpus heimii)* near FRIM's Bidor field research station.

Dr Ang Lai Hoe who heads the Ecophysiology Unit at FRIM said the multi-storied forest management project shows that these dipterocarps can be domesticated as plantation species and are suitable for upgrading present *A. mangium* plantations into a higher value timber production area.

The trees perform best at planting widths of between 15 to 33.3 m, with *S. leprosula* producing the highest total stand volume per hectare. The planting of *N. heimii* is considered strategic as its timber is facing severe shortage and it is the most expensive timber to date. Although a relatively slow grower, it can grow in the open after the initial stage of establishment.

Dr Ang said a planting density of 450 trees/ha would supply enough potential crop trees for producing a merchantable volume of 150 m^3/ha, assuming a 45% survival rate at the end of the rotation.

Mixed plantations (*Hevea* trees interspersed with teak or sentang) are appropriate for smallholding to maximize revenue from teak or sentang logs while ensuring a continuous flow of annual income during the latex exploitation period. This option appears attractive given the bonus income from teak or sentang integrated with the hedgegrow planting of *Hevea.* FIF

Information obtained from Dr Baskaran Krishnapillay (baskaran@frim.gov.my), Dr Ang Lai Hoe (anglh@frim.gov.my), Dr Najib Lotfy Arshad (najib@frim.gov.my) and the paper, Establishment Technique Of Shorea Leprosula, Shorea Parvifolia And Neobalanocarpus Heimii Plantations by Hiroshi Nagai, Takuya Honma, Che Aziz Bin Ali and Dr Ang

Watch this space... *Void land in oil palm estates can be put to productive use with timber cultivation*

Forest Plantation Timber

FRIM's Mille

Pictures and information pr ovided by Rosdi Koter (rosdi@frim.gov.my)

RESEARCH on 15 fast-growing, high-yielding plantation timber species is being carried out for afforestation of idle land and reforestation of logged-over forests, thus aiding efforts to conserve our natural and virgin forests.

An example is the RM 500,000 forest plantation research project on an eight-hectare plot in FRIM that is sponsored by Hong Leong Group Malaysia.

▲ **Angsana** *(Pterocarpus indicus)*
Structural timber for light to heavy construction, joists, rafters, beams and interior finishes. Its red-hued and fine-figured timber makes it valuable for high quality furniture, panelling, musical instruments, cabinet work, interior joinery and decorative flooring. Agricultural implements, cart and gun carriages, oil presses, tool handles and carvings are other uses for this wood. A 20-year rotation with a Mai_d of 1.3cm.

◀ **Acacia** *(Acacia hybrid & Acacia mangium)*
Used for furniture and cabinet making, door and window frames and moulding light flooring. It also provides pulpwood after six to eight years of growth, and sawn timber after 15 years. Mai_d of 2.2cm.

▲ **Jati** *(Tectona grandis)*
Used for interior finishes and interior joinery such as windows and solid panel doors. Also for laboratory and kitchen tables. It takes at least 15 years to mature with a Mai_d of 1.8cm.

▶ **Meranti Bukit** *(Shorea platyclados)*
A light to medium weight hardwood, it is the most common type of utility timber. Suitable for medium and heavy construction work, for doors and window frames, utility flooring and boat building. Takes at least 30 years to mature with a Mai_d of 1cm.

◀ **Meranti Sarang Punai** *(Shorea parvifolia)*
Used for light-duty flooring, panelling, ceilings, shelves and interior partitions. Takes at least 30 years to mature with a Mai_d of 1cm.

▶ **African Maho gany** *(Khaya ivorensis)*
Used for furniture and cabinetwork, veneer and plywood and occasionally for construction and boat decking. It takes at least 15 years to mature. It has a Mai_d of 2 cm.

ennium Trees

Spanning five years, the studies include monitoring the trees' growth rate and yields, fertilizer requirements and maintenance work. In the past, the focus was on a single or a few species, but now developing a broad base of species is the preferred approach to diversify the timber industry and spread the risks.

The trees featured on these pages are among the present potential plantation species expected to be the country's commercial timbers of the future. FIF

Note: Mai$_d$ refers to the mean annual diameter increment

▲ **Sungkai** *(Peronema canescans)*
Used for pillars in houses, furniture and cabinets for decorative veneer and external frames. A 15-year rotation with a Mai$_d$ of 2cm.

▲ **Sentang** *(Azadirachta excelsa)*
Used for joinery, interior finishing, panelling, partitioning, sliced veneer, flooring, turneries and matches. It takes at least 15 years to mature, has a Mai$_d$ of 2.1cm and an espacement of 2.5m by 4m yields 12m^3/ha of wood annually in the first 10 years. A well-known village tree in Peninsular Malaysia, its young leaves are consumed as a vegetable, while mature leaves are sought after as medicine. Closely resembles popular species like nyatoh and mahogany, with a density comparable to meranti, keruing, nyatoh and ramin. Its modulus of rupture, compression parallel to grain and shear properties are superior to rubberwood.

Merawan Siput Jantan *(Hopea odorata)* ▲
The wood is suitable for rollers in the textile industry and for piles and bridge construction. It takes at least 30 years to mature. A Mai$_d$ of 1cm.

Meranti Tembaga *(Shorea leprosula)* ▲
Excellent timber for joinery, utility furniture, shop and office fittings, panelling, ceilings, cabin fittings, light-duty flooring and interior partitions. It takes at least 30 years to mature with a Mai$_d$ of 1cm.

Jelutong ▶
(Dyera costulata)
Suitable for light industries requiring versatile properties such as match sticks and pencils. Also used for furniture parts, door knobs and ceilings. It takes at least 20 years to mature with a Mai$_d$ of 1.6cm.

Natural Propagation

Stubborn Seeds That Go To Seed

Recalcitrant seeds and the challenge of ensuring enough quality planting stock

LIKE spiralling shuttlecocks teased by a breeze, ripened seeds of dipterocarp trees parachute down to the forest floor come fruiting season.

In the fecund jungle soil, under the protective shade of their mother tree, these winged bearers of the next generation of tropical timber's most important family of trees, promptly germinate, grow and wait…

They wait for Mother to lose a branch, shed some leaves… anything that would open the forest canopy and let there be light. Sunshine triggers a frenzied growth and rivalry for space and nutrients among the saplings, until the strongest survives to become the new tree on the block.

This cycle of natural forest regeneration must be aped (with modifications, no less) for the forest plantation scenario. But there is just one problem: the seeds, once collected, must be sowed quickly, or they perish. Large collections for storage and future planting in reforestation and afforestation schemes can thus prove an uphill task.

Some 70% of our tropical timber species produce such 'recalcitrant' seeds, meaning they do not undergo dormancy, but are metabolically primed for immediate germination once they reach maturity.

With their high moisture content (as high as 90%), these large, unorthodox seeds die if dried below certain moisture limits (12-30%) or subjected to low temperatures (below 16ºC), defying most conventional storage techniques.

At FRIM's Seed Technology Unit (STU), successful methods to store such seeds for up to a year have been developed. The seedling chamber storage constructed with optimal light, temperature and humidity conditions stores germinated seeds treated with fungicide. The seedlings' growth are slowed, attaining a height of 20 — 25 cm over a three to 12-month period, with a survival rate of between 60 and 80%.

Seeds are also allowed to germinate and grow in the deep shade of the forest floor and dug out and transplanted to a nursery, when needed, where they are exposed to gradual increments of light and temperature to encourage further development.

For long term storage (apart from *in situ* conservation in national parks and forest reserves and *ex* situ conservation in arboreta and botanic gardens), cryopreservation of whole seeds or embryos in liquid nitrogen (at –196ºC) has been successful with 10 recalcitrant and 23 non-recalcitrant species.

"We are now developing protocols to conserve rare and endemic timber species in Malaysia," said Dr Marzalina Mansor who heads STU.

Another source of seed attrition is the improper handling of seeds during transportation. Dr Marzalina helped the Forestry Department Of Peninsular Malaysia build the mobile seed-seedling chamber which can secure seed viability for up to 20 days, useful for long journeys.

The laboratory at STU also determines the quality of seeds (with moisture content and germination capacity as the main criteria) brought in from the various phenological plots and seed production areas in the country.

Seed collection also poses a problem as tropical trees are erratic seed bearers, flowering at intervals of three to eight years in response to climatic changes. STU conducts continuous monitoring of their plots to observe forest trees' flowering and fruiting pattern and how climate changes affect leaf and bud formation, leaf fall, floral anthesis, fruit set and ripening.

STU comes out with a monthly bulletin on when and where forest trees are fruiting, although the accurate prediction of flowering and fruiting seasons is still in its infancy. Drought, El Nino and month-long drops in night temperatures prior to flowering have been thought to trigger fruiting in some areas.

With the current emphasis on indigenous dipterocarp tree species in addition to exotics for our plantation forests, the anticipated increase in demand for recalcitrant seeds should be good news: with shorter storage intervals, seed survival rates would concomitantly rise. FIF

Gyrating parachutists that can't wait to grow... *Dipterocarp 'shuttlecock' seeds (left & bottom)*

ASMARHASSAN

For more information, contact Dr Marzalina Mansor at (mzalina@frim.gov.my)

In Vitro Propagation

Test-Tube Trees

Tissue culture propagation paves the way for future forest species reproduction

WITHIN a 600-sq ft of laboratory space, 100,000 plants can be grown, at the rate of a million plants reproduced within a year from just 10 specimens.

This is the power of tissue culture propagation. Plus, in contrast to recalcitrant seeds, *in vitro* storage of planting stock is indefinite, and elite clones with superior traits (high-yield, rapid-growth, pest and disease tolerance, et. cetera) can be reproduced with guaranteed identical and uniform traits, thus ensuring field performance and improved yield forecast.

The only snag: propagation protocols for recalcitrant tropical tree species such as dipterocarps, the species most valued for their timber, take a long time to develop.

So far, FRIM's Tissue Culture Unit has managed to successfully undertake tissue culture propagation of the non-dipterocarp species of teak, jelutong, sesenduk, khaya and acacia hybrids.

The Unit has the high-value timber species of *Shorea* in culture, but these, said biotechnologist Dr Kodi Isparan Kandasamy at the Unit, are not yet ready for commercialisation.

The other often-quoted disadvantage of micro-cuttings and somatic embryogenesis (the two methods used in tissue culture propagation) is the high cost and level of expertise involved.

But Dr Kodi is quick to dismiss it. "It is not expensive when you are talking of mass propagation (at the rate mentioned above)," he said. And people can be trained.

To date, some of the clients that have bought FRIM's tissue cultured planting stock include Staedtler (M) Berhad (jelutong), the National Tobacco Council (acacia) and Koshii & Co. Ltd. (acacia hybrid). There are also negotiations for a German reforestation company to acquire various tissue-cultured plants.

Planting materials from tissue culture require careful nursing during the transition from the lab to the nursery or field. Some plants (as are most forest species) tend to be exceptionally sensitive to environmental changes, requiring high precision 'weaning technologies' for successful acclimatisation and commercialisation of the plantlets.

DR KODI ISPARAN KANDASAMY

Bottled Botany... *Karas tissue-cultured plants*

These weaning technologies include temperature, humidity, carbon dioxide and light intensity controls. Dr Kodi said FRIM is working with a private company on tissue culture propagation, where the company will provide such precision engineering facilities in a specially built greenhouse at FRIM's grounds.

Tissue culture systems are also a pre-requisite for any form of genetic engineering work as engineered cells would need to be regenerated and mass-propagated for evaluation and subsequent field planting. FIF

For more information, contact Dr Kodi Isparan Kandasamy (kodiswaran@frim.gov.my)

DR AMINAH HAMZAH

Rooted cuttings of Shorea leprosula (top) and six-year-old S. leprosula trees grown from cuttings

Vegetative Propagation

Developing A Cutting Edge

Rooting for cuttings as a source of planting stock

TAPPING into cuttings as planting stock is feasible save for one drawback: the lack of a tap root to anchor the regenerated plant.

Instead, the plants (or timber trees in this context) that eventually develop from the rooted stems obtained from saplings, grow ancillary roots out of which a main root will develop to keep the plant in the ground.

"These roots, however, still do a good job of holding down the plantation trees in the interim before they are felled for their timber," said Dr Aminah Hamzah who heads FRIM's Nursery Unit.

Cuttings, in fact, are an easy, relatively cheap and successful method to propagate trees in the face of recalcitrant seeds that are difficult to store. Cuttings also serve as clones of the saplings from which they are obtained and thus predictable in the duplication of desirable traits valued in timber trees.

Presently, cuttings, with a 70% survival rate for both dipterocarps (14 species) and non-dipterocarps (seven species) serve about 10% of planting stock supply for the State forestry departments and nurseries, and private plantation companies.

Cuttings are first dipped into a hormone solution to encourage rooting. Dipterocarp species take between 12 and 16 weeks to root, while non-dipterocarp species are easier rooters, taking from eight to 12 weeks. The cuttings are then planted into a rooting medium to develop into saplings within four to six months' time, before being transplanted in plantations. FIF

For more information, contact Dr Aminah Hamzah (aminah@frim.gov.my)

Forest Pathology

Merit, Mushrooms & Maladies

Her research on fungi and diseases of forest plantation trees has earned Dr Lee Su See accolades not least of which is the 2000 International Union Of Forestry Research Organizations Scientific Achievement Award

WHEN trees fall sick, who do you call? Disease-buster Dr Lee Su See, for one.

But if chasing away the insidious ghosts of illness is to be effective and least costly, planters ought to seek advice at the *onset* of plantation establishment – especially since monocultures are more vulnerable to disease outbreaks (and fires) as compared to natural forests.

"Often by the time we are notified of abnormalities, it is already too late. Tree mortality would be a given," said Dr Lee who heads the Forest Pathology Unit at FRIM's Forest Plantation Division.

Training plantation workers in the early diagnosis of tree diseases is thus essential to nip pathological problems in the bud, and stem the grief over needless loss.

Thorough land clearing to remove fungi-infected woody debris when setting up plantations would be the best approach in preventing root diseases in trees (fungi, as opposed to bacteria or viruses, being the most common cause of tree ailments in plantations).

Otherwise fungicides, and control/ management techniques like trench-digging, spacing and planting mixed species of varying disease susceptibility to act as barriers to the spread of the infection, would be needed. These would be labour-intensive, thus incurring more costs.

The ultimate in disease control would be disease-resistant clones or provenances. Now there is also experimental work on genetically-modified trees for disease and insect-resistance, such as transgenic teak that is being trial planted in FRIM.

A constraint in local forest pathology at present is the wide range of species (both indigenous and exotic) that need to be studied, but with limited manpower (unlike single species research enjoyed by institutes like the Malaysian Rubber Board and the Malaysian Palm Oil Board).

Another difficulty is that credible disease surveys require numerous, big enough plantations as research sites. Such is not the case yet in Malaysia. Current available data on diseases of indigenous tree species are based on natural, and not plantation forests, or on small plantation plots.

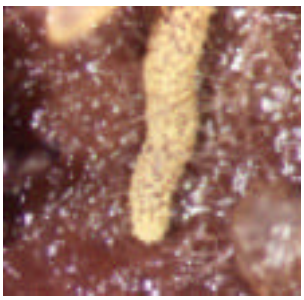
"Experimental sites are needed where pathogenicity studies can be done under plantation conditions. Now such research have to be carried out in nurseries and on juvenile plants, but extrapolating results from these tests can be misleading," said Dr Lee.

The move to establish more FRIM research field stations with areas set aside for forest pathology studies is therefore a step forward.

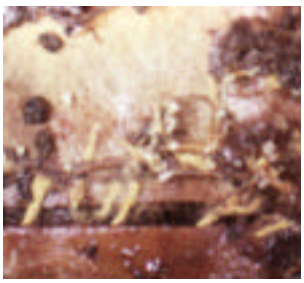
Pictures by DR LEE SU SEE

Basking in scientific acclaim… *Dr Lee makes her mark in ectomycorrhizal research*

Fungal-mentally dead… *Ganoderma pseudoferreum fruiting on a dead A. mangium tree. This fungus is a root rot pathogen of many tree species, including rubber and Acacia spp.*



Taking root… *Ectomycorrhizal root of Hopea adorata – note the bright, yellow fungal structures on the root surface and the thread-like hyphae extending out into the soil*

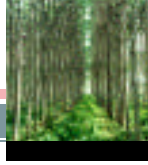


Maggots they are not… *Ectomycorrhizal root of Hopea odorata – (Dipterocarpaceae)*

But these obstacles have not stopped Dr Lee from accumulating awards for her work such as the IUFRO Scientific Achievement Award in August, 2000 in recognition of her contributions to forest pathology and dipterocarp mycorrhizal research.

Mycorrhizas are the modified roots that result from the symbiotic association between fungi and the roots of trees, which enhances the uptake of water and nutrients, particularly phosphorus. They play an important role in successful seedling establishment of many plants including those of dipterocarps, particularly in degraded soils.

With the move to establish plantations of indigenous forest trees,



dipterocarp mycorrhizas for forest regeneration and recovery would come in handy.

Dr Lee is currently the local project coordinator for the European Union-funded study, *Harnessing Mycorrhizal Symbiosis In Mixed Dipterocarpaceae-Acacia Mangium Forest Plantations In Malaysia And The Philippines*, collaborating with French, British, Finnish and Filipino scientists.

The study aims to see if degraded land such as tin tailings (more than 100,000 ha in Peninsular Malaysia) and non-productive grassland (17% of the total land area in the Philippines) can be successfully rehabilitated with such a system.

Other objectives are setting up an ectomycorrhizal fungal bank for South-East Asia and improving the technology for mass production of ectomycorrhizal inoculum and the inoculation of dipterocarp cuttings in nurseries.

Dr Lee has also made significant contributions in the diseases of fast-growing *Acacias*, being one of the key researchers to identify heart rot in *Acacia mangium* in the 1980s, and later root rot in these species.

She has also helped establish, in collaboration with other scientists, a comprehensive herbarium collection of ectomycorrhizal and wood decay fungi in FRIM. It is estimated that some 70% of Malaysian fungi have yet to be discovered.

The latest feather in her cap is winning a Fulbright scholarship for a research stint (the detection and control of *Phytophthora* and *Phellinus* root diseases) at Oregon State University in the United States, beginning this September.

Judging from Dr Lee's merit-accruing career history, neither will it be her last. FIF

ERRATA

OF FACTS gone mad, higher intelligence masquerading as wildlife and the environment, and scientific names with their affinity for all things Latin, being just Greek to some of us.

We're referring to a heading in last issue's FIF (Eco-Friendly Timber: Certifiable Facts) where the single quotes for 'Certifiable' got lopped off, and a quote attributed to Ismail Harun (Are We Making The Grade?) where wildlife and the environment are exhorted to work with us to make sustainable forest management (SFM) work. What we meant is that we need to keep these two aspects in mind in achieving sustainability.

As for nomenclature, names of species ought to be italicised, but family names get normal treatment. So it's *Cinnamomum* spp. (page 12, column 1, paragraph six, line 2), but spp. of Sapotaceae (page 13, column 3, paragraph 3, line 10). The miscommunication is regretted. FIF

Forest Genetics

Encouraging Late Bloomers

Early flowering is believed to be a major reason for forking in plantation teak trees. FRIM embarks on a study to identify teak floral genes that can delay flowering time

TEAK trees planted outside their natural distribution tend to flower earlier – at two to four years compared to five or six years for naturally grown trees.

But precocious flowering, besides injury and disease, is thought to be a major cause of forking in teak. (And forking is bad news because it means shorter bole heights and less premium timber).

The first flowering occurs on the main shoot, which undergoes dieback soon after. In order to continue growing normally, two lateral buds at the base of the inflorescence develop to become leading shoots. These shoots develop at equal pace into branches, resulting in forking of the main stem. Early flowering also reduces vegetative growth, as flowering processes use up a lot of energy.

Genetically improved planting with 'turned off' or delayed flowering would thus be desirable for teak plantations. Understanding the function and interaction of the important genes involved in flowering pathways are hence necessary to identify candidate genes that could possibly modify flowering time in teak.

The isolation and cloning of teak floral genes are carried out using several approaches. One approach is the construction and screening of a teak genomic library to clone the promoter region of teak floral genes.

A genomic library is a collection of genomic DNA fragments inserted into cloning vectors such as the Lambda bacteriophage (a bacterial virus). Genomic DNAisolated from teak leaf tissue, is partially digested with a restriction enzyme. Digested fragments sized 15-23kb (kb refers to kilobase, a measurement of DNAlength) are then cloned into the Lambda GEM vector. The genomic library produced is amplified to increase the titer (the number of virus particles per millilitre of solution). A heterologous DNA probe is used to screen the library.

Another approach is the construction and screening of a cDNAlibrary. A cDNAlibrary is a collection of complimentary DNAconverted from mRNA (messenger RNA) populations as a result of gene expressions in specific tissue.

Yet another approach is the construction of a subtractive library, which is a collection of cDNA expressed in specific tissue, but not in others.

Two other approaches used are a modified version of the restriction fragment differential display to clone genes which share a common sequence or domain, and the reverse transcriptase–polymerase chain reaction method.

To date, the study has successfully isolated and cloned several partial floral genes of teak. From these partial genes, full-length genes will be isolated and cloned. These will later be tested for their expression *in vitro* (e.g. in yeast cultures) and then transferred into plant model systems (e.g. *Arabidopsis*) to see the effect of each gene on flowering time and flower patterns. FIF

Information obtained from Mohd Rosli Haron (mrosli@frim.gov.my)

News Briefs

The Grapevine

State Samba: Brazil Scores In Conser vation

LOCAL governments often complain that having protected areas in their territory makes them lose revenues they could have obtained by taxing other land uses. Several Brazilian States, including Minas Gerais and Parana, have responded by creating a special fund for municipalities with conservation areas to compensate them for the lost revenue.

Ever since 1992, the State government of Parana has divided up 2.5% of all the value added taxes it collects among the State's municipal governments based on how much conservation area they have, and how well protected it is. Minas Gerais has made similar payments since 1996, but the State allocates the money based on the amount of land conserved, not the quality of protection. Half of all municipalities in Parana and one third of those in Minas Gerais currently receive such payments, which they can use however they want.

As a result of these programmes, many local governments now actually want to enlarge the area devoted to conservation. Since the programmes started, conservation areas have increased 165% in Parana and 62% in Minas Gerais. – ***Forest Policy Experts,CIFOR***

Kiwis' Skid Site Safety System

THE Kiwis have come up with an improved system to reduce injuries at skid sites from rolling logs and machinery. Hooking a computer to a rear vision video camera inside a Bell Logger cabin, the system helps operators to detect people working around them when a visual or audible warning is activated as the camera picks up data on people wearing high visibility clothing. Forestry work is deemed among the most dangerous of occupations, with log processing skid site accidents contributing to most injuries. – ***Industrial Research Limited***

Community Forests: Asian Stories

OVER the last two decades, a number of Asian countries have made widely celebrated reforms designed to give local people greater rights and responsibilities over forests.

Joint forest management in India, community forestry in Nepal, the household responsibility system in China and community-based natural resource management in the Philippines, are examples.

However, government forestry departments have retained control over key decisions and kept the best forests for themselves. High taxes, market controls, and licensing requirements have limited poor people's earnings. Local elites have captured many of the benefits and poor households often don't dare to object.

Many forestry officials defend their actions by arguing that villagers do not take good care of forests and use these arguments as an excuse to protect their privileges and sources of income, rather than looking for creative ways to strengthen local capacity. Poor forest users have fared better when built alliances with NGOs and sympathetic government officials and donors. National and regional organisations of forests users and smallholders in India, Nepal, and the Philippines made significant headway by protesting, lobbying, and taking their case to the courts and the media. – ***Forest Policy Experts, CIFOR*** FIF

Saving Fraser's Hill

An example on how to compile critical data on valuable forests outside protected areas, here is solid data to promote the protection that Fraser's Hill deserves

The Seed Plant Flora Of F raser's Hill, Peninsular Malaysia by Ruth Kiew; 1998/107 pages; RM 30/USD 30; Order Code:RP 121

Review by Robert R. De Wulf

FRASER'S HILL, greened largely with lower montane forest, is a resort on the Main Range of Peninsular Malaysia, covering 2,804 ha of ridges and steep valleys between 630 m and 1,460 m altitude.

The area is under jurisdiction of the Fraser's Hill Development Corporation, but has no legal or permanent protection. Its fate is thus mainly dependent on future development of which its impact on the forest environment is barely estimable.

The hill has a high conservation importance, with more than 10% of Peninsular Malaysia's flora, and many rare and endangered species. Also, its flora displays a unique combination of phytogeographic links, due to its pivotal position on the Main Range. About 27% of the total flora of Fraser's Hill is of conservation concern.

The need for a research pamphlet such as this one is obvious: to draw attention to conservation values of unprotected forest areas. The author has attempted to fit the salient facts about Fraser's Hill in a small (14.5 x 21 cm) paperback in FRIM's Research Pamphlet series.

The bulk of this publication consists of a checklist of the seed plants of Fraser's Hill, preceded by introductory chapters starting with the brief account of the early history of botanical collecting at the hill.

The chapter of forest types and habitats documents the different sites (a better word than 'habitat') and its characteristic species. But here a map of the area, featuring its location, the main forest types, and the places mentioned in the text, is sorely lacking.

The chapter on flora lists the seed plant flora according to total number and endemism categorized over Gymnosperms, Dicotyledons and Monocotyledons. An informative table on the level of endemism of families represented by more than 10 species at Fraser's Hill testifies to the conservation importance of the area.

A chapter on phytogeography frames the regional importance of the area. Regretfully, the map depicting the distribution of the Burmese-Thai floristic zone has very poor information value. The chapter on phenology is based on the author's field observations between 1991 and 1995. This information will perhaps add to the limited knowledge of phenology in the forests of Malesia, but is somewhat out of place in this research pamphlet.

Of more importance is the chapter on the conservation status of the species of Fraser's Hill, which starts with a useful clarification on the new categorisation (1994) of the IUCN Red List Categories, and a comparison with the older criteria and designations.

More on next page

From previous page

Of considerable conservation interest are the ensuing tables listing endangered taxa found at Fraser's Hill. The present status of the flora is documented in a separate chapter, featuring again a rather poorly edited map.

The author rightfully points to the value of computerized herbarium databases to aid in compiling checklists. The research pamphlet concludes with 15 pages of full colour photographs. For a research pamphlet, this pictorial addition of such a high quality is certainly uncommon.

Tables are crammed with information, but larger print would render them more readable. It is also unclear why no effort was taken to number chapters and paragraphs.

This research pamphlet will be of immediate interest to those with a conservation interest in the Indo-Malayan realm, serving as a useful example on how to compile critical data on valuable forests outside protected areas. FIF

De Wulf is from the Department Of Forest And Water Management, University Of Ghent in Belgium

How An Airport Grew A Forest

*In 1995, FRIM was commissioned to set up a forest environment within the premises of the Kuala Lumpur International Airport. This is a pictorial documentation of the flagship project**

A Forest In The Windows:The Story Of How KLIA 's Special Forests Were Crafted by Louis Ratnam and Mohd. Afendi Hussin; 2000/119 pages; RM 50/USD 50; Order Code: KLIA

Review by Dr Gary Theseir a

WHILE the concept of a forest ecosystem behind glass is not a new one, the construction of such a self-sustaining entity within the confines of a glass, steel and concrete edifice raised unique and complex problems.

Unlike the usual glass house or conservatory, which tolerates, indeed requires, frequent intervention and maintenance, designing a balanced and self-perpetuating ecosystem presents a far greater challenge.

To do so in a completed airport would be virtually impossible. Fortunately, the concurrent construction of both the airport and forest seemed to be mutually beneficial (or at least mutually non-disruptive) to both.

The book is a pictorial chronology of events, addressing problems of spatial logistics, tree acclimatisation, water and nutrient supply and the importance of ecosystem factors such as soil compaction and weed competition.

The pictures and captions describing tree preparation and relocation are particularly comprehensive. So, too, details on the foundation technologies needed to 'float' a substrate of living soil above a baggage handling facility and the need to protect the infrastructure from the forest and vice versa.

Presented in great detail is the section describing the preparation, and filling of the area designated as the new 'forest soil', and final placement of the trees in their new home.

The book does not shy away from lessons learned along the way. Novel methods of tree transportation (when a proper crane is not available) and backfill planting (when trees begin arriving even as the soil substrate is being constructed) are presented with grace and aplomb.

The first appendix lists the 32 species of tree, 24 species of palm and bamboo and 39 species of shrub and fern (all counted, 4,450 plants) used in the project.

Unfortunately, some of the common names of the shrubs and ferns are incorrectly listed, detracting from an otherwise useful feature for those seeking ideas for stocking their own 'forest in the windows'. The second raises some ideas of possible ecosystems that FRIM might set its sights on as future construction projects.

While not by any means a technical manual on ecosystem construction, the book nevertheless should rank high on the list of anyone wishing to embark on a project involving 'instant trees' or 'constructed ecosystems', with the do's and don'ts of building your own ecosystem coming across loud and clear. FIF

Dr Theseira is from the Ecophysiology Unit at FRIM's Forest Plantation Division

**Among key FRIM officers involved were project head Dr Zakaria Ibrahim, Rosslan Yaacob, Mohd. Afendi Hussin and Khairiri Abu Bakar*

Cleaning Up Our Act, Working Up A Sweat

INTENT on proving itself a good corporate citizen, the Sony group of companies in Malaysia last June had 400 of its staff plant 90 trees at FRIM and clean up its grounds, *gotong-royong* style.

Some 50 FRIM employees chipped in with the community project, held in conjunction with World Environment Day on June 5.

JAAFARAHMAD

Grin and Green… *Japanese students on tour stopped over at FRIM to do a bit of tree planting earlier this year*

The event also saw 40 orphans from the Darul Khifayah Orphanage in Jalan Ipoh, Kuala Lumpur treated to lunch, a nature walk and the presence of local artiste Amy Mastura who witnessed the teenagers' efforts at creativity in an art competition. They also attended a nature talk and quiz.

All work and no play would make FRIM staff a dull lot. And so, later that month, to the beat of Hindi *bhangra* and songs of lilting Malay, they went through the paces in a pleasantly mild aerobics session. Twenty-five youngsters from the Special Olympics Association of Selangor and Kuala Lumpur also joined in the fun, taking to the morning wake-up call with unabashed gusto.

They were participating in the Malaysian Nature Society (MNS)'s nature education programme which included nature walks, a scavenger hunt, learning about stream ecology, an overnight camp the night before, and stargazing.

The programme is sponsored by Shell Malaysia and was held in conjunction with a MOU signing ceremony between MNS, FRIM and Shell to further develop their partnership in managing the Nature Education Centre (NEC) in FRIM.

The NEC develops nature appreciation packages for students, teachers, the corporate sector and the public. For more information about NEC's activities, contact Gary Lim at natsoc@po.jaring.my or call him at 03-62771703. You can also write to MNS at P.O. Box 10750, 50724, Kuala Lumpur. FIF