laporan**tahunan** **annual**report 2005

Institut Penyelidikan Perhutanan Malaysia
Forest Research Institute Malaysia (FRIM)

Lembaga Penyelidikan dan Pembangunan Perhutanan Malaysia
Malaysian Forestry Research and Development Board

Kementerian Sumber Asli dan Alam Sekitar
Ministry of Natural Resources and Environment

FRIM

No: 0110461 No: 1124 No: 0111014
MS ISO 9001:2000 CERTIFIED

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RASIONAL MUKA DEPAN

Montaj hutan paya laut dan hasil hutan menggambarkan paduan yang dinamik dan bertenaga antara hutan Malaysia sebagai penyedia sumber asli dengan wawasan FRIM dalam meningkatkan nilai sumber asli ini menerusi penyelidikan dan pembangunan.

Dengan sekumpulan saintis dan penyelidik yang berdedikasi sebagai teras operasinya, FRIM akan meneruskan keberkesanan pemindahan hasil penyelidikan kepada sektor agro-industri di Malaysia.

COVER PAGE RATIONALE

The montage of mangroves and forest products depicts the dynamic and vibrant interplay of the Malaysian forest as a provider of natural resources and FRIM's vision of enhancing the value of these resources through research and development.

With a dedicated team of scientists and researchers at the core of its operation, FRIM shall pursue effective transfer of research outputs to the agro-industrial sector in Malaysia.

LEMBAGA PENYELIDIKAN DAN PEMBANGUNAN PERHUTANAN MALAYSIA
MALAYSIAN FORESTRY RESEARCH AND DEVELOPMENT BOARD

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MALAYSIAN FORESTRY RESEARCH AND DEVELOPMENT BOARD

LAPORAN PENGERUSI
CHAIRMAN'S REPORT

Tahun 2005 merupakan tahun pertama saya berkhidmat sepenuhnya sebagai Pengerusi MFRDB. Saya ingin mengucapkan setinggi-tinggi penghargaan kepada ahli Lembaga yang telah berkhidmat dari bulan Januari hingga September 2005. Mereka termasuklah Tuan Hj. Mohd. Yusoff Hj. Mydin, Y.Bhg. Dato' Hj. Abdul Rashid Mat Amin, En. Razani Ujang, En. Lall Singh Gill, En. Raymund Tan, G.S., Dr. Paul Chai, P.K., Y.Bhg. Datuk Daniel Khiong, K.S. dan En. Choo, Y.W. MFRDB juga mengalu-alukan ahli Lembaga yang baru serta yang dilantik semula untuk meneruskan perkhidmatan mereka.

Memandangkan tahun 2005 merupakan tahun terakhir dalam Rancangan Malaysia ke-9 (RMK-9), sudah sewajarnyalah FRIM membangunkan sebelas Program Penyelidikan bagi RMK-9 (2006-2010). Dengan matlamat, objektif, bidang keutamaan dan bidang tumpuan yang telah dikenal pasti, rancangan penyelidikan ini akan dapat membantu menentukan hala tuju dan aktiviti penyelidikan FRIM pada lima tahun yang akan datang.

Bagi sektor perhutanan, rancangan penyelidikannya termasuklah *Sustainable Management of Natural Forest; Quantification and Sustenance of Ecological Functions and Services of Forests; Conservation and Management of Forest Biodiversity; Urban Forestry and Forest Recreation Management;* dan *Forest Plantations for Sustainable Development of Forest Industries*. Bagi Sektor Bioteknologi, tiga rancangan penyelidikan telah dikenal pasti. Ini termasuklah *Natural Product Discovery and Herbal Processing Technology; Biotechnology in Forestry for Knowledge and Wealth Creation;* dan *In Search of Promising Lead Compounds for the Development of Phytopharmaceuticals*. Bagi Sektor Hasil Hutan pula, rancangan penyelidikannya ialah *Protection and Development of Wood-based Products; Quality and Market Enhancement of Wood-Based Products via Technology Development;* dan *Utilisation of Wood and Non-Wood Fibres for Value-added Products.*

Tahniah saya ucapkan kepada FRIM yang telah berjaya memperoleh pembiayaan IRPA sebanyak RM 8 juta bagi program penyelidikan khas yang bertajuk, *"Safeguarding the forest plant biodiversity of Peninsular Malaysia"* yang dibahagikan kepada dua projek iaitu, *"Flora of Peninsular Malaysia"* dan *"Conservation monitoring of some rare and threatened plants of Peninsular Malaysia"*. Dana yang diberikan oleh (MPKSN) sangatlah dihargai. Di bawah dana projek penyelidikan ini, sebuah Buku Panduan Pakar dalam Biodiversiti, dan Maklumat Repositori Biodiversiti di Malaysia telah disusun dan akan diterbitkan.

MFRDB akan terus mendokong dan memberi sokongan dalam segala aktiviti penyelidikan di FRIM. Dalam konteks ini, Lembaga telah meluluskan sejumlah RM350,000 bagi membiayai tiga projek penyelidikan. Ini termasuklah projek pembiakbakaan kelip-kelip (RM100,000), teknik pemulihan paya laut untuk perlindungan pantai (RM100,000), dan pembangunan produk herba (RM150,000).

Pada tahun ini juga, Kementerian Sumber Asli dan Alam Sekitar telah menubuhkan satu Pasukan Petugas Khas bagi Penanaman Paya Laut dan Spesies Pantai di Kawasan Pantai di Malaysia. Di bawah Pasukan Petugas Khas ini, Jawatankuasa Teknikal Penyelidikan dan Pembangunan (dipengerusikan oleh FRIM) telah menganjurkan satu Bengkel Kebangsaan di Sungai Petani, Kedah dari 13 hingga 14 Jun 2005. Bengkel ini adalah untuk membincangkan pengalaman, isu dan pengajaran yang berkaitan dengan pemulihan paya laut di sepanjang pantai yang telah terhakis.

Peruntukan sebanyak RM 1 juta daripada NRE telah disalurkan untuk membangunkan kawasan perlindungan yang menjimatkan kos di kawasan pantai paya laut yang terhakis. MFRDB juga turut berbangga dengan pencapaian saintis FRIM yang berjaya mendapat pengiktirafan antarabangsa melalui pelantikan mereka di dalam organisasi di peringkat antarabangsa. Pada tahun ini Dr. Abdul Rahim Nik (Pengarah Kanan Bahagian Perhutanan dan Pemuliharaan) telah dilantik sebagai Ahli Jawatankuasa Penasihat bagi Danish Centre for Forest Landscape and Planning, Denmark. Dr. Chan Hung Tuck (Pengarah Bahagian Pengurusan Penyelidikan) telah dilantik sebagai Naib Presiden Persatuan Antarabangsa Ekosistem Paya Laut (ISME), Okinawa, Japan, dan Lembaga Editor, Penyelidikan Ekologi, Journal of the Ecological Society of Japan. Dr. Lee Su See (Pegawai Penyelidik Kanan, Program Hutan Ladang, Bahagian Bioteknologi) telah dilantik sebagai Ahli Lembaga Eksekutif IUFRO dan sebagai Ahli Jawatankuasa Pengurusan IUFRO. Dr. Saw Leng Guan (Pengarah Program Pusat Biodiversiti Flora, Bahagian Perhutanan dan Pemuliharaan) telah dilantik sebagai Ahli Jawatankuasa Audit Sains, Royal Botanic Gardens, Kew, U.K. Manakala Dr. Noor Azlin Yahya (Pengarah Program, Hutan Bandar dan Rekreasi, Bahagian Perhutanan dan Pemuliharaan) dilantik sebagai Commissioner for Malaysia, International Federation of Parks and Recreation Administration (IFPRA), U.K.

Dengan pelantikan ahli baru dan pelantikan semula ahli sedia ada, Lembaga akan terus menyokong dan membimbing FRIM untuk menjadi salah sebuah institusi penyelidikan yang terunggul di dalam negara dan serantau. MFRDB dan FRIM sudah pasti akan menghadapi pelbagai cabaran bagi tahun 2006 dan seterusnya.

The year 2005 represented my second year as Chairman of MFRDB. I would like to extend my gratitude to members of the Board who had served from January to September 2005. They include Tuan Hj. Mohd. Yusoff Hj. Mydin, Y.Bhg. Dato' Hj. Abdul Rashid Mat Amin, En. Razani Ujang, En. Lall Singh Gill, En. Raymund Tan, G.S., Dr. Paul Chai, P.K., Y.Bhg. Datuk Daniel Khiong, K.S. and En. Choo, Y.W. To new and continuing members, the MFRDB warmly welcomes you.

As 2005 was the final year of the Eighth Malaysia Plan, it was most appropriate that FRIM had developed eleven Research Programmes for the Ninth Malaysia Plan (2006-2010). With goals, objectives, priority areas and focus areas identified, these programmes would chart the research directions and activities of the institute for the next five years.

For the Forestry Sector, the programmes are Sustainable Management of Natural Forest; Quantification and Sustenance of Ecological Functions and Services of Forests; Conservation and Management of Forest Biodiversity; Urban Forestry and Forest Recreation Management; and Forest Plantations for Sustainable Development of Forest Industries. For the Biotechnology Sector, three programmes have been identified. They are Natural Product Discovery and Herbal Processing Technology; Biotechnology in Forestry for Knowledge and Wealth Creation; and In Search of Promising Lead Compounds for the Development of Phytopharmaceuticals. For the Forest Products Sector, the programmes are Protection and Development of Wood-based Products; Quality and Market Enhancement of Wood-Based Products via Technology Development; and Utilisation of Wood and Non-Wood Fibres for Value-added Products.

Congratulations to FRIM for securing a total funding of RM 8 million from IRPA for a special research programme entitled, "Safeguarding the forest plant biodiversity of Peninsular Malaysia" which consists of two projects entitled, "Flora of Peninsular Malaysia" and "Conservation monitoring of some rare and threatened plants of Peninsular Malaysia". The support provided by the National Council for Scientific Research and Development (MPKSN) is gratefully acknowledged. Under these two projects, a Directory of Expertise in Biodiversity, and Information on Biodiversity Repositories in Malaysia have been compiled.

The MFRDB continued to support the research activities of FRIM. In this context, the Board approved a total of RM350,000 to support three research projects. They included the firefly breeding project (RM100,000), restoration techniques of mangroves for coastal protection (RM100,000), and development of herbal products (RM150,000).

During the year, the Ministry of Natural Resources and Environment (NRE) convened a Special Task Force Committee on Planting of Mangroves and other Coastal Species in Coastal Areas in Malaysia. Under the Special Task Force Committee, the Technical Committee on Research and Development (chaired by FRIM) had organised a National Workshop in Sungai Petani, Kedah from 13 to 14 June 2005. The workshop was aimed at discussing experiences, issues and lessons learnt with regard to mangrove restoration along eroding shores. An allocation of RM1 million was procured from NRE to develop a demonstration area for cost-effective protection of eroding mangrove shores in 2006.

The MFRDB takes great pride in acknowledging that FRIM scientists are gaining international recognition through appointments by organisations overseas. For the year, Dr. Abdul Rahim Nik (Senior Director of Forestry and Conservation Division) was appointed Member of International Advisory Committee of the Danish Centre for Forest Landscape and Planning, Denmark. Dr. Chan Hung Tuck (Director of Research Management Division) was appointed Vice-President of the International Society for Mangrove Ecosystems (ISME), Okinawa, Japan, and Board of Editors, Ecological Research, Journal of the Ecological Society of Japan. Dr. Lee Su See (Senior Research Officer, Forest Plantations Programme, Biotechnology Division) was appointed as General Member of the IUFRO Executive Board and as Management Committee Member for IUFRO. Dr. Saw Leng Guan (Director of the Tropical Forest Biodiversity Centre Programme, Forestry and Conservation Division) was appointed Science Audit Committee Member of the Royal Botanic Gardens, Kew, U.K. Dr. Noor Azlin Yahya (Director of the Urban Forestry and Recreation Programme, Forestry and Conservation Division) was appointed Commissioner for Malaysia, International Federation of Parks and Recreation Administration (IFPRA), U.K.

With newly appointed and reappointed members, the Board will continue to guide and support FRIM in its endeavour to be one of the premier research institutions in the country and in the region. The year 2006 and beyond would definitely be challenging years for the MFRDB and FRIM.

DATO' SERI DR. ISAHAK YEOP MOHAMAD SHAR
PJN, DPCM, DPMP, PMP, KMN

Pengerusi MFRDB
Chairman of the MFRDB

Hingga 30 September 2007
Until 30 September 2007

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National University of Malaysia

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Penasihat Alam Sekitar Kerajaan Sarawak
Advisor on the Environment, Sarawak

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Institut Penyelidikan Perhutanan Malaysia
Forest Research Institute Malaysia

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Barisan hadapan (dari kiri)
Front row (from the left)
Pn. Ong Joo Ling, Y.B. Datuk Dr. James Dawos Mamit, Y.Bhg. Dato' Dr. Abdul Razak Mohd. Ali, Y.Bhg. Dato' Seri Dr. Isahak Yeop Mohamad Shar (Pengerusi), Y.Bhg. Dato' Sheikh Othman Sheikh Abdul Rahman, Y.Bhg. Dato' Azahar Muda, Pn. Aziyah Mohamed

Barisan belakang (dari kiri)
Back row (from the left)
En. Nik Mohd. Shah Nik Mustafa, Dr. Lee Ying Fah, Dr. Raymond Chan Heun Yin, En. Ahmad Loman, Y.Bhg. Dato' Mohd. Nazuri Hashim Shah, Tn. Hj. Rabuan Sulaiman

Tiada di dalam gambar
Not in picture
Y.Bhg. Dato' Prof. Dr. Abdul Latiff Mohamed, Y.Bhg. Datu Cheong Ek Choon

Hingga 30 September 2007
Until 30 September 2007

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Lembaga Getah Malaysia
Malaysian Rubber Board

Y.BHG. DATO' DR. ABDUL RAZAK MOHD. ALI
DIMP, JMN, FMIC
Institut Penyelidikan Perhutanan Malaysia
Forest Research Institute Malaysia

Hingga 30 September 2007
Until 30 September 2007

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Jabatan Perhutanan Semenanjung Malaysia
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Lembaga Perindustrian Kayu Malaysia
Malaysian Timber Industry Board (MTIB)

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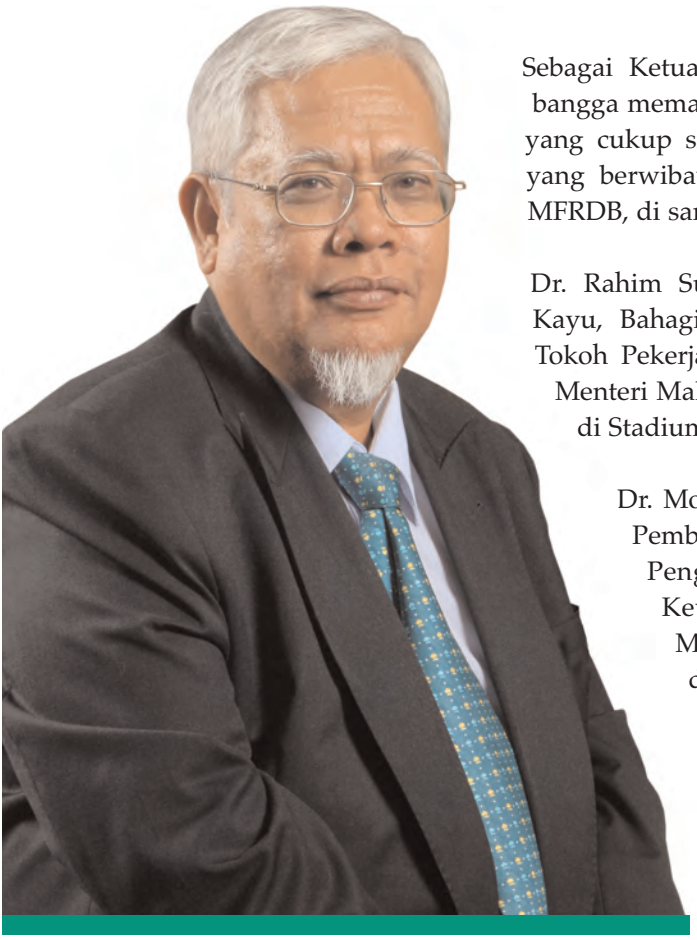
ABDUL RAHMAN *DIMP, JP*
EN. CHANDRA SEKARAN (Silih Ganti)
Persatuan Pekilang Panel Malaysia
Malaysian Panel-Products Manufacturer's
Association (MPMA)

INSTITUT PENYELIDIKAN PERHUTANAN MALAYSIA

FOREST RESEARCH INSTITUTE MALAYSIA

LAPORAN KETUA PENGARAH
DIRECTOR GENERAL'S REPORT



Sebagai Ketua Pengarah FRIM sejak sedekad yang lalu, saya berasa bangga memandangkan tahun 2005 merupakan tahun pencapaian FRIM yang cukup signifikan. Kejayaan yang dicapai ialah hasil kepimpinan yang berwibawa serta sokongan yang tidak berbelah bagi daripada MFRDB, di samping prestasi cemerlang penyelidik FRIM.

Dr. Rahim Sudin (Pengarah Program Pembinaan dan Perlindungan Kayu, Bahagian Pembangunan Produk) terpilih menerima anugerah Tokoh Pekerja Lelaki 2005. Anugerah disampaikan oleh YAB Perdana Menteri Malaysia bersempena sambutan Hari Pekerja pada 7 Mei 2005 di Stadium Bukit Jalil, Kuala Lumpur.

Dr. Mohd. Nor Yusof (Pengarah Program Kimia Kayu, Bahagian Pembangunan Produk) dan En. Md. Nasir Dayat (Cawangan Pengurusan Pentadbiran, Bahagian Pengurusan dan Kewangan) masing-masing dianugerahi pingat Kesatria Mangku Negara (KMN) dan Pingat Pangkuan Negara (PPN) daripada Seri Paduka Baginda Yang di-Pertuan Agong pada 4 Jun 2005. Dua orang pegawai dan seorang kakitangan FRIM turut dianugerahkan Darjah Kebesaran daripada DYMM Paduka Seri Sultan Perak Darul Ridzuan, pada 18 Jun 2005 iaitu En. Abdul Halim Jawi - Darjah Ahli Cura Si Manja Kini (ACM), En. Lim Seng Choon - Ahli Mahkota Perak (AMP) dan Puan Dasima Ramudin - Pingat Jaksa Kebaktian (PJK).

Pada tahun ini, saintis FRIM telah memenangi banyak anugerah penyelidikan di peringkat antarabangsa dan kebangsaan. Projek FRIM, *"Accelerated drying system for production of eco-friendly rubberwood stock with minimum preservative requirement for furniture export market"* oleh En. Choo Kheng Ten dan kumpulannya telah memenangi Anugerah Inovasi Penyelidikan Bersama antara Sektor Awam dengan Sektor Swasta (AIPB) tahun 2005, 17 hingga 18 November 2005. Anugerah tahunan ini diberi kepada projek kerjasama penyelidikan antara sektor awam dengan swasta di negara ini.

Lapan penyertaan dari FRIM berjaya merangkul anugerah sempena Ekspo Sains, Teknologi dan Inovasi (ITEX 2005) yang diadakan di Pusat Dagangan Dunia Putra (PWTC), Kuala Lumpur dari 19 hingga 22 Mei 2005. Pingat Perak dimenangi oleh *"Standardised extract of Centella asiatica," "Multi-designs of furniture from oil palm LVL,"* dan *"Non-destructive testing system based on ear-brain analogy."* Manakala *"B3-A1 multi-purpose applicator, 3 in 1 nature preservative," "Laminated furniture component from oil palm trunk veneer," "Non-structural laminated veneer lumber from oil palm trunk,"* dan *"Sayonara MRSA"* memenangi pingat gangsa.

FRIM turut memenangi beberapa anugerah pada Pameran Penyelidikan dan Inovasi 2005 yang diadakan di Universiti Putra Malaysia dari 16 hingga 17 Mac 2005, dan pada Pameran Penyelidikan dan Pembangunan IPTA yang diadakan di PWTC dari 30 September hingga 2 Oktober 2005.

Projek FRIM, *"The weaning chamber specially adapted to local conditions for tissue-cultured plants"* oleh Dr. Kodi Isparan Kandasamy memenangi pingat gangsa sempena Pameran Antarabangsa Reka Cipta ke-33 di Geneva, Switzerland.

Pada Julai 2005, Makmal Genetik, Bahagian Bioteknologi, telah mendapat akreditasi MS ISO 9001:2000 dari SIRIM QAS International Sdn. Bhd. Akreditasi yang sama yang telah diperoleh Makmal Teknologi Biji Benih sejak September 2002, telah dilanjutkan sehingga September 2008. Pada bulan Jun 2005, Makmal Ujian Komposit Kayu telah memperoleh akreditasi ISO/IEC 17025 dari Jabatan Standard Malaysia. Bagi tahun kedua dan kesebelas berturut-turut, Makmal Ujian Komposit Kayu dan Makmal Analisis Awetan Kayu masing-masing menerima Anugerah Makmal Cemerlang, IKM dari Institut Kimia Malaysia.

Pada tahun 2005, prestasi FRIM dalam bidang sumber manusia begitu memberangsangkan dengan lapan orang Pegawai Penyelidik telah berjaya menamatkan pengajian ijazah lanjutan. Tahniah saya ucapkan kepada Wan Tarmeze Wan Ariffin (University of Birmingham), Muhamad Omar Mohd. Khaidzir (University of Sheffield), Norwati Adnan (UKM), Kevin Ng Kit Siong (UM), Jayanti Nadarajan (University of Abertay Dundee), dan Ahmad Fauzi Puasa (UPM) yang berjaya memperoleh Ph. D., dan kepada Suffian Misran (UPM), serta Abd. Hamid Salleh (UiTM) yang berjaya menamatkan Ijazah Sarjana Sains.

FRIM telah berjaya menganjurkan beberapa persidangan, simposium, seminar dan mesyuarat di peringkat kebangsaan dan antarabangsa. Dengan kerjasama Persatuan Antarabangsa Ekosistem Paya Laut (ISME), UNDP-GEF, Wetland International, ITTO dan Jabatan Perhutanan Semenanjung Malaysia, FRIM telah menganjurkan Mesyuarat Agung keenam ISME, Simposium Paya Laut ISME yang bertajuk *"The Importance of Mangrove and other Coastal Ecosystems in Mitigating Tsunami Disasters"*, Mesyuarat Jawatankuasa Eksekutif ISME dan Bengkel *"Global Mangrove Information System" (GLOMIS)*. Kesemua acara ini telah diadakan di Hotel Pan Pacific, Kuala Lumpur dari 23 hingga 26 Ogos 2005. FRIM berfungsi sebagai Pusat Serantau GLOMIS bagi Asia Selatan dan Asia Tenggara.

Seterusnya, FRIM turut menganjurkan Persidangan Pulpa dan Kertas yang bertajuk *"Plantation, Recycled and Non-Wood Fibres: The Way Forward"* di Hilton Kuala Lumpur dari 16 hingga 18 Ogos 2005, dan Persidangan Penyelidikan Perhutanan dan Hasil Hutan (CFFPR 2005) yang bertemakan *"Investment for Sustainable Heritage and Wealth"* yang diadakan di Hotel Pan Pacific, Kuala Lumpur dari 22 hingga 24 November 2005. Seminar Tumbuhan Ubatan dan Beraroma yang bertemakan *"Harnessing Cures from Nature: Trends and Prospects"* yang diadakan di Cititel Mid Valley, Kuala Lumpur dari 13 hingga 14 September 2005. Seterusnya diikuti pula oleh Herbal Asia, iaitu pameran antarabangsa yang diadakan di Mid Valley Mega Mall, Kuala Lumpur dari 15 hingga 18 September 2005.

FRIM turut berbangga kerana dipilih sebagai lokasi Mesyuarat Ketua-Ketua Eksekutif Badan Berkanun Persekutuan (KEBBP) yang diadakan pada 26 September 2005. Sebagai tanda kenang-kenangan mesyuarat yang dipengerusikan oleh Ketua Setiausaha Negara, satu upacara khas menanam pokok telah diadakan di Taman Botani Kepong.

Bagi mengekalkan statusnya sebagai pusat kecemerlangan penyelidikan perhutanan tropika yang terunggul di dalam negara dan juga serantau, FRIM perlulah terus berkembang dan cemerlang di bawah Rancangan Malaysia ke-9. Dengan momentum yang telah dibina di dalam organisasi kita, saya berkeyakinan matlamat ini akan dapat direalisasi.

As the Director General of FRIM for the past decade, I am proud to say that 2005 was indeed a year of significant achievements for the institute. Some of the achievements were in part due to the able leadership and support of the MFRDB, and to the outstanding performance of some of FRIM's researchers.

Dr. Rahim Sudin (Director of Timber Construction and Preservation Programme, Product Development Division) was honoured "Anugerah Tokoh Pekerja Lelaki". The award was given by the Honourable Prime Minister of Malaysia in commemoration of Labour Day 2005, celebrated on 7 May 2005 in the Bukit Jalil Stadium, Kuala Lumpur.

Dr. Mohd. Nor Yusof (Director of Wood Chemistry Programme, Product Development Division) and Md. Nasir Dayat (Admistrative Management Branch, Management and Finance Division) were conferred Kesatria Mangku Negara (KMN) and Pingat Pangkuan Negara (PPN) from Seri Paduka Baginda Yang di-Pertuan Agong on 4 June 2005, respectively. Two officers and a staff member of FRIM also received Anugerah Darjah Kebesaran from DYMM Paduka Seri Sultan Perak Darul Ridzuan on 18 June 2005. They were En. Abdul Halim Jawi - Darjah Ahli Cura Si Manja Kini (ACM), En. Lim Seng Choon - Ahli Mahkota Perak (AMP) and Puan Dasima Ramudin - Pingat Jaksa Kebaktian (PJK).

For the year, FRIM scientists won national and international research awards. FRIM's project, "Accelerated drying system for production of eco-friendly rubberwood stock with minimum preservative requirement for furniture export market" by En. Choo Kheng Ten and his team won the Anugerah Inovasi Penyelidikan Bersama antara Sektor Awam dengan Sektor Swasta (AIPB) tahun 2005, 17 to 18 November 2005. The annual award is given to the best collaborative research project between the public and private sectors in the country.

Eight of FRIM's submissions won awards during the Science, Technology and Innovation Exposition (ITEX 2005) held in the Putra World Trade Centre (PWTC) in Kuala Lumpur from 19 to 22 May 2005. Silver medals went to standardised extract of Centella asiatica, multi-designs of furniture from oil palm LVL, and non-destructive testing system based on ear-brain analogy. B3-A1 multi-purpose applicator, 3 in 1 nature preservative, laminated furniture component from oil palm trunk veneer, non-structural laminated veneer lumber from oil palm trunk, and sayonara MRSA won bronze medals.

FRIM also won awards at the Invention, Research and Innovation Exhibition 2005 held in UPM from 16 to 17 March 2005, and at the R&D from IPTA Exhibition held in the PWTC from 30 September to 2 October 2005.

FRIM's project, "The weaning chamber specially adapted to local conditions for tissue-cultured plants" by Dr. Kodi Isparan Kandasamy won the Bronze Medal during the 33rd International Exhibition of Inventions held from 6 to 10 April 2005 in Geneva, Switzerland.

In July 2005, the Genetics Laboratory, Biotechnology Division, was accreditated MS ISO 9001:2000 from SIRIM QAS International Sdn. Bhd. Similar accreditation given to the Seed Technology Laboratory since September 2002, was extended to September 2008. In June 2005, the Wood Composite Testing Laboratory was accreditated ISO/IEC 17025 from the Department of Standard Malaysia.

For the second and eleventh consecutive year, the Wood Composites Testing Laboratory and Wood Preservative Analytical Laboratory have been awarded the IKM Laboratory Excellence Awards from the Malaysian Institute of Chemistry respectively.

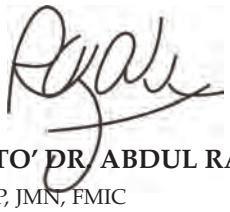
In 2005, FRIM's performance in HRD was outstanding in that eight Research Officers completed their post-graduate training. Congratulations go to Wan Tarmeze Wan Ariffin (University of Birmingham), Muhamad Omar Mohd. Khaidzir (University of Sheffield), Norwati Adnan (UKM), Kevin Ng Kit Siong (UM), Jayanti Nadarajan (University of Abertay Dundee), and Ahmad Fauzi Puasa (UPM) for obtaining their Ph.D., and to Suffian Misran (UPM), and Abd. Hamid Salleh (UiTM) for completing their M.Sc.

FRIM organised several important national and international conferences, symposia, seminars and meetings during the year. In collaboration with the International Society for Mangrove Ecosystems (ISME), UNDP-GEF, Wetland International, ITTO and Forestry Department Peninsular Malaysia, FRIM organised the Sixth ISME General Assembly, the ISME Mangrove Symposium on "The Importance of Mangrove and other Coastal Ecosystems in Mitigating Tsunami Disasters", the ISME Executive Committee Meetings and the Global Mangrove Information System (GLOMIS) Workshop. These events were held at the Pan Pacific Hotel, Kuala Lumpur from 23 to 26 August 2005. It is noteworthy that FRIM functions as the GLOMIS Regional Centre for South and Southeast Asia.

Other conferences organised by FRIM included the Pulp and Paper Conference entitled "Plantation, Recycled and Non-Wood Fibres: The Way Forward" held in Hilton Kuala Lumpur from 16 to 18 August 2005, and the Conference on Forestry and Forest Products Research (CFFPR 2005) "Investment for Sustainable Heritage and Wealth" held in the Pan Pacific Hotel, Kuala Lumpur from 22 to 24 November 2005. The Seminar on Medicinal and Aromatic Plants "Harnessing Cures from Nature: Trends and Prospects" was held in Cititel Mid Valley, Kuala Lumpur from 13 to 14 September 2005. The seminar was followed by Herbal Asia, an international exhibition held in Mid Valley Mega Mall, Kuala Lumpur from 15 to 18 September 2005.

It was indeed an honour that FRIM was chosen as the venue for the Mesyuarat Ketua-Ketua Eksekutif Badan Berkanun Persekutuan (KEBBP) held on 26 September 2005. To commemorate the meeting, chaired by the Chief Secretary of the Government, a special tree planting ceremony was organised at the Kepong Botanic Gardens.

To maintain its status as a centre of excellence for tropical forestry research in the country and in the region, it is crucial that FRIM continues to grow and excel under the Ninth Malaysia Plan. With the momentum built up within the institute, I am confident that this goal will be realised.



DATO' DR. ABDUL RAZAK MOHD. ALI
DIMP, JMN, FMIC

Ketua Pengarah FRIM
Director General FRIM

AHLI DIREKTORAT
DIRECTORATE MEMBERS

Pengerusi / *Chairman*

Y.BHG. DATO' DR. ABDUL RAZAK MOHD. ALI
DIMP, JMN, FMIC
Ketua Pengarah
Director General

Ahli / Members

Y.BHG. DATO' DR. WAN RAZALI WAN MOHD.
DPMT, JSM, KMN, FIFM
Timbalan Ketua Pengarah
(Penyelidikan dan Pembangunan)
Deputy Director General (Research and Development)

Y.BHG. DATO' DR. ABD. LATIF MOHMOD
DIMP, KMN, AMN
Timbalan Ketua Pengarah (Operasi)
Deputy Director General (Operations)

DR. ABDUL RASHID HJ. ABD. MALIK
Pengarah Kanan Bahagian Pembangunan Perniagaan
Senior Director Business Development Division

DR. ABDUL RAHIM NIK *AMN*
Pengarah Kanan Bahagian Perhutanan dan Pemuliharaan
Senior Director Forestry and Conservation Division

DR. HOI WHY KONG, *AMN*
Pengarah Kanan Bahagian Pembangunan Produk
Senior Director Product Development Division

DR. BASKARAN KRISHNAPILLAY
Pengarah Kanan Bahagian Bioteknologi
Senior Director Biotechnology Division

EN. MOHD. ZAMSHARI ABD. RAHMAN
Pengarah Bahagian Pengurusan dan Kewangan
Director Management and Finance Division

PN. WAN RAHMAH WAN A. RAOF
Pengarah Bahagian Pengurusan Sumber Manusia
Director Human Resources Management Division

DR. CHAN HUNG TUCK *KMN*
Pengarah Bahagian Pengurusan Penyelidikan
Director Research Management Division

DR. SAW LENG GUAN
Pengarah Program Pusat Biodiversiti Hutan Tropika
Director Tropical Forest Biodiversity Centre Programme

DR. SHAMSUDIN IBRAHIM
Pengarah Program Pengurusan dan
Ekologi Hutan
Director Forest Management and Ecology Programme

DR. NOOR AZLIN YAHYA
Pengarah Program Hutan Bandar dan Rekreasi
Director Urban Forestry and Recreation Programme

DR. MOHD. NOR MOHD. YUSOFF
Pengarah Program Kimia Kayu
Director Wood Chemistry Programme

DR. RAHIM SUDIN
Pengarah Program Pembinaan dan
Perlindungan Kayu
Director Timber Construction and
Protection Programme

DR. TAN YU ENG
Pengarah Program Pemprosesan dan
Teknologi Kayu
Director Timber Processing and
Technology Programme

DR. ABD. RASIP ABD. GHANI
Pengarah Program Hutan Ladang
Director Forest Plantations Programme

DR. RASADAH MAT ALI
Pengarah Program Tumbuhan Ubatan
Director Medicinal Plants Programme

DR. MARZALINA MANSOR
Pengarah Program Bioteknologi Hutan
Director Forest Biotechnology Programme

DR. WOON WENG CHUEN, *LIMIS*
Pengarah Program Tekno-Ekonomi
Director Techno-Economics Programme

DR. NORINI HARON
Ketua Hal Ehwal Antarabangsa (Setiausaha)
Head of International Affairs (Secretary)

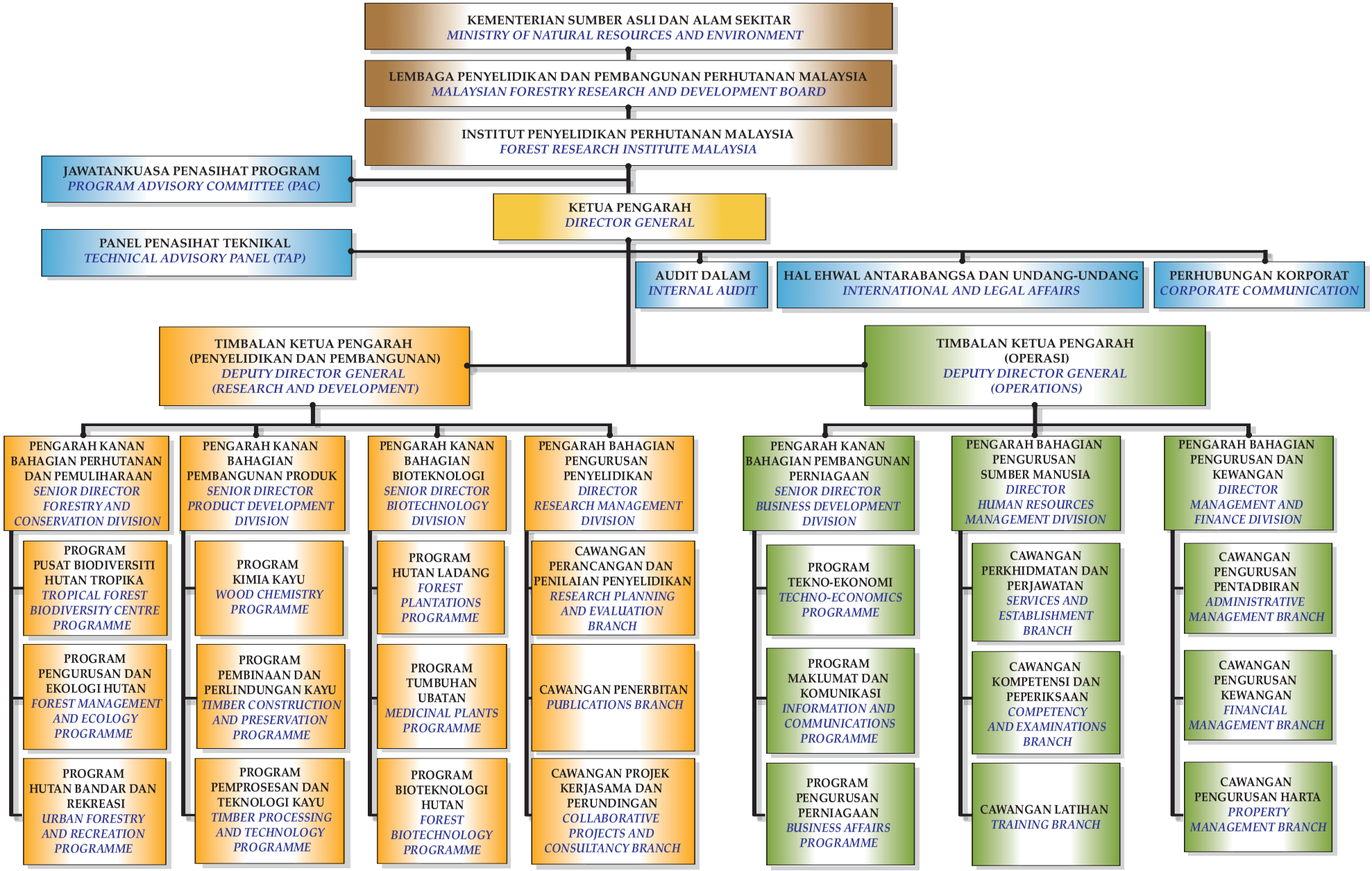
AHLI DIREKTORAT
DIRECTORATE MEMBERS

Berdiri (dari kiri)
Standing (from the left)
Dr. Rasadah Mat Ali, Dr. Rahim Sudin, Dr. Ab. Rasip Ab. Ghani, Dr. Baskaran Krishnapillay, Dr. Abdul Rahim Nik, Dr. Hoi Why Kong, Dr. Tan Yu Eng, Dr. Saw Leng Guan, Dr. Shamsudin Ibrahim, Dr. Woon Weng Chuen, Dr. Mohd. Nor Mohd. Yusoff, Dr. Abdul Rashid Hj. Abd. Malik, Dr. Noor Azlin Yahya, Dr. Norini Haron

Duduk (dari kiri)
Seated (from the left)
Pn. Wan Rahmah Wan A. Raof, Dato' Dr. Wan Razali Wan Mohd.,
Dato' Dr. Abdul Razak Mohd. Ali (Ketua Pengarah), Dato' Dr. Abd. Latif Mohmod,
Dr. Marzalina Mansor

Tiada di dalam gambar
Not in picture
Dr. Chan Hung Tuck, En. Mohd. Zamshari Abd. Rahman

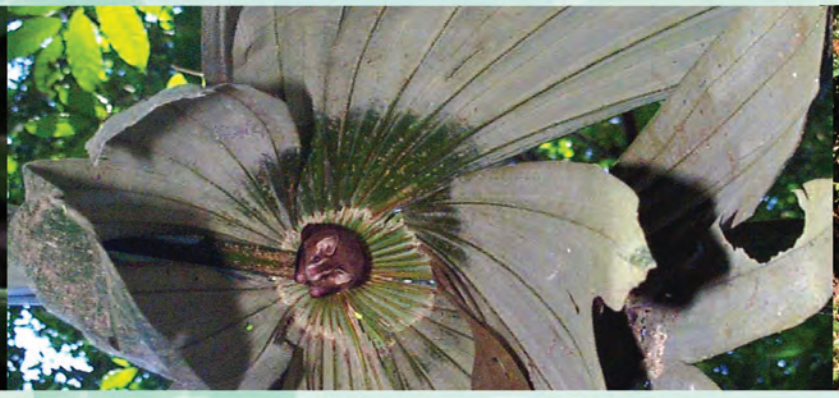
CARTA ORGANISASI FRIM
FRIM ORGANISATIONAL CHART



Misi
Mission

FRIM bertanggungjawab memajukan pengetahuan dan teknologi yang sesuai bagi pemuliharaan, pengurusan, pembangunan dan penggunaan sumber-sumber hutan, dan akan mencapai kecemerlangan dalam penyelidikan saintifik, pembangunan dan pengembangan dalam sektor perhutanan.

FRIM shall develop appropriate knowledge and technology for the conservation, management, development and utilisation of forestry resources; and shall pursue excellence in scientific research, development and technology transfer in the forestry sector.


Objektif
Objectives

- Menjana pengetahuan dan membangunkan teknologi yang sesuai bagi pemuliharaan, pengurusan, pembangunan dan penggunaan sumber hutan
- Menyediakan perkhidmatan berasaskan penyelidikan yang memenuhi keperluan pelanggan
- Memperdagangkan hasil-hasil penyelidikan dan pembangunan
- Memperoleh dan menyebar maklumat
- Meningkatkan kesedaran terhadap peranan alam sekitar dan pemuliharaan hutan
- Mencapai kecemerlangan dan memperoleh kepimpinan dalam penyelidikan perhutanan tropika

- *To generate knowledge and develop appropriate technology for the conservation, management, development and utilisation of forestry resources*
- *To provide research-based services to meet the needs of clients*
- *To commercialise R&D results*
- *To acquire and disseminate information*
- *To create awareness on the environmental and conservation roles of forestry*
- *To pursue excellence and attain leadership in tropical forestry research*

Fungsi
Functions

Fungsi dan aktiviti utama FRIM adalah:

- Untuk menjalan dan menganjurkan penyelidikan mengenai pembangunan sektor perhutanan dan pemuliharaan sumber hutan
- Untuk memperoleh dan menyebar maklumat berkaitan dengan pengurusan dan pembangunan perhutanan, hasil hutan dan penggunaan hasil hutan
- Untuk menyelaraskan penyelidikan berhubung dengan perhutanan dan penggunaan sumber hutan di dalam Malaysia dan mengadakan hubungan kerjasama dengan badan-badan di luar Malaysia berkaitan dengan perkara-perkara tersebut

The primary functions and activities of FRIM are:

- *To conduct and advance research towards development of the forest and forestry industries sector*
- *To obtain and disseminate information regarding the management and development of forestry, forestry products and their utilisation*
- *To co-ordinate research activities related to forestry and utilisation of forestry resources in Malaysia, and to facilitate co-operation and linkages with organisations outside Malaysia for the above matters*

Piagam Pelanggan
Clients' Charter

Kami berjanji untuk berusaha membangun dan menggalakkan penggunaan sumber dan hasil hutan secara berkekalan melalui penyelidikan, pengembangan dan penggunaannya. Bagi tujuan ini, kami memberi jaminan seperti berikut:

- Menyediakan penyelesaian praktikal kepada masalah berkaitan pengurusan dan penggunaan sumber dan hasil hutan dengan tepat, jimat dan mengikut jadual
- Menyediakan satu program pembangunan sumber manusia bagi mewujudkan golongan saintis yang berkebolehan dan berwibawa
- Menyebarkan hasil teknologi, penyelidikan serta memberi perkhidmatan nasihat dan teknikal yang tepat dengan cepat secara profesional dan mudah difaham kepada setiap peringkat pengguna
- Menjamin untuk memberi kemudahan dan perkhidmatan profesional dalam meningkatkan kesedaran awam terhadap alam sekitar
- Menyediakan suasana kerja yang tidak birokratik bagi menggalakkan cetusan idea di kalangan saintis dan perhubungan lebih rapat dengan pelanggan

We pledge to develop and enhance the utilisation of forestry resources and produce on a sustainable basis through research, development and application. For this purpose, we ensure the following:

- *Make available reliable, economical and timely solutions to problems related to management and utilisation of forestry resources and forestry produce*
- *Prepare a human resource development programme to create a core of dedicated scientists of calibre and ability*
- *Disseminate speedily appropriate and reliable scientific and technological information in a professional and easily accessible manner to all levels of clients and users through consultation and advice*
- *Provide professional advice to the public to ensure that public awareness on the environment is heightened*
- *Provide a conducive working environment to encourage creativity among scientists, and to maintain a close rapport with clients*

Slogan Kualiti
Quality Slogan

"Kualiti teras kecemerlangan, Inovasi kunci keunggulan"

"Quality is the pillar for excellence, Innovation is the key to preeminence"

Dasar Kualiti
Quality Policy

Kami bertanggungjawab untuk mencapai kecemerlangan dalam penyelidikan saintifik dan pembangunan dalam usaha pengembangan sektor perhutanan dan juga menghasilkan inovasi yang sesuai bagi semua pelanggan. Kami akan pastikan semua yang bekerja dengan kami bersama-sama bertanggungjawab dan mematuhi standard kualiti yang telah ditetapkan.

***We** are committed to achieving excellence in scientific research and development in the efforts to develop the forestry industries sector and also to derive innovations for the benefit of the clients. We shall ensure that those working together with us shall be committed and adhere to the quality standards that have been identified.*

PENYELIDIKAN DAN PEMBANGUNAN

RESEARCH AND DEVELOPMENT

Spesies baru *Scaphochlamys* di Semenanjung Malaysia
New Scaphochlamys species in Peninsular Malaysia

Malaysia dikenali dunia dengan kepelbagaian flora yang terdapat di hutan-hujan tropikanya yang berusia 50 juta tahun. Sehingga kini, kira-kira 15,000 jenis tumbuhan berbunga telah direkodkan. Senarai ini semakin meningkat dengan penemuan spesies tumbuhan yang baru dan rekod yang baru setiap tahun. Pada tahun 2005, ahli-ahli botani dari Pusat Biodiversiti Hutan Tropika telah merekodkan tiga lagi spesies baru halia iaitu *Scaphochlamys abdullahii*, *S. cordata* dan *S. laxa*. Antara tiga spesies ini, *S. abdullahii* telah dinamakan sebagai penghormatan kepada Perdana Menteri, YAB Dato' Seri Abdullah Ahmad Badawi terhadap galakan beliau ke arah pemuliharaan kepelbagaian biologi di Malaysia. Ketiga-tiga spesies ini merupakan tumbuhan renek yang hanya dijumpai di hutan tanah pamah dan kawasan bukit di Pahang dan Terengganu. Penemuan baru ini mengesahkan lagi kedudukan Malaysia sebagai pusat kepelbagaian *Scaphochlamys* dengan 27 daripada 30 spesies yang diketahui terdapat di sini. Genus *Scaphochlamys* sangat unik berbanding flora tempatan yang lain memandangkan 23 spesies atau 76.7% daripada keseluruhan spesies yang diketahui adalah endemik kepada negara ini. Ini sekali lagi membuktikan terdapatnya warisan semula jadi yang tidak ternilai di negara kita.

1 Jambak bunga *Scaphochlamys abdullahii* dalam warna merah yang menarik
The attractive red inflorescence of the Scaphochlamys abdullahi

2 *Scaphochlamys cordata* tumbuh di antara daun-daun kering di dalam hutan
Scaphochlamys cordata growing among the forest litter

3 *Scaphochlamys laxa* dengan bunga berwarna putih yang unik
Scaphochlamys laxa with unique white flowers

Malaysia is globally known for its diverse flora found in the 50 million year-old rainforest. The species richness is very great; about 15,000 flowering plants have been recorded thus far. And the list continues to expand with new plant species and records being discovered annually. In 2005, the botanists from Tropical Forest Biodiversity Centre have added another three new species of gingers into the record, they are Scaphochlamys abdullahii, S. cordata and S. laxa. Among these three species, S. abdullahii was named in honour of our Honourable Prime Minister YAB Dato' Seri Abdullah Ahmad Badawi for his support towards conservation of biodiversity in Malaysia. All three are small herbs, endemic to the lowland and hill forest of Pahang and Terengganu. With these new findings, it further confirms that Malaysia, home to 27 out of 30 known species, is the centre of diversity for Scaphochlamys. The genus Scaphochlamys is very unique among the indigenous flora because 23 species or 76.7% of the total known are endemic in the country. This again speaks of the priceless natural heritage we have in this country.

Regim penebangan optimum bagi pengurusan hutan pengeluaran yang unik
Optimum harvesting regimes for unique production forests

Pada masa ini semua kawasan hutan darat produktif termasuk hutan paya gambut (HPG) diurus menggunakan sistem pengurusan memilih (SMS) yang telah dipraktikkan sejak tahun 1978. Sistem tersebut yang diwujudkan bagi pengurusan hutan bukit ialah sistem anjal yang membenarkan penebangan pokok berdasarkan batas tebangan minimum bagi pengusahasilan yang ekonomik dan pada masa yang sama memerlukan penyediaan pokok untuk pusingan tebangan akan datang yang dijangkakan dalam masa kitaran 30 tahun. Keberkesanan SMS bergantung pada beberapa faktor seperti kepastian kadar pertumbuhan dan kemandirian, kerosakan akibat pembalakan dan penyediaan pokok yang mencukupi untuk tebangan yang akan datang. Keraguan terhadap keberkesanan SMS bagi pengekalan sumber hutan telah mendapat perhatian memandangkan pokok-pokok untuk tebangan akan datang didapati mengalami kadar kerosakan yang tinggi, proses pemulihan yang perlahan terhadap dirian hutan yang tinggal dan berlakunya perubahan dari segi struktur dan komposisi dirian hutan berkenaan. Semasa operasi pembalakan, kaum dipterokarpa yang sememangnya secara semula jadi berkelompok akan mengalami kadar kerosakan dan seterusnya kadar kematian dirian yang lebih tinggi. Kajian juga menyatakan bahawa ciri berkelompok pada dirian-dirian hutan yang unik akan menghasilkan kerosakan yang tinggi akibat pembalakan jika hanya satu had batas tebangan diguna pakai. Fenomena tersebut akan menjadi lebih kritikal bagi dirian-dirian hutan unik seperti hutan seraya dan kapur.

Oleh yang demikian, perlu difahami bahawa wujudnya dirian hutan yang unik seperti hutan ramin, bintangor, kapur, seraya dan meranti bukit yang mempunyai struktur dan komposisi yang berbeza berbanding dirian hutan yang biasa. Malahan hutan ramin dan bintangor yang wujud di HPG merupakan satu ekosistem yang berbeza sama sekali, yakni dirian hutan ini didominasi oleh satu atau dua spesies sahaja. Manakala hutan jenis seraya, kapur dan meranti bukit didominasi oleh satu spesies sahaja. Oleh itu, hutan jenis ini diurus dengan mengambil kira struktur dirian dan taburan spesiesnya. Preskripsi pengurusan berdasarkan spesies dominan wajar dihasilkan bagi pengurusan hutan yang lebih baik untuk pengusahasilan yang berkekalan serta untuk pemeliharaan dan pengekalan ekosistem. Memahami keperluan berkenaan, dua projek penyelidikan yang berkaitan sedang dilaksanakan oleh FRIM. Projek penyelidikan itu sedang dijalankan di HPG dan hutan bukit. Projek HPG ini akan dijalankan di Kompartmen 77, Hutan Simpan Pekan di Pahang iaitu di kawasan ramin dan bintangor sebagai spesies dominan. Projek penyelidikan ini dilaksanakan bersama-sama Jabatan Perhutanan Negeri Perak, Pahang dan Terengganu yang telah dikenal pasti antara kawasan kajian yang berpotensi. Dalam kajian tersebut, data-data penting akan dikutip untuk dianalisis bagi menghasilkan preskripsi-preskripsi pengurusan yang mampan. Seterusnya, preskripsi pengurusan yang dihasilkan akan diuji kaji terlebih dahulu di lapangan menggunakan sistem pembalakan sedia ada bagi menilai kesan dan tindak balas spesies-spesies dominan tersebut. Sebagai penutup, sistem pengurusan hutan spesifik yang memberi tumpuan pada ciri-ciri fizikal dan ekologi spesies-spesies dominan perlulah diwujudkan. Namun begitu, perkara yang penting pada masa ini ialah sama ada untuk menerima pakai pendekatan regim tebangan optimum ini dalam membantu pengurusan secara berkekalan bagi semua jenis hutan. Diharapkan pada masa hadapan pendekatan ini akan dapat diguna pakai bagi menguruskan semua jenis hutan produktif.

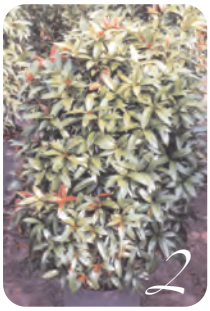
All inland production forests as well as peat swamp forests are currently being managed under the SMS or Selective Management System which came into practice in 1978. The system developed for inland hill forest is flexible and allows the removal of trees according to a minimum diameter limit while at the same time ensuring an economic cut and the retention of advanced residual crop for the second cut estimated about 30 years later. The success of SMS is dependent on several factors like certain growth and mortality rates, logging damage and adequacy of sufficient residual stocking. However concerns have been raised on the effectiveness of SMS in achieving sustainability of forests due to high residual damage, slow recovery and change in structure and composition of the residual stand. This is especially so for dipterocarps because their clumped nature resulted in more damage and higher mortality during logging. Research has also indicated that the clumping of species in such forest may result in high logging damage if single cutting limits were applied. The concerns raised above may be more serious for unique stands such as Seraya Ridge and Kapur forests. Hence stocking standards for SMS may not be met for such forests.

In this regard there is a need to recognize that there exist unique forest types such as Ramin, Bintangor, Kapur, Seraya and Meranti bukit forests where the structure and composition of the forests are different from the normal hill dipterocarp forests. In fact, Ramin and Bintangor forests which are peat swamp forest types are a different ecosystem from inland forests altogether. These forest types are also dominated by one or two species and in some cases such as the Seraya forests, the species is gregariously concentrated on the ridges. Consequently, these sub-types of forest should be managed differently taking into account forest structure and species distribution. In viewing the importance of managing timber resources based on the species sub-types, two relevant research projects were undertaken by FRIM. The projects were being conducted in peat swamp and inland forests. The peat swamp project has its study site in Compartment 77 in Pekan Forest Reserve, Pahang where Ramin and Bintangor are dominant. The inland project implemented with collaboration from the forestry departments of Perak, Pahang and Terengganu and suitable study sites were located. Relevant research activities will be conducted in both the peat swamp and inland forests to acquire necessary information and data for developing management prescriptions. The management prescriptions will subsequently be tested on the ground by using normal harvesting system in order to assess impacts and examine response of the species to the prescriptions. In conclusion, it is important to develop specific management systems focused at the species level by taking into account their physical and ecological characteristics. Among the critical aspects of forest management is a decision to impose an optimum harvesting regime that will help to achieve sustainable management of all forest types. Perhaps, this trend of managing forest for specific species may be expanded to all production forests in the future.

Perencat pertumbuhan tanaman dalam penyenggaraan landskap bandar tropika
Plant growth regulators in the maintenance of urban tropical landscapes

Industri landskap di Malaysia berkembang dengan pesat sejak beberapa tahun yang lalu, diikuti oleh pembentukan polisi kerajaan untuk menjadikan negara ini sebagai negara taman menjelang tahun 2005. Selaras dengan polisi tersebut, pelbagai spesies tumbuhan telah diperkenalkan sebagai tanaman hiasan terutamanya di kawasan yang baru membangun. Peningkatan bilangan tumbuhan dan spesies baru yang ditanam memperlihatkan cabaran baru dalam pengurusan landskap. Peningkatan bilangan tumbuhan yang perlu disenggara dan peningkatan kos serta kekurangan tenaga buruh adalah antara kekangan yang menyebabkan kelemahan dalam penyenggaraan landskap. Pemangkasan dan cantasan merupakan dua aspek penting dalam penyenggaraan taman yang harus dilakukan secara berturutan dan dengan kadar yang kerap bagi memastikan tumbuhan tersebut berperanan dalam pembangunan landskap dari aspek fungsi dan nilai estetika. Walau bagaimanapun, kedua-dua operasi penyenggaraan ini melibatkan kos dan intensif buruh.

Kajian yang dilakukan di FRIM mendapati perencat pertumbuhan tanaman atau *plant growth regulators* (PGR) seperti paclobutrazol dan uniconazola berupaya mengawal pertumbuhan tanaman. Penggunaan PGR diketahui berperanan dalam merencat biosintesis gibralin dalam tanaman, mengurangkan pengembangan sel dan mengurangkan pertumbuhan tanaman. Dalam kajian ini, paclobutrazol dan uniconazola digunakan untuk mengawal pertumbuhan dua spesies tumbuhan landskap iaitu *Syzygium campanulatum* dan *Ficus microcarpa*. Tanaman piawai didapati menghasilkan bentuk yang tidak sempurna berbanding tanaman yang dirawat dengan paclobutrazol dan uniconazola. Tumbuhan yang dirawat mempunyai ciri pertumbuhan yang lebih padat disebabkan oleh penyimpanan pertumbuhan pembiakan hasil aplikasi sebatian-sebatian tersebut. Oleh itu, aktiviti mencantas tumbuhan untuk tujuan penyenggaraan silara dapat dikurangkan. Secara tidak langsung, tenaga kerja penyenggaraan dapat menumpukan perhatian terhadap aspek penyenggaraan yang lain. Penampilan dari aspek tarikan spesies landskap dapat dikekalkan bagi meningkatkan pemandangan persekitaran bandar. Daun yang dihasilkan oleh tumbuhan yang dirawat ini juga didapati menjadi lebih kecil tetapi tiada penghasilan formasi daun yang tidak normal ditemui. Daun yang dikeluarkan adalah lebih hijau dan berkilat hasil peningkatan kandungan relatif klorofil.



Perbezaan pertumbuhan *Syzygium campanulatum;* pokok kawalan yang tidak dirawat (**1**) dan pokok selepas lapan bulan dirawat dengan uniconazola (**2**). Ketinggian pokok yang dikawal ialah 1.8 m manakala ketinggian pokok yang dirawat hanya 0.9 m tetapi dengan silara yang lebih lebat.

*The differences in growth of Syzygium campanulatum; untreated control plant (**1**) and uniconazole-treated plant (**2**) eight-months after application. The control plant is about 1.8 m in height while the treated plant only measures 0.9 m but with more compact crown*

Aplikasi PGR menawarkan penggunaan teknik bebas bahan kimia dalam mengawal pertumbuhan tanaman, dan boleh digunakan sebagai alternatif dalam penyenggaraan tanaman. Ini akan membantu dari segi kekurangan tenaga kerja, masa dan peruntukan operasi. Aplikasi PGR juga menghasilkan silara tanaman yang lebih padat dan ini akan memberi nilai tambah dari segi estetika dan fungsi landskap di persekitaran bandar. Penggunaan PGR yang sesuai mampu menawarkan pilihan penyenggaraan yang lebih baik dalam mengurus spesies landskap bandar yang mempunyai kadar pertumbuhan yang cepat terutamanya untuk tanaman pagar, topiari, dan bentuk tanaman hiasan yang lain. Berasaskan potensinya sebagai teknik yang efektif dalam penyenggaraan tanaman penyelidikan ini berjaya mendapat tempat keempat dalam Anugerah Reka Cipta FRIM 2004. Projek ini juga memenangi tempat kedua bagi poster terbaik di *Conference on Forestry and Forest Products Research* (CFFPR) 2003.

The Malaysian landscape industry has grown rapidly over the last few years following a policy made by the government to turn the country into a garden nation by the year 2005. As a consequence, many new plants species were introduced as ornamental plants especially for newly developed areas. The increasing number of plants and new species being planted presented new challenges for landscape management. The increasing number of plants to be maintained and the increasing costs and shortage of labor are some of the constraints that led to poor landscape maintenance. Pruning and trimming are two of the most important aspects in plant maintenance that should be performed continuously and frequently to ensure that plants conform to the functional and aesthetic aspects of landscape development. However, these two maintenance operations are both costly and labor intensive.

A study conducted in FRIM found that plant growth regulators (PGRs) i.e. paclobutrazol and uniconazole inhibited plant's growth. The application of PGRs is known to inhibit gibberellin biosynthesis in plants, reduce cell elongation and hence retard the plant growth. Studies have shown that paclobutrazol and uniconazole were able to control the vigorous growth of selected landscape species, Syzygium campanulatum and Ficus microcarpa. Plants not subjected to the growth inhibitors had irregular shapes when compared to those applied with paclobutrazol and uniconazole. Treated plants had a more compacted feature due to the inhibition of vegetative growth as a result of the application of these compounds. Therefore, frequent trimming activities for maintaining the crown forms were reduced. Maintenance crews can then concentrate on other aspects of maintenance. Leaves of treated plants were smaller but without abnormal leaf formation. It was also found that these leaves were greener and shinier as a result of increased amount of relative chlorophyll content. Application of PGRs has therefore resulted in a more compacted crown which added to their aesthetic and landscape function in the urban environment. The proper use of PGRs may offer a better landscape maintenance option for managing vigorous species in the urban landscape especially the hedge plant, topiary, or other ornamental plants forms.

This study won the second place for best poster award during the Conference on Forestry and Forest Products Research (CFFPR) 2003 and fourth place for FRIM's Invention Award 2004.

Topiari *Ficus microcarpa;* topiari yang dikawal dan tidak dirawat (**3**) kelihatan terlalu tinggi manakala topiari yang dirawat dengan paclobutrazol mengekalkan bentuknya 12 bulan selepas dirawat (**4**).

*The topiary of Ficus microcarpa; untreated control topiary (**3**) was overgrown while the paclobutrazol-treated topiary retained its shape 12 months after application (4).*

Pempulpaan mekanikal berkimia ke atas sesenduk
Chemi-mechanical pulping of sesenduk

Cawangan Pulpa dan Kertas, Bahagian Pembangunan Produk, FRIM telah banyak menjalankan penyelidikan ke atas pelbagai bahan lignoselulosa. Selain itu, beberapa proses pempulpaan turut dijalankan terhadap bahan-bahan tersebut. Pada tahun 2005, satu kajian terhadap potensi kayu sesenduk *(Endospermum malaccense)* sebagai kayu pulpa telah dijalankan. Kayu sesenduk merupakan spesies balak yang tidak tahan lama dan mempunyai kegunaan yang terhad. Kajian potensinya sebagai bahan bagi menghasilkan pulpa diharapkan dapat memberi nilai tambah kepada spesies tersebut.

Selain proses konvensional seperti pempulpaan kraf, satu proses pempulpaan yang menggabungkan proses kimia dan mekanikal turut dikaji. Proses yang dipanggil pempulpaan mekanikal berkimia (CMP) ini merangkumi prarawatan serpai kayu menggunakan bahan kimia seperti natrium hidroksida (NaOH) yang diikuti oleh pempulpaan mekanikal pada tekanan atmosfera. Antara kelebihan proses ini ialah meningkatkan hasil pempulpaan, meningkatkan kekuatan pulpa mekanikal serta mengurangkan kesan pencemaran alam sekitar.

Kajian pempulpaan merangkumi parameter prarawatan CMP iaitu kepekatan, suhu, tempoh impregnasi dan tempoh rendaman dalam likuor NaOH. Corak perubahan yang diperoleh dapat memberi gambaran perilaku kayu sesenduk terhadap proses CMP. Analisis kandungan kimia mendapati sesenduk mempunyai kandungan holoselulosa sebanyak 72% manakala lignin sebanyak 26%. Walaupun sesenduk mempunyai gentian yang agak panjang, ia mempunyai dinding sel yang agak tebal berbanding spesies kayu keras yang lain. Kajian yang dijalankan mendapati jumlah hasil pulpa yang diperoleh melebihi 70%. Penggunaan NaOH dalam proses CMP didapati mampu meningkatkan sifat kekuatan kertas seperti kekuatan tegangan dan koyakan. Sifat semula jadi kayu sesenduk yang berwarna cerah menghasilkan kertas yang mempunyai kecerahan yang tinggi.

The Pulp and Paper Branch under the Product Development Division in FRIM has conducted numerous researches on a large variety of lignocellulosic materials. Apart from that, various pulping processes were conducted on those materials. In 2005, a research study was conducted on the potential of Sesenduk (Endospermum malaccense) for pulpwood. Being a non-durable timber species, Sesenduk has limited uses. It is hoped that this study will show the value and potential of Sesenduk as pulpwood.

Chemi-mechanical pulping (CMP) analyses as well as morphological studies were carried out besides the conventional pulping process such as the kraft process. CMP involved the pre-treatment of woodchips with sodium hydroxide (NaOH) followed by atmospheric refining. This process had the advantages of producing a high yield of pulp, increased the mechanical pulp strength and reduced environmental pollution.

Parameters such as NaOH liquor concentration, temperature, impregnation time, soaking time and pattern variation were all investigated. Results showed that Sesenduk after CMP treatment contained 72% holocellulose and 26% lignin. Morphological studies showed that compared to other hard woods, cell walls were thick and yielded long fibres. Pulping yields of more than 70% could be achieved. Paper produced from NaOH treatment increased the tensile and tearing strengths of the paper produced. The natural light colour of Sesenduk also produced papers with high brightness.

Penggunaan kanji kation dalam pembuatan kertas daripada hibrid *Acacia*
The use of cationic starch in making paper from Acacia hybrids

Kanji kation digunakan dalam pembuatan kertas untuk meningkatkan kekuatan kertas dan memperbaik penahanan lepasan awal. Kanji boleh diekstrak daripada pelbagai sumber tumbuhan seperti ubi, jagung, kentang dan lain-lain. Kanji asli mempunyai penahanan yang lemah kerana kebiasaannya ia tidak bercas dan diserap lemah oleh gentian. Kanji kation dihasilkan dengan memasukkan monomer reaktif atau amin tertiari polimer atau terbitan amonia kuartenari ke dalam molekul. Proses kationisasi telah meningkatkan keberkesanan penggunaan kanji disebabkan oleh keupayaannya untuk membantu ikatan di antara gentian. Kanji kation memperbaik kekuatan kering dengan meningkatkan kekuatan ikatan antara gentian. Ini disokong dengan laporan bahawa kanji kation boleh dijerap sehingga 100% pada tahap kemasukan biasa.

Kanji digunakan dalam ampaian kertas pada tahap 0.25 hingga 2.5% berdasarkan berat gentian. Kanji selalunya ditambah di kawasan hujung basah iaitu di antara penghalus dengan kotak kepala. Penerokaan mengenai penggunaan hibrid *Acacia* sebagai pulpa kayu keras adalah penting memandangkan kebanyakan kajian mengenai aditif kekuatan kering lebih tertumpu pada pulpa kayu lembut. Tinjauan kajian mengenai hibrid *Acacia* iaitu *Acacia mangium* x *Acacia auriculiformis* sebagai bahan mentah alternatif untuk industri pulpa dan kertas tempatan bermula ekoran daripada masalah mengenai kebergantungan kepada kertas kitar semula dan kekurangan sumber kayu yang semakin kritikal untuk industri tersebut. Penyelidikan mengenai potensi kayu hibrid *Acacia* untuk aplikasi pulpa dan kertas bermula sejak tahun 2002 di FRIM.

Kajian dijalankan pada skala makmal untuk menyelidik mengenai kesan penambahan kanji kation ke dalam pulpa daripada hibrid *Acacia*. Pemboleh ubah yang dikaji dalam kajian ini antaranya ialah darjah penggantian kanji kation, tahap penambahan, pH media, pengadukan dan pemukulan. Kajian menunjukkan bahawa kekuatan kertas iaitu kekuatan tegangan, pecahan dan lipatan bertambah baik dengan penambahan kanji kation pada darjah penggantian yang rendah dan pada 2% tahap penambahan berdasarkan berat pulpa keringan ketuhar. Berdasarkan pemerhatian, tindakan pemukulan meningkatkan kekuatan kertas yang telah ditambah kanji kation berbanding kertas yang mengalami pemukulan dan tanpa penambahan. Penahanan kanji kation menjadi tinggi apabila pulpa mengalami kesan pengadukan dan pemukulan.

Cationic starch is used in papermaking to increase paper strength and improve first pass retention. Starch can be extracted directly from a number of plant sources such as tapioca, corn, wheat, potato, and many others. Native starches are generally uncharged and only weakly absorbed by fibres, which result in poor retention. Starch is normally made in a cationic form by introducing a reactive monomeric or polymeric tertiary amine or quaternary ammonium derivative into the molecule. The cationisation process has led to an improvement of the efficiency of starch utilisation due to its interfibre bonding ability. Cationic starch improves dry strength by making the interfibre bonding of paper much stronger. In fact, it was reported that cationic starch can be retained up to 100% of the general level of addition.

Starch is normally applied in paper furnishes at a level of 0.25 to 2.5% based on fibres. It is usually added at the wet-end, somewhere between the refiner and the headbox. Since most of the studies into dry strength additives have been confined to softwood pulps thus the use of Acacia hybrids, being hardwood pulps, should be explored. The depletion of timber supply and the heavily dependence on recycled papers have seen Acacia hybrids, Acacia mangium x Acacia auriculiformis as an alternative raw material for the local pulp and paper industry. The research on the use of Acacia hybrids for pulp and paper application started in 2002.

A study was carried out at a laboratory scale to investigate the effect of adding a cationic starch onto pulps prepared from Acacia hybrid pulps. The variables of interest investigated in this study included degree of substitution (DS) of the starch, level of addition, pH of the medium, effect of stirring and beating. Research has shown that the strengths of the handsheets viz. tensile, burst and fold were improved by the addition of cationic starch at low degree substitution and at 2% addition based on oven-dried pulp. It was also observed that a beating mechanism increased the strength of the hand sheets with cationic starch as compared to that of hand sheets without cationic starch. The retention of cationic starch on the hand sheets increased when pulps were stirred and beaten.

Kenaf dalam pembuatan papan serpai, papan gentian berketumpatan sederhana dan komposit kayu polimer
Kenaf in particleboard, MDF and wood polymer composite manufacturing

Potensi untuk menggunakan kenaf dalam pembuatan papan serpai, papan gentian berketumpatan sederhana (MDF) dan komposit kayu polimer telah dinilai. Bahagian teras batang kenaf telah digunakan untuk pembuatan papan serpai dan MDF kepada tiga ketumpatan sasar (500, 600 dan 700 kg/m^3) dengan tiga jenis resin iaitu, urea formaldehid (UF), fenol formaldehid (PF) dan melamin urea formaldehid (MUF). Keputusan sifat-sifat mekanikal menunjukkan papan yang berketumpatan 600 dan 700 kg/m^3 telah memenuhi had minimum piawaian EN. Papan yang menggunakan resin MUF menunjukkan sifat-sifat mekanikal yang lebih baik berbanding resin lain. Manakala penggunaan fenol formaldehid menunjukkan ciri-ciri rintangan air yang lebih baik. Penyelidikan juga menunjukkan potensi menghasilkan komposit kayu polimer dengan adunan campuran polipropilena (PP) dan partikel kayu sehingga 50%.

The potential of kenaf as a manufacturing material for particleboards, medium density fiberboards (MDF) and wood polymer composites were assessed. Kenaf cores were used to produce particleboards and MDF's at three target densities (500, 600, 700 kg/m^3), and with three types of resin viz. urea formaldehyde (UF), phenol formaldehyde (PF) and melamine urea formaldehyde (MUF). Properties of the boards at densities of 600 and 700 kg/m^3 for the three resin types complied with EN Standard specifications. The utilisation of MUF bonded boards displayed superior mechanical strength over other types of resin. In terms of water resistance Phenol formaldehyde bonded boards showed promising results. The study also revealed the feasibility of mixing kenaf core fiber with the plastic material Polypropylene (PP) at admixtures of up to a maximum of 50% particle loading in the manufacture of wood polymer composites (WPC).

Alternatif kepada metil bromida untuk rawatan kayu
Alternatives to methyl bromide for timber disinfestations

Metil bromida digunakan untuk merawat kayu yang diserang oleh serangga dan/atau kulat. Namun demikian, metil bromida juga ialah salah satu bahan kimia yang menghakis lapisan ozon, satu lapisan pencegah yang menapis sinaran ultraungu yang berbahaya daripada matahari. Di kebanyakan negara, penggunaan metil bromida telah dihentikan secara berperingkat untuk memenuhi komitmen negara terhadap Protokol Montreal. Di samping itu, kos rawatan metil bromida juga semakin meningkat. Terdapat pelbagai gas baru telah dicadangkan sebagai alternatif kepada metil bromida. Kajian perlu dijalankan untuk menguji dan mendemonstrasi keberkesanan gas-gas baru terhadap perosak kayu tempatan. Institut Penyelidikan Perhutanan Malaysia terlibat dalam satu projek bagi tujuan ini bersama-sama Jabatan Pertanian Malaysia dan Jabatan Alam Sekitar dengan bantuan teknikal oleh penyelidik daripada CSIRO. Projek ini ditaja oleh UNDP.

Dua gas alternatif telah diuji iaitu sulfida karbonil (COS) dan sinogen (C_2N_2) – dan dibuat perbandingan dengan metil bromida. Serangga kayu yang diuji ialah *Heterobostrichus aequalis, Minthea rugicollis, Coptotermes curvignathus* dan satu spesies pengganti, *Ryzopertha dominica*. Di samping itu, tiga spesies kulat yang diperoleh daripada Makmal Kaji Penyakit FRIM iaitu *Schizophyllum commune* (FP436), *Lasidioplodia theobromae* (FP635) dan *Trametes lactinea* (FP330) juga diuji.

Ryzopertha dominica dapat dihapuskan sepenuhnya dengan metil bromida, sulfida karbonil dan sinogen pada kepekatan 10, 15, 20 dan 25 mg/l untuk selama 8 dan 24 jam pendedahan yang dijalankan. Ujian ke atas *Minthea rugicollis* menggunakan gas-gas pada tahap kepekatan dan masa pendedahan yang serupa dapat menghapuskan kesemua serangga kecuali untuk sulfida karbonil pada 10 mg/l dan 8 jam pendedahan.

Metil bromida membuktikan keberkesanannya terhadap kesemua kulat yang diuji. Pada kepekatan 30 mg/l dan ke atas, kesemua kulat yang diuji dimusnahkan dalam masa pendedahan 8 jam. Akan tetapi, kesemua kulat yang diuji masih hidup dengan gas sinogen pada kepekatan 20 dan 25 mg/l untuk masa pendedahan masing-masing selama 24 jam dan 8 jam. Pada kepekatan dan/atau masa pendedahan lebih tinggi kesemua kulat yang diuji dimusnahkan. Sulfida karbonil pada kepekatan sehingga 60 mg/l untuk selama 24 jam pendedahan tidak dapat memusnahkan kesemua kulat yang diuji. Ini menunjukkan bahawa kepekatan atau/dan masa pendedahan yang lebih diperlukan untuk memusnahkan kulat kayu yang diuji.

Methyl bromide is commonly used in timber disinfestations. However, it is also one of the chemicals that deplete the stratospheric ozone layer, a protective shield that filters out harmful ultraviolet radiation from the sun. Worldwide, methyl bromide use has been phased out in stages in order to meet commitments to the Montreal Protocol. At the same time, the cost of methyl bromide disinfestations has also increased. The Forest Research Institute Malaysia with funding from the UNDP, in collaboration with the Department of Agriculture, Malaysia and the Department of Environment, Malaysia and researchers from CSIRO investigated a range of alternative disinfestants to methyl bromide. Investigations focused on bio-assays required to evaluate and demonstrate the efficacies of these new gases against common timber pests in Malaysia.

Two alternative gases were evaluated in the laboratory – carbonyl sulfide (COS) and cyanogen (C_2N_2). The efficacy of these gases were compared to that of methyl bromide. Insects tested were Heterobostrichus aequalis, Minthea rugicollis, Coptotermes curvignathus and a surrogate species, Ryzopertha dominica. Besides that, three fungal pathogens obtained from the Forest Pathology Laboratory of FRIM were also tested. These were Schizophyllum commune (FP436), Lasidioplodia theobromae (FP635) and Trametes lactinea (FP330).

Ryzopertha dominica was completely susceptible to methyl bromide, carbonyl sulphide and cyanogen at concentrations of 10, 15, 20 and 25 mg/l after 8 and 24 hours exposure time respectively. Minthea rugicollis subjected to the test chemicals, concentration levels and exposure times were also susceptible except for carbonyl sulphide at a concentration of 10 mg/l and 8 hours exposure time.

Methyl bromide proved to be effective against all the test fungi at a concentration of 30 mg/l and at 8 hour exposure. Under the gas cyanogen all the test fungi survived at concentrations of up to 20 and 25 mg/l at exposure times of 8 and 24 hours respectively. At higher concentration and exposure time all the test fungi were killed. Carbonyl sulfide with concentrations of up to 60 mg/l and at 24 hours exposure times proved ineffective against all test fungi. This suggested that a higher concentration and exposure time were required to kill wood fungi with this gas.

Papan strand berorientasi daripada kaedah penjarangan
Oriented strand board from thinnings

Kerja-kerja penjarangan pokok semasa penubuhan ladang hutan lazimnya menghasilkan kuantiti kayu berdiameter kecil yang hanya akan terbiar sekiranya tidak digunakan untuk pemprosesan komersial. Justeru, satu kajian ke atas potensi kayu-kayu penjarangan tersebut untuk pembuatan papan strand berorientasi (OSB) telah dijalankan. OSB ialah produk panel kayu berteknologi tinggi yang dihasilkan daripada hirisan atau cebisan-cebisan kecil kayu. Di negara maju seperti Amerika Utara, Eropah dan Jepun, OSB telah digunakan secara meluas untuk menggantikan papan lapis bagi kerja-kerja pembinaan bangunan, papan acuan simen dan kotak peralatan mesin.

Bahan penjarangan hibrid *Acacia*, sentang *(Azadirachta excelsa)* dan jati *(Tectona grandis)* telah didapati masing-masing di tapak penanaman ladang hutan di FRIM, Merlimau di Melaka dan Mata Ayer, Perlis. Untuk setiap spesies, sebanyak 27 keping OSB 3-lapisan telah dihasilkan pada tiga ketumpatan yang berbeza dan tiga tahap resin fenol formaldehid (PF) iaitu pada 3, 5 dan 7 peratus tahap campuran. Setiap papan gentian tersebut dikemaskan dan dipotong kepada saiz untuk diuji dan dikondisikan pada suhu 20$\pm$2 ^{o}C dan kelembapan bandingan 65$\pm$5%. Kepingan-kepingan papan tersebut telah diuji untuk sifat-sifat mekanikal dan fizikal berdasarkan piawaian EN yang ditetapkan untuk OSB.

Pada amnya, sifat-sifat mekanikal OSB hibrid *Acacia* memenuhi keperluan piawaian yang ditetapkan. Walaupun begitu, rawatan masih diperlukan untuk memperbaik sifat-sifat ikatan dalaman (internal bond) dan pembengkakan ketebalan (thickness swelling). Daripada pemerhatian, kekuatan optimum papan OSB yang dihasilkan adalah pada ketumpatan 650 kg/m^3. Sebaliknya, peningkatan ketumpatan yang lebih tinggi memberi kesan pengurangan pada sifat-sifat kekuatan papan dan pada masa yang sama juga meningkatkan kos penghasilan.

Bahan penjarangan daripada kayu sentang juga berpotensi untuk penghasilan OSB. Daripada sampel yang dihasilkan, sifat-sifat mekanikal dan fizikal papan OSB didapati jauh lebih baik berbanding had nilai piawaian. Sifat ikatan dalaman (internal bond) yang menepati keperluan piawaian minimum ialah papan yang mempunyai ketumpatan dan sukatan resin yang tinggi.

Sifat-sifat mekanikal dan fizikal OSB kayu jati adalah jauh melebihi nilai piawai pada semua tahap ketumpatan dan sukatan resin kecuali untuk papan yang dihasilkan pada ketumpatan dan kandungan resin yang paling rendah iaitu masing-masing 500 kg/m^3 dan 3%.

Kajian ini menunjukkan bahawa bahan penjarangan ladang hutan berpotensi untuk digunakan dalam penghasilan OSB yang akan membantu meningkatkan ekonomi penumbuhan ladang hutan.

Thinning exercises in forest plantation establishments generate a substantial amount of wood residues that goes to rot if not utilised commercially. The potential of using thinning materials for Oriented Strand Board (OSB) production was evaluated. OSB is an engineered, mat-formed panel product made of strands, flakes or wafers that are sliced from wood material. In developed countries such as those in North America, Europe and Japan, OSB has been widely used to replace plywood in building constructions, shuttering boards and box crates applications.

Thinning materials of Acacia hybrid, sentang (Azadirachta excelsa) and teak (Tectona grandis) were collected from plantation plots in FRIM, Merlimau, Malacca and Mata Ayer, Perlis respectively. For each species, a total of 27 pieces of three-layered OSB were produced at three target densities and three levels of resin phenol formaldehyde (PF) namely 3, 5 and 7% level of admixtures. The boards were trimmed, cut into test pieces and conditioned at 20 ± 2^{0}C and 65 ± 5% RH. The test pieces were tested for mechanical and physical properties according to established European OSB standard specifications.

Generally the mechanical properties of Acacia hybrid OSB passed the standard requirements. However, minor treatment may be required to improve the internal bond and thickness swelling of the board. The optimum strength of the board was observed when OSB produced was at the target density of 650 kg/m^3. Further increment of the density had an adverse effect on the strength of the board and also increased the production cost.

Azadirachta excelsa (sentang) thinning material is also another potential raw material to be used for OSB production. The physical and mechanical properties of OSB produced from sentang were much better compared to the standard requirements. The internal bonds comply with the minimum requirement of the standard boards produced at a higher density and resin level.

The mechanical and physical properties of teak (Tectona grandis) OSB also showed potential and were much higher compared to the standard values at all levels of target density and resin content except for the board produced at the lowest density and resin content of 500 kg/m^3 and 3% respectively.

The study showed that small diameter log obtained from thinning of forest plantation species such as Acacia hybrid, sentang and teak could potentially be used for the production of OSB. This will improve the economic of plantation establishment.

Komponen perabot daripada LVOP
Furniture components from LVOP

Sektor industri perkayuan merupakan salah satu penyumbang utama kepada ekonomi negara kita. Permintaan di peringkat global terhadap industri ini telah meningkatkan eksport perkayuan negara dari setahun ke setahun. Pada tahun 2004, nilai eksport industri perkayuan negara dianggarkan lebih kurang RM 14.1 bilion. Eksport perabot negara juga telah didapati meningkat kepada 7.3% menjadikan nilai eksport sebanyak RM 5.4 bilion dalam tahun yang sama. Walau bagaimanapun eksport perabot yang berasaskan kayu getah menghadapi masalah dalam beberapa dekad yang lalu memandangkan bahan kayu getah semakin berkurangan. Salah satu cara untuk mencari penyelesaian terhadap kekurangan bahan mentah kayu getah ini adalah dengan menggunakan batang kelapa sawit yang kini masih dianggap sebagai bahan terbuang. Penyelidikan dan Pembangunan (R&D) yang dijalankan oleh FRIM telah membuktikan bahan terbuang ini berpotensi digunakan sebagai bahan alternatif untuk pembuatan perabot melalui teknik venir berlaminasi. Teknik ini merupakan adaptasi daripada teknik venir kayu berlaminasi. Penyelidikan penggunaan laminasi venir daripada batang kelapa sawit (LVOP) ini difokuskan kepada ciri-ciri kekuatan bahan tersebut dan juga kesesuaian reka bentuk.

The wood based industry is one of the main contributors to economic growth in Malaysia. Total exports from the wood based industry have been increasing due to the demand from the global market. In 2004 this increase earned an equivalent sum of RM14.1 billion for the country's exports. Furniture exports increased by 7.3% to RM5.4 billion. However, the shortage of raw material especially rubberwood has affected this export in the last few years and is projected to increase in the coming years. One solution to this shortage is to use Oil palm (Elaeis guineensis) wood which until recently was considered a waste. FRIM's R&D into the utilization of this waste has shown that there is potential in the production of wood laminated products; a commodity commonly used in the furniture industry. This laminated veneer oil palm (LVOP) product is an adaptation of the laminated veneer lumber (LVL) process. R&D has primarily focused on how suitable LVOP products were for furniture by studying its strength characteristics and suitability in furniture design requirements.

Pulangan hasil venir
Veneer recovery

Penyelidikan berkaitan pulangan hasil venir daripada batang kelapa sawit telah dilakukan ke atas balak batang kelapa sawit yang diambil dari Ladang Kuala Sedim, Kulim, Kedah. Balak batang kelapa sawit berumur dalam lingkungan 25 tahun telah ditebang dan dikupas pada kepanjangan 9 kaki. Hasil venir didapati melebihi 45% dan jika balak tersebut dikupas pada kepanjangan yang lebih pendek mengikut saiz komponen perabot maka pulangan hasil venir akan melebihi 60%.

Research was carried out on logs recovered from the Kuala Sedim Oil Palm Estate in Kulim, Kedah. These logs were less than 25 years old. Veneer recovery from billets at nine feet length was at 45% recovery and more. If the logs length were cut at furniture components length, veneer recovery increased to more than 60%.

Pemilihan dan kualiti venir
Veneer quality and sorting

Kualiti venir kelapa sawit berlaminasi (LVOP) bergantung pada ketumpatan kayu kelapa sawit itu sendiri. Ketumpatan batang kelapa sawit itu berbeza daripada kawasan tengah (inner core) hingga ke bahagian luar (pheriphery region) antara 227 kg/m^3 hingga 530 kg/m^3. Di samping itu terdapat juga perbezaan ketumpatan antara bahagian bawah (basal) dan juga atas (terminal portion). Oleh yang demikian venir yang dihasilkan daripada sebatang pokok perlu dipilih dan disusun untuk memastikan ia sesuai dijadikan komponen perabot berlaminasi venir.

The quality of LVOP products were dependent on the density of the trunk wood. Density measurements from the inner core zone to the periphery of the oil palm trunks showed that densities ranged from 227 to 530 kg/m^3. There was also density variations from wood located at the basal and terminal portions of the oil palm trunks. Hence veneers obtained from these various zones should be sorted and for each type its suitability for furniture use determined.

Proses tekanan (tekanan panas)
Pressing (hot press)

Venir yang telah dipilih dan disusun akan disapukan perekat urea formaldehid (UF). Susunan venir secara selari ini akan dimampatkan menggunakan mesin tekanan panas. Kualiti hasil venir berlaminasi ini bergantung pada jumlah kekuatan tekanan yang dikenakan, jumlah lapisan venir, kesesuaian susunan venir mengikut ketumpatan, keserataan perekatan dan masa tekanan. Kesemua faktor itu akan menentukan kebolehan mekanikal, kesesuaian ketumpatan, ketebalan dan juga spesifik graviti panel berlaminasi itu. Faktor-faktor tersebut dikaji dan ditentukan agar bersesuaian dengan penghasilan komponen perabot.

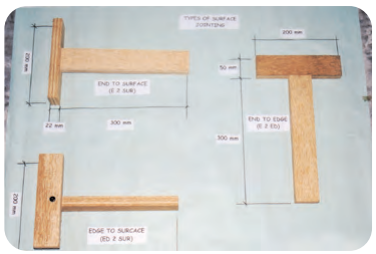
Secara keseluruhannya hasil kajian ini menunjukkan panel berlaminasi yang dihasilkan akan mempunyai kualiti yang baik dan bersesuaian untuk komponen perabot sekiranya venir yang digunakan ialah bahagian bawah (basal portion) batang kelapa sawit dan perlu dikenakan tekanan yang tinggi dan bersesuaian.

Laminates from veneers at various zones and locations on the trunk were then made with the glue Urea Formaldehyde (UF). Pressure through direct heating or hot press was then applied. It was shown that hot pressing and the amount of pressure applied, number of veneer layers, types of veneer layers, glue volume, and time for setting, all determined the mechanical performance, thickness, density and specific gravity of the LVOP. These various veneers were then studied for their suitability as furniture laminates. Generally the results showed that mechanical performance of LVOP was greater for veneer made with high pressure and if the veneers came from the basal portion of an oil palm trunk.

Ujian sambungan berbentuk T
T-shaped joint test

Sambungan berbentuk T dibuat menggunakan LVOP. Sambungan yang sama juga dibuat menggunakan kayu getah untuk tujuan perbandingan. Semua sampel menggunakan parameter yang sama seperti tekanan, tahap kepanasan dan juga masa. Tiga jenis sambungan adalah seperti yang berikut::

- Hujung dengan tepi
- Tepi dengan permukaan
- Hujung dengan permukaan



Tiga jenis sambungan berbentuk T
Three types of T-shaped surface joint

Keputusan ujian menunjukkan sambungan yang menggunakan bahan venir berlaminasi daripada kelapa sawit mempunyai perbezaan yang ketara berbanding bahan venir berlaminasi daripada kayu getah.

The T-shaped joint test was applied to three types of joints made from LVOP. Laminate Veneers from Rubber Wood (LVRW) was used as a comparison. All samples tested were made with the same pressure, temperature and time. The three joints are:

- *end-to-edge joint*
- *edge-to-surface joint*
- *end-to-surface joint*

Test results indicated that joints made from LVOP showed significant differences from joints made from LVRW.

Memasang kerusi sekolah
Assembling the student chair

Pembinaan perabot
Furniture construction

Percubaan menghasilkan perabot kerusi sekolah berdasarkan reka bentuk yang sedia ada menggunakan venir berlaminasi daripada batang kelapa sawit telah berjaya dibuat.

Kerusi sekolah daripada LVRW
Student chair from LVRW

Kerusi ini dibuat menggunakan sistem sambungan seperti yang berikut:

- Dowel
- Lubang dan putting
- Skru
- Kunci Allen

Kerusi sekolah daripada LVOP
Student chair from LVOP

Kerusi sekolah ini juga dihasilkan menggunakan permukaan luar venir daripada kayu getah dan juga permukaan luar venir daripada oak sebagai perbandingan.

A successful trial was made to make an LVOP student chair furniture using existing furniture designs with jointing systems such as:

- *Dowel*
- *Tenon and mortise*
- *Screw*
- *Allen screw*

Student chair furniture were also made from two other laminates that is LVRW and Surface Oak Veneer for comparison.

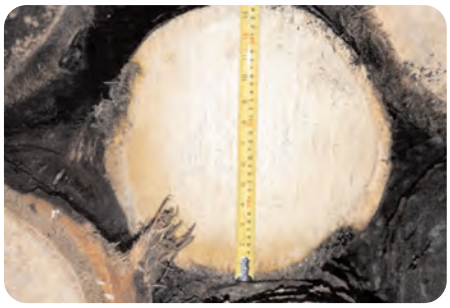
Kerusi sekolah daripada permukaan luar venir oak
Student chair from veneer of Surface Oak

Ujian fizikal
Physical testing

Ujian kekuatan dan ketahanan untuk kerusi
Strength and durability test for chair

Kerusi sekolah venir berlaminasi daripada batang kelapa sawit ini telah melalui ujian kekuatan dan ketahanan menggunakan piawaian BS EN 4875: Part 1: 2001 (Piawaian Ujian Perabot) dan didapati memenuhi kehendak piawaian. Walaupun ketumpatan antara venir berlaminasi batang kelapa sawit (LVOP) dan venir berlaminasi kayu getah (LVRW) mempunyai perbezaan yang ketara, kerusi laminasi batang kelapa sawit telah berjaya memenuhi kehendak piawaian BS EN 4875: Part 1: 2001.

The LVOP student chair was tested for physical strength and durability following BS EN 4875:Part 1:2001 (Furniture testing standards). The chair fulfilled all required standards. Although the density of LVOP and LVRW was significantly different, the LVOP chair still measured up to all standard requirements of BS EN 4875 : Part 1: 2001.



Kayu balak kelapa sawit berdiameter antara 36-72 cm
Oil palm logs with diameter varying from 36 – 72 cm

Keberkesanan kos
Cost-effectiveness

Bahan mentah batang kelapa sawit buat masa ini boleh didapati secara percuma dan hanya akan melibatkan kos pengangkutan. Pemprosesan pengeluaran venir menggunakan batang kelapa sawit adalah sama dengan pengeluaran venir daripada kayu-kayu tropika lain. Walau bagaimanapun untuk proses pengeringan secara komersial dan efektif, venir daripada kelapa sawit memerlukan teknik dan sistem pengeringan yang berbeza. Venir yang dihasilkan daripada sebatang pokok kelapa sawit dianggarkan 50% tetapi jika batang kelapa sawit dipotong mengikut panjang komponen perabot dan dikupas, hasil pulangan venir akan melebihi 50%. Penggunaan perekat untuk menghasilkan panel berlaminasi adalah sama seperti pengeluaran panel berlaminasi daripada kayu-kayu tropika lain tetapi venir daripada batang kelapa sawit melebihi 50% penggunaan perekat untuk penghasilan panel berlaminasi. Jika bahan kemasiapan yang dikenakan pada permukaan panel berlaminasi daripada kelapa sawit lebih menyerap berbanding panel laminasi daripada venir kayu tropika lain, ia boleh diatasi dengan meletakkan bahan penutup (fillers) dan pelitup (sealers) secukupnya.

Projek penyelidikan ini telah memenangi pingat perak dan gangsa dalam pertandingan "The 16th International Invention, Innovation Industrial Design and Technology Exhibition 2005 (ITEX 05)" di PWTC, Kuala Lumpur. Projek ini juga telah memenangi Anugerah Penyelidikan Terbaik FRIM, 2005.

Raw material for veneer laminate manufacturing is free and the only cost incurred is transportation cost. Preliminary processing for oil palm trunks for veneer laminate manufacturing is similar to those required for tropical hard woods. However for the drying process after veneer is cut by a rotary machine, a special dryer is needed if commercial production is to be achieved. Veneer recovery from the trunks was good with more than 50% recovery. Recovery can be increased if furniture component lengths were used. Manufacturing process of LVOP was similar to the manufacture of other laminates. Glue needs were slightly more, about 50% more than the laminates from other tropical woods. When finishing is applied, LVOP's absorbed more chemicals compared to rubberwood but this increase can be overcome with the addition of more fillers and sealers.

This project won the silver and bronze medal at the 16th International Invention, Innovation Industrial Design & Technology Exhibition 2005 (ITEX 05) at PWTC Kuala Lumpur. It also won FRIM's Best Research Award 2005.

1 Peringkat pertama dalam pengeluaran venir kelapa sawit
The first stage production of oil palm veneer

2 Venir dikeringkan menggunakan sistem penghantar penggelek
Veneers being dried using roller conveyer system

3 Permukaan venir disapu dengan pelekat urea formaldehid
Urea Formaldehyde glue was spread on the veneer surface

4 Venir sedia untuk ditekan menggunakan tekanan panas
Veneers ready for pressing using hot press

5 Venir di dalam acuan ditekan menggunakan pemanasan terus
Veneers in mould being pressed through direct heating

Sistem pengeringan dipercepat dengan bahan awet yang minimum bagi pengeluaran kayu getah

Accelerated drying system for rubberwood production with minimum preservatives

Inovasi ini merupakan pengubahsuaian tanur pengewapan konvensional kepada sistem yang menjimatkan tenaga dan berdaya pengeringan suhu tinggi (HTD). Sistem HTD digunakan untuk mengeringkan kayu pada suhu lebih daripada 100°C manakala pengeringan secara konvensional melibatkan suhu tidak melebihi 80°C seperti yang digunakan untuk pengeringan kayu getah (Malaysian oak).

Ciri-ciri penting sistem tanur HTD termasuklah:

- Bangunan yang bertutup, dilengkapi pintu, talian pengendali dengan troli platform yang memegang tindanan kayu
- Sistem pemanasan, pelembapan dan kawalan pengudaraan yang baik
- Peredaran udara paksa pada kelajuan yang sangat tinggi
- Peralatan industri yang bertindak sebagai pusat pemantauan dan pengawalan pelbagai parameter pengeringan tanur sewaktu proses pengeringan
- Kaedah pengeringan kayu getah yang mengoptimumkan kadar dan kualiti pemprosesan stok yang dikeringkan

Media pemanasan, iaitu udara panas pada suhu melebihi 100°C diperoleh daripada penukar haba bersirip yang mendapat tenaga haba daripada sistem dandang. Selain itu, sistem pengeringan HTD juga memerlukan injap stim, alat atur stim dan penyejat stim yang dipasang terbalik mengikut keperluan teknikal sistem HTD bagi mengoptimumkan pengendalian tanur dengan efisien. Sistem HTD ini juga menggabungkan protokol penahan fizikal yang diselenggara di sepanjang proses pengeringan dan diperlukan untuk pengeringan yang berkualiti.

Inovasi ini mempunyai pelbagai ciri yang dipertingkat berbanding sistem pengeringan tanur konvensional.

This innovation involved the modification of a conventional steam-heated kiln into an energy-efficient system with high temperature drying (HTD) capability. A HTD system was used to dry timber at temperature greater than 100°C, whereas, the existing conventional drying involved drying of timber batches at temperature not more than 80°C, as in the case of drying of Malaysian Oak (rubberwood) timber.

Essential features of the HTD kiln system included the following:

- *An enclosed building fitted with a door, handling line with a platform trolley holding the timber stacks*
- *An efficient heating, humidifying system and ventilation control*
- *Provision for forced air circulation at very high speed*
- *An industrial instrumentation which acted as centre for monitoring and controlling various drying parameters of kiln throughout the drying process*
- *A drying recipe for the Malaysian Oak (rubberwood) optimized the rate and quality of throughput of dried dimension stocks.*

The heating medium, heated air at temperatures in excess of 100°C, was provided by finned heat-exchanger which was powered by steam supplied from a boiler system. The other important feature of the HTD drying system encompassed the steam valves, steam regulator and steam evaporator which were retro-fitted according to intended technical requirement of the HTD system to optimize the efficient running of the kiln. This HTD system also incorporated a physical restraint protocol which was maintained throughout the drying process and was essential for quality drying of the timber batches.

This innovation compared to a conventional kiln drying system had a number of much improved attributes.

Mengurangkan kesan negatif ke atas alam sekitar
Reduce negative impact on the environment

Proses ini meminimumkan penggunaan awetan kimia ke atas balak kayu getah, yang merupakan kayu ladang utama dalam pengeluaran perabot dan kayu tanggam yang bermutu tinggi untuk pasaran eksport. Rawatan haba tinggi diperlukan untuk mendapatkan kesan pengasapan (mengelakkan serangan serangga) ke atas kayu balak. Sistem HTD juga menyediakan alternatif bagi membalas ancaman beberapa Negara Kesatuan Eropah (EU) yang menghasut supaya disekat/haramkan penggunaan awetan kimia ke atas kayu balak daripada kayu getah Malaysia. Di samping itu, kayu getah Malaysia telah dihasilkan dari ladang secara mampan dan menggantikan bekalan kayu yang semakin berkurangan dari hutan asli yang dieksploitasi.

The process minimized the use of chemical preservative on the Malaysian Oak timber, which was currently the major renewable plantation timber for manufacturing of high-class joinery and furniture for export market. Essentially the high-heat treatment served to provide a fumigation effect (against insects' attacks) to the timber. Hence, the HTD system also offered an alternative solution on countering the threat by some of the European Union (EU) countries, which were agitating for the ban mainly on the use of chemical preservative in Malaysian Oak timber. Moreover the Malaysian Oak timber is sustainably produced from plantations and substitutes for a depleting wood supply from the exploited natural forests.

Sistem yang menjimatkan tenaga
Energy-efficient system

Ciri tanur HTD yang mengekalkan suhu tinggi menjadikannya sistem pengeringan dipercepat yang menjimatkan tenaga, yang membolehkan proses pengeringan tanur dimensi stok kayu getah Malaysia yang sesuai untuk industri perabot yang berasaskan kayu. Tempoh pengeringan bagi stok dimensi yang digergaji setebal 30 mm dikurangkan kepada 2 atau 3 hari berbanding pengeringan konvensional yang memerlukan 8 hingga 11 hari.

The high temperature-sustained feature of the HTD kiln, provided by an energy-efficient accelerated drying system, enabled a fast-throughput of kiln dried Malaysian Oak dimension stocks suitable for the wood based furniture industry. The drying time for 30 mm-thick sawn dimension stocks was reduced to 2 to 3 days as compared to the conventional drying time which required a total drying period of 8 to 11 days.

Operasi yang menjimatkan kos
Cost-efficient operation

Kajian tekno-ekonomi dijalankan untuk menilai dan membuat perbandingan ke atas ciri-ciri penjimatan kos bagi pembinaan tanur pemanasan-haba konvensional yang baru dengan tanur HTD, dengan mengambil kira kemudahan pengeringan yang dilengkapi dandang dan sistem bekalan air. Kajian menunjukkan bahawa kemudahan loji pengeringan tanur HTD dapat dibina dengan pelaburan modal yang kurang daripada amaun yang diperlukan untuk membina loji pengeringan konvensional. Perbandingan dibuat berdasarkan daya pemprosesan kayu bagi kedua-dua jenis sistem tanur.

Projek ini mendapat pingat "Anugerah Inovasi Perkhidmatan Awam Tahun 2005, Kategori Anugerah Inovasi Penyelidikan Bersama antara Sektor Awam dengan Sektor Swasta ".

A techno-economic study was carried out to assess and compare the cost-effective attributes on building new conventional steam-heated kiln and a HTD kiln, by taking into consideration the complete drying facilities equipped with boiler and water supply system. The study showed that a complete HTD kiln drying plant facilities could be set up with a capital investment of significantly less than the amount required for setting up a conventional drying plant. The comparison was based on the same output capacity for both kiln types.

This project was awarded the 'Anugerah Inovasi Perkhidmatan Awam Tahun 2005, Kategori Anugerah Inovasi Penyelidikan Bersama Antara Sektor Awam dengan Sektor Swasta (AIPB)'.

Pengeringan *Acacia mangium* yang optimum dengan sistem tanur pengeringan berwap

Optimizing Acacia mangium drying with a conventional steam-heated kiln system

Sistem pengewapan pengeringan tanur secara konvensional telah diubahsuai bagi pengeringan *Acacia mangium* sebagai rumusan untuk jadual pengeringan kayu acacia. Pada dasarnya, rumusan kaedah pengeringan melibatkan dua komponen ujian iaitu analisis ujian pengeringan cepat (QDT) dan ujian kadar pengeringan (DRT) dan data yang diperoleh akan mengikuti jadual proses optimum.

QDT menganggarkan keadaan awal pengeringan tanur melalui sukatan awal suhu bebuli kering dan tekanan bebuli basah (WBD). Kedua-dua bacaan akan menjadi permulaan bagi proses pengoptimuman jadual pengeringan yang seterusnya. Satu lagi ujian DRT dilakukan untuk memeriksa ciri-ciri pengeringan kayu di peringkat penurunan kadar pengeringan. Stok kayu *Acacia* 30 mm dan seterusnya 55 mm dimensi digunakan dalam ujian awal ini selepas penyediaan sampel kayu yang sesuai. Kandungan lembapan awal kayu *Acacia* digergaji sebelum dijadikan balak adalah antara 80%-100%. Berdasarkan jadual tanur empirik bagi stok kayu setebal 30 mm, hasil kedua-dua ujian, pengoptimuman jadual pengeringan *Acacia mangium* yang seterusnya telah berjaya dijalankan di dua loji pengeringan tanur komersial. Jadual yang dioptimumkan adalah sesuai bagi stok balak yang berketebalan 105 X 35 mm.

Stok kayu yang baru mestilah dilekatkan pada pelekat 25 mm padu sekurang-kurangnya dua minggu dalam pengeringan angin (di bawah teduhan), kandungan lembapan dikurangkan antara 65% hingga 70% sebelum peringkat pengeringan yang sebenarnya. Masa pengeringan tanur yang dapat dicapai ialah 18 hingga 20 hari dengan sasaran kandungan lembapan kira-kira 9 hingga 10%. Kejadian kecacatan kayu seperti pengempisan dan bergelung adalah tidak signifikan. Penyebaran kandungan lembapan di antara kayu dikesan, bagaimanapun, rawatan penyesuaian atau rawatan penyamaan kandungan lembapan berjaya mengurangkan kejadian ini. Pengoptimuman jadual saiz stok 55 mm *Acacia mangium* masih berjalan.

Jadual tanur yang dioptimum serta prosedur yang berkaitan bagi saiz stok *Acacia mangium* berketebalan sehingga 35 mm telah diedarkan kepada penyelia dan pengusaha 12 loji pengeringan tanur komersial pada Kursus Kekompetenan Pengusaha Tanur (September 2005) yang dianjurkan bersama-sama oleh FRIM, Universiti Putra Malaysia dan MTIB.

A conventional steam heated kiln drying system was used in the optimization of a drying schedule for acaciawood. Essentially, the formulation of the drying recipe involved two separate testing procedures vis-à-vis the Quick Drying Test (QDT) and Drying Rate Test (DRT) analysis. The data obtained went into the final schedule optimization process.

The QDT will estimate the initial kiln drying condition through the measurement of the starting dry bulb temperature (DBT) and the wet bulb depression (WBD) readings. These two measurements will be the starting point in the subsequent process of kiln schedule optimization. The other test, DRT was conducted to examine drying characteristics of the timber during the decreasing drying rate stage. 30 mm and a subsequent 55 m dimension stocks of acaciawood were used in this initial test after suitable sample preparations. The initial moisture content of sawn Acacia lumber, upon conversion from logs, ranged from approximately 80% to 100%. Based on the 'empirical' kiln schedule for 30 mm thick lumber stock, further drying schedule optimization for Acacia mangium was successfully performed at 2 commercial kiln drying plants. The optimized schedule so obtained was suitable for timber stock sizes up to 105 x 35 mm (thickness).

It is recommended that the fresh stocks of timber must be stacked on stickers of 25 mm square for at least two weeks of air drying (under shed) by which time the moisture content was generally reduced to a range of 65% to 70% prior to actual kiln drying stage. The kiln drying time achievable was approximately 18 to 20 days with a targeted moisture content of about 9 to 10%. The incidence of deformation in the form of collapse and honey combing was not significant. Some inter-board moisture content dispersion was detected; however, a recommended 24 to 36 hour conditioning treatment or moisture content equalization treatment was able to minimize the occurrence. The schedule optimization of Acacia mangium stock size of 55 mm thickness is still in progress.

The optimized kiln schedule and the related operating procedure, for up to 35 mm thickness Acacia mangium stock size had been disseminated to 12 commercial dry kiln plant supervisors-cum-operators during the recent (September 2005) Kiln Operator Competency Course organized jointly by FRIM, UPM and MTIB. This is in addition to the two custom drying service providers who are co-opted members in this project.

Pokok mengkudu, kerengga dan ladang mahogani
Mengkudu trees, kerengga and mahogany plantations

FRIM secara aktif sedang menjalankan penyelidikan tentang kerengga, *Oecophylla smaragdina.* Kerengga merupakan serangga pemangsa yang hidup di pokok dan merupakan agen kawalan biologi yang berpotensi terhadap *Hypsipyla robusta,* sejenis kupu-kupu pengorek pucuk. Kupu-kupu ini ialah perosak yang mengakibatkan kemusnahan yang teruk pada tanaman mahogani di Malaysia dan negara-negara lain. Kerengga membina sarang pada pokok mahogani dan pokok-pokok lain seperti rambutan dan manggis. Sarang kerengga dibuat dengan mencantum daun-daun dengan benang sutera daripada larva kerengga. Ia menjaga kawasannya dengan agresif dan berkemungkinan kehadiran kerengga mengurangkan kerosakan pada batang pokok. Kerengga akan memakan telur kupu-kupu perosak ataupun menghalang kupu-kupu betina bertelur. Kajian tertumpu pada cara untuk menarik kerengga ke ladang mahogani, serta untuk mengekalkan populasi kerengga yang tinggi. Salah satu aspek yang dikaji ialah kemungkinan menanam pokok mahogani secara berselang dengan spesies lain yang dapat menarik kehadiran kerengga. Satu kajian di dua belas tapak di empat habitat yang berbeza mencatatkan tiga puluh satu spesies pokok tempat kerengga bersarang. Beberapa spesies pokok ini dicerap menyokong populasi kerengga yang besar.

Kerengga mengerumuni nektar pada buah mengkudu yang sedang membesar
Kerengga aggregating around nectaries on a developing mengkudu fruit

Kajian seterusnya yang membandingkan kepadatan relatif kerengga pada *Morinda citrifolia, Bruguiera parvifolia, Hibiscus tiliaceus* dan *Avicennia officinalis* mendapati *M. citrifolia* (mengkudu) ialah tumbuhan yang paling digemari kerengga ini untuk membina sarangnya. Beberapa ciri yang menjadikan pokok mengkudu digemari ialah madu bunga yang menghasilkan sap manis yang membentuk sebahagian daripada diet kerengga, dan daun yang lebar dan mudah lentur yang sangat sesuai untuk dibentuk menjadi sarang. Mengkudu turut menjadi perumah bagi koya, afid dan teritip. Serangga-serangga ini "dijaga" oleh kerengga dan sebagai balasan, kerengga memperoleh manisan, yang merupakan sumber makanan utamanya. Selain berfungsi sebagai tapak kerengga membuat sarang, pokok mengkudu juga mempunyai nilai perubatan dan ditanam oleh penduduk kampung tempatan. Sebab itulah, pokok mengkudu sangat sesuai untuk ditanam secara berselang dengan pokok spesies mahogani seperti *Khaya ivorensis* dalam membantu dan menggalakkan lagi perkembangan populasi kerengga di ladang mahogani. Kajian lanjutan sedang dijalankan untuk menilai potensi pokok mengkudu.

FRIM has been actively conducting research on the weaver ant, Oecophylla smaragdina, known locally as kerengga. This predatory tree-dwelling ant was identified as a promising biological control agent of Hypsipyla robusta, a shoot-boring moth that is the most destructive pest of mahogany plantations in Malaysia and many other countries. The ant nests in mahogany trees and many other trees such as rambutan and mangosteen. Living leaves are pulled together and held in place with silk threads produced by the ant larvae. These ants patrol their territory aggressively, and it is thought that their presence on the trees reduces borer damage because the ants eat the eggs of the moth or deter the egg-laying females. Research has focused on how to successfully introduce the ants into mahogany plantations, and on what can be done to maintain high population levels of the ants on the trees. One aspect investigated was the possibility of inter-planting mahogany trees with other plant species that favor the establishment of the ants. A survey of twelve sites across four different habitats recorded thirty-one plant species on which this ant nested, and some of these plant species were observed to support particularly large ant populations.

Sarang kerengga pada pokok mengkudu
A kerengga nest on a young mengkudu plant

A subsequent study comparing the relative abundance of kerengga on Morinda citrifolia, Bruguiera parvifolia, Hibiscus tiliaceus and Avicennia officinalis revealed that M. citrifolia (mengkudu) was a plant on which the ants most preferred to nest. Some of the favorable characteristics that mengkudu possesses are nectaries exuding sugary sap that forms a part of the ant's diet, and large flexible leaves that are good for nest-building. Mengkudu also commonly harbors a few mealybug, aphid and scale insect species that the ant is known to attend in exchange for honeydew, a major food source. In addition to being a good nurse tree for kerengga, this plant is valued for its medicinal properties and is grown locally by village communities. Mengkudu may, therefore, be a suitable candidate for inter-planting with species of mahogany like Khaya ivorensis, to assist in the establishment of kerengga. Further studies are underway to evaluate its potential.

Serangan anai-anai bawah tanah Asia mungkin meningkat di kawasan bandar di Malaysia

The danger of Asian subterranean termites in Malaysian urban areas

Anai-anai bawah tanah Asia, *Coptotermes gestroi* dari Asia Tenggara, merupakan spesies yang menyerang bangunan. Kajian Unit Entomologi FRIM baru-baru ini menunjukkan bahawa *C. gestroi* merupakan spesies perosak utama yang menyerang bangunan-bangunan di Asia Tenggara; sebelum ini, spesies ini dikenali dengan pelbagai nama yang lain di kawasan Asia Tenggara. Selain itu, spesies *Coptotermes* yang telah diperkenalkan secara tidak sengaja ke Amerika Utara dan Selatan, serta beberapa kawasan di Kepulauan Caribbean, juga telah dikenali sebagai anai-anai bawah tanah Asia.

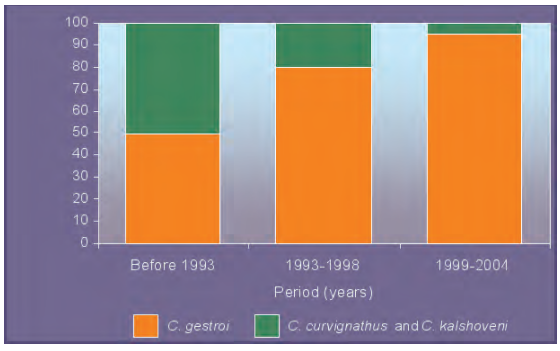
Sejak dua dekad yang lalu, serangan anai-anai *C. gestroi* ke atas bangunan di Semenanjung Malaysia semakin meningkat berbanding serangan spesies-spesies lain. Ini mungkin disebabkan spesies anai-anai ini semakin berjaya dalam pengkolonian kawasan bandar. Selain itu, perubahan dalam reka bentuk bangunan-bangunan moden serta kaedah pembinaan baru yang dianggap dapat menjimatkan kos, mungkin memudahkan spesies ini menyerang bangunan. Serangan *C. gestroi* yang semakin meningkat mungkin juga disebabkan oleh penyusutan dalam bilangan spesies *Coptotermes* lain di kawasan kota.

Anai-anai bawah tanah Asia kerap ditemui di dalam dan di luar bangunan. Spesies anai-anai yang lain, walaupun ditemui di perkarangan bangunan, jarang memasuki atau menyerang di dalam kawasan bangunan. Kajian FRIM telah berjaya mengenal pasti identiti spesies yang menyerang bangunan-bangunan di Malaysia. Pengenalpastian spesies perosak yang utama dan kajian keseriusan impaknya ke atas sektor pembinaan, akan membolehkan penumpuan strategi pengurusan perosak yang mantap ke atas spesies ini.

The Asian subterranean termite, Coptotermes gestroi, is a building-infesting termite species from Southeast Asia. Recent studies by the Entomology Unit of FRIM showed that it was the primary termite species infesting buildings in Southeast Asia, correcting the view that different pest species occurred in different countries. The species introduced to parts of North and South America and a number of Caribbean islands was also shown to be the Asian Subterranean Termite.

Over the last two decades there has been an increase in the proportion of building infestations by C. gestroi in Peninsular Malaysia. The most likely explanation for this trend is increased colonisation of urban areas over the years by this termite species. Other explanations could be that there may have been gradual changes in building design and construction that are predisposing modern buildings to infestations of this species, or that there is a decline in the abundance of other Coptotermes species in urban areas.

The Asian subterranean termite was shown to commonly occur both inside and outside buildings, unlike some other termite species, which were common outside buildings but rarely entered them. FRIM's studies have cleared confusion over the species that actually enter buildings in Malaysia. The narrowing down of the true pest species and the determination of their actual relative importance is enabling industry to focus termite management strategies on the species of greatest economic importance.



Graf menunjukkan peningkatan dalam serangan anai-anai bawah tanah Asia pada bangunan (warna jingga), berbanding spesies *Coptotermes* yang lain, dalam tiga tempoh masa.
The graph shows a rise in the proportion of building infestations by the Asian subterranean termite (orange), in comparison to other Coptotermes species, over three time periods.

Perhutanan tani tanaman tembakau di tanah bris
Agroforestry in tobacco farm on bris soil

Penggunaan kayu api sebagai bahan bakar masih lagi digunakan di negara ini dalam industri pembuatan batu-bata dan peleburan tebu di kilang serta pengawetan daun tembakau. Ada beberapa spesies yang dikenal pasti dan telah digunakan dalam aktiviti ini dan yang paling kerap digunakan ialah kayu getah. Akhir-akhir ini, bekalan kayu getah kian merosot akibat permintaan dan kos yang tinggi. Oleh itu, satu alternatif perlu dicari untuk menggantikan kayu getah sebagai bahan api.

Acacia, sejenis tumbuhan berkekacang telah dipilih memandangkan ia berupaya tumbuh di tanah bris dan dapat memberikan kadar pertumbuhan yang menggalakkan. Satu lagi kelebihan spesiaes ini ialah melalui kaedah perhutanan tani iaitu dengan menanam di sekeliling pokok tembakau yang dipanggil 'perimeter planting' ataupun di kawasan lapang atau kosong.

Terdapat beberapa faedah lain dengan menanam akasia di kawasan penanaman tembakau. Selain untuk dijadikan sebagai bahan bakar, akasia boleh digunakan untuk pembuatan perabot dan kayu gergaji pada masa hadapan. Spesies ini juga dikenali sebagai spesies pengikat nitrogen dan memperkaya nutrien dengan pengumpulan dan pereputan daun-daun di atas tanah. Ia juga boleh dijadikan pokok teduhan sebelum spesies bernilai komersial diperkenalkan di tengah-tengah pokok ini (*line planting*). Antara yang sedang dicuba ialah penanaman spesies herba iaitu tongkat ali dan kacip fatimah. Bunga-bunga akasia juga boleh dijadikan bahan makanan lebah dan secara tidak langsung boleh dimajukan sebagai kawasan ternakan lebah bagi penghasilan madu. Untuk jangka panjang, perhutanan tani akasia-tembakau akan dapat meningkatkan pendapatan petani tembakau melalui pembelbagaian produk.

Dua kawasan tanah BRIS telah dikenal pasti iaitu seluas 40 ha di Rhu Tapai, Merang, Terengganu dan 10 ha di Ayer Tawar, Tok Bali, Kelantan. Jenis tanah di kawasan ini ialah Rhu 2 dan Rhu Tapai dengan kadar nutrien rendah termasuk nitrogen, fosforus dan potasium. Kajian awal sosio ekonomi di kawasan ini menunjukkan 94% terdiri daripada penanam/petani lelaki dan selebihnya ialah penanam/petani wanita. Pekerjaan asal mereka kebanyakannya ialah nelayan yang hidup susah. Taraf pendidikan juga di tahap rendah dan hanya segelintir sahaja yang berjaya menamatkan pendidikan di peringkat menengah. Nelayan-nelayan ini telah diperuntuk keluasan tanah 1.34 ha sehingga 1.38 ha untuk dimajukan dengan penanaman tembakau. Mengikut perangkaan 2002, jumlah pengeluaran daun basah ialah sebanyak 3000 hingga 4000 kg bagi setiap hektar dan setiap penanam/petani. Purata pendapatan tahunan ialah sebanyak RM 26,000 di Rhu Tapai manakala di Ayer Tawar sebanyak RM 28,000.

Kajian keberkesanan pembakaran kayu akasia berbanding kayu getah telah dijalankan dengan kerjasama pihak Lembaga Tembakau Negara (LTN). Hasil menunjukkan selepas 144 jam pembakaran di rumah pembakaran sebanyak 3,775 kg kayu akasia dan 3080 kg kayu getah telah digunakan. Keberkesanan pembakaran yang diperoleh mendapati bahawa kedua-dua kayu ini mempunyai keberkesanan yang sama kecuali perbandingan penghasilan abu yang berbeza iaitu sebanyak 18 kg bagi kayu akasia dan 40 kg bagi kayu getah. Ini menunjukkan pembakaran kayu akasia mengurangkan kerja-kerja pembersihan kesan pembakaran kayu untuk aktiviti pengawetan ini.

Sejumlah 42 ha kawasan kosong di sekeling kawasan penanaman tembakau di Rhu Tapai dan 10 ha di Ayer tawar telah dibersihkan menggunakan jentera bagi penanaman akasia ini. Jarak antara pokok yang ditetapkan ialah 3 m x 3 m di samping pembuatan lubang tanaman seluas 1 m x 1 m x 1 m di kawasan yang telah dipancangkan. Bagi mendapatkan pertumbuhan akasia yang baik, tanah lapisan atas yang berkualiti hendaklah digunakan dan campuran baja penggalak akar dimasukkan ke dalam lubang terbabit. Aktiviti ini telah dijalankan pada musim hujan dari bulan Oktober hingga Januari. Sejumlah 3500 anak pokok akasia telah ditanam di Rhu Tapai dan 10,000 lagi di Ayer Tawar. Tiga spesies akasia telah ditanam di kawasan ini iaitu hibrid *Acacia* (*Acacia mangium* X *Acacia auriculiformis*), *Acacia mangium* dan *Acacia auriculiformis*. Hasil kajian pertumbuhan menunjukkan kadar kematian sebanyak 15% dan tiada kesan serangan perosak dan serangga pada pokok akasia sehingga kini. Purata ketinggian selepas 3 setengah tahun ditanam ialah 5.3 m manakala diamater ialah 5.4 cm.

Pembakaran kayu getah (a) dan kayu akasia (b)
Burning of rubberwood (a) and acaciawood (b)

Di samping itu, tongkat ali sebanyak 37,000 juga telah ditanam di tengah-tengah pokok *Acacia* untuk memberikan naungan kepada pokok ini. Hasil kajian menunjukkan kadar kehidupan ialah sebanyak 80%. Kematian yang tinggi ini disebabkan kesan penanaman secara terbuka terutama di tepi jalan atau di tepi kawasan kosong. Di samping itu ia menunjukkan kesan serangan ulat harimau yang menyebabkan peratus kematian adalah tinggi. Projek ini akan terus dipantau sehingga dirian berusia 7 tahun dan dijangka akan dituai untuk dijadikan bahan api dan juga kayu bagi kegunaan perabot. Gambaran tentang kepentingan ternakan lebah pada masa hadapan diambil kira dengan kematangan pokok akasia serta akan mengeluarkan bunga untuk kegunaan lebah tersebut.

Firewood is still in use in this country. It is used in brick making, as fuel for furnaces in sugarcane mills and dry kilns and for the curing of tobacco leaves. Several species of wood have been used as fuel but the most common is rubberwood. In recent years rubberwood supply has declined because of rising demand and costs. Thus there has been a search for alternatives to rubberwood as fuel.

Acacia, a leguminous plant was chosen because it grew well in bris soils, was easily planted and was a fast growing species. A further advantage was that the planting of Acacia could be achieved through an agroforestry approach and when done in tandem with tobacco farms usually took the form of perimeter planting and vacant space planting.

There are several benefits for planting Acacia in tobacco farms. Besides fuel, Acacia can be utilized for the production of furniture and as a leguminous plant could fix nitrogen and enrich the sub-fertile bris soil over the years. It's decomposing fallen leaves and small branches would add nutrients to the soil and other cash crops could be profitably planted in the inter-rows. These crops could include herbs such as Tongkat ali and Kacip fatimah. Since Acacia flowers abundantly, bee rearing could be undertaken as a profitable activity in parallel. In the long term Acacia-tobacco agroforestry would be able to improve the incomes of tobacco farmers through product diversification.

Two bris soil sites covering a total of 40 ha at Rhu Tapai, Terengganu and Ayer Tawar, Kelantan were selected. The soils at the sites were mainly Rhu 2 and Rhu Tapai series with very low nutrient content particularly nitrogen, phosphorus and potassium. Preliminary socio-economic studies revealed that 94% of the farmers were male and the remaining 6% were female. Most were formerly fishermen and poor. The level of education is low and very few completed their secondary education. These fishermen were relocated and given 1.34 to 1.38 ha of bris land for tobacco farming. In 2002 annual production of wet tobacco leaves was about 3000 to 4000 kg per ha per farmer and their annual income averaged about RM 26,000 in Rhu Tapai and RM 28,000 in Ayer Tawar respectively.

A preliminary study conducted jointly with the Lembaga Tembakau Negara evaluated the efficiency of burning acaciawood compared to rubberwood. After 144 hours of burning in a tobacco kiln the amount used was 3,775 kg for Acacia, and 3,080 kg for rubberwwod. While acaciawood used was more, the burning efficiencies for both types of wood were similar. Ash left after burning for acaciawood was 18 kg while rubberwood ash was 40 kg. The less ash produced meant that burning acaciawood reduced the need for extensive clearing of the furnaces and thus reduced maintenance activities.

A total of 42 ha vacant areas around tobacco farms at Rhu Tapai and another 10 ha at Ayer Tawar were cleared for the planting of Acacias. Lining were done with planting distance 3 m x 3 m and followed by big holing of 1 m x 1 m x 1 m dimension. Good quality top-soil mixed with rock phosphate was manually placed in each hole to provide better growth for Acacia in bris soil. At the onset of the rainy season in the month of October, 35,000 Acacia plants at one foot height were planted in Rhu Tapai and 10,000 plants in Ayer Tawar. These plants were Acacia hybrids that is Acacia mangium X Acacia auriculiformis. Three and half years after planting, the rate of growth of these plants were impressive with 15% casualty and no disease incidence. The average height was around 5.3 m while the diameter was around 5.4 cm.

Hibrid *Acacia* yang berusia tiga tahun di tanah bris
Three-year-old Acacia hybrids on bris soil

Tongkat ali di bawah pokok *Acacia*
Tongkat ali under Acacia

A total of 37,000 tongkat ali plants was also established in the inter-rows of the Acacia plants. A survival of approximately 80% was reported for these herbs. High casualty rates were noted at the Acacia farm fringes under direct sunlight. The surviving trees were regularly maintained particularly against tiger moth caterpillar attack. The project continues to be monitored and it is projected that at the seventh year, the Acacia plantation would be ready for harvesting as fuel wood and furniture wood. It is also envisaged that bee rearing would be an important addition once when the Acacia trees reach maturity and flowering takes place.

Minyak pati sebagai bahan pencegah nyamuk
Essential oils as mosquito repellents

Walaupun dengan perkembangan yang meluas dalam bidang sains perubatan di sepanjang dekad yang lalu, penyakit bawaan nyamuk seperti demam denggi, malaria dan Japanese encephalitis terus menjadi penyakit yang paling digeruni dan merupakan penyebab kematian jika tidak diambil langkah pencegahan. Kawalan-kawalan untuk mencegah penyakit boleh dilaksanakan sama ada di peringkat larva atau nyamuk dewasa. Aktiviti kawalan vektor nyamuk kini sangat bergantung pada penggunaan racun serangga dan bahan penghindar sintetik.

Baru-baru ini, dua sebatian metabolit sekunder daripada tumbuhan ubatan dan beraroma didapati berpotensi bagi mengawal nyamuk, khususnya *Aedes aegypti* yang merupakan salah satu vektor bagi penyakit ini. Kajian yang dijalankan di FRIM menunjukkan bahawa banyak tumbuhan beraroma seperti *Citrus hystrix, Ocimum tenuiflorum, Ocimum citriodorum, Pelargonium citrosum* dan *Pogostemon cablin* yang menunjukkan aktiviti larvisidal dan pencegahan apabila diuji terhadap larva instar ketiga serta ujian pencegahan nyamuk. Keberkesanan minyak pati tersebut dalam menghalang gigitan nyamuk terutamanya *A. aegypti* dinilai menggunakan satu kit pencegah berdasarkan kaedah piawaian E951-83 [American Society Testing and Materials (ASTM)] dan diuji terhadap manusia secara sukarela. Minyak pati yang paling berkesan ialah *O. citriodorum* dan *C. hystrix* dengan nilai EC_{50} berjulat daripada 0.00047 sehingga 0.00768 mg cm^{-2}.

Aktiviti minyak pati ini biasanya dikaitkan dengan kehadiran sebatian monoterpena yang terdapat di dalam minyak pati tersebut seperti a-pinena, sitronellol, sitronellal, geraniol dan sitral. Komponen-komponen ini telah diuji secara individu dan menunjukkan sifat-sifat pencegahan yang tinggi terhadap nyamuk *A. aegypti*. Penyelidikan semasa terhadap minyak pati di FRIM, kini menjurus ke arah pemahaman kesan terapeutik tumbuhan terhadap perlindungan kulit, penyakit kulit dan pembangunan produk nilai-tambah menggunakan minyak pati berbioaktif. Kajian penyelidikan seperti ini akan memberi panduan untuk pembangunan mampan tumbuhan beraroma dari Malaysia bagi menghasilkan produk kosmeseutikal nobel dan produk penghindar nyamuk.

Despite the great advances in medical sciences in the past decade, mosquito-borne diseases such as dengue fever, malaria and Japanese encephalitis continue to be the most feared of all diseases with death as the inevitable result, if prevention was not instituted. Disease prevention usually targeted the larval or the adult stages of mosquitoes by chemical insecticides and synthetic repellents.

Recently, new compounds from secondary metabolites of medicinal and aromatic plants have been discovered to have great potential in the control of mosquitoes; particularly the mosquito Aedes aegypti one of the primary vectors of these diseases. Research studies in FRIM have shown that many aromatic plants such as Citrus hystrix, Ocimum tenuiflorum, Ocimum citriodorum, Pelargonium citrosum and Pogostemon cablin showed promising larvicidal and mosquito repellency properties when tested against the third instar larvae of A. aegypti. Mosquito repellency properties were assessed using a repellency kit with human volunteers. All tests methodologies followed the American Society Testing and Materials (ASTM) standard E951-83. Results showed that the most effective repellants were the essential oils of O. citriodorum and C. hystrix with EC_{50} values ranging from 0.00047 to 0.00768 mg cm^{-2} respectively.

The activity of the essential oils was correlated to the presence of monoterpene compounds in the oils such as a-pinene, citronellol, citronellal, geraniol and citral. These compounds, when individually tested, showed high repellent properties against A. aegypti. Essential oil research at FRIM is currently also directed towards a better understanding of the therapeutic effects of these oils on skin-related conditions and as a protectant for skin. It is hoped that these research activities on these bioactive essential oils will result in the development of novel cosmeceutical and mosquito repellent products.

Kawalan kualiti tongkat ali dan pegaga dengan kit proteomik sehenti
Quality control of Tongkat ali and Pegaga with a One-stop Proteomic kit

Penggunaan ekstrak *Eurycoma longifolia* dan *Centella asiatica* semakin bertambah di Malaysia dan di negara-negara jiran kerana meningkatnya pengetahuan saintifik tentang manfaat terapeutiknya. Banyak produk makanan seperti kopi dan minuman tonik menggunakan ekstrak ini. Dengan meningkatnya permintaan terhadap produk ini, harga ekstrak tersebut di pasaran turut meningkat. Bagaimanapun kualiti ekstrak yang terdapat di pasaran adalah berbeza-beza disebabkan tiadanya pemantauan dari segi kawalan mutu pada masa ini.

Ketulenan ekstrak *E. longifolia* dan *C. asiatica* di dalam produk komersial boleh ditentukan melalui ujian proteomik yang menggunakan gel elektroforesis dua dimensi (2 DE). Teknik ini melibatkan pemisahan protein yang menunjukkan kualiti *E. longifolia* dan *C. asiatica* menggunakan teknik 2 DE.

Protokol tersebut telah dibangunkan untuk menguji ketulenan produk komersial yang mengandungi ekstrak *E. longifolia* dan *C. asiatica.* Sebanyak satu miligram ekstrak larut air dicampurkan dengan larutan penimbal sampel dan larutan rehidrasi. Selepas rehidrasi pasif, protein tersebut diasingkan berdasarkan takat isoelektriknya. Seterusnya protein diasingkan berasaskan berat molekulnya dan kemudian diwarnakan dalam larutan perak, dan ini menghasilkan peta protein. Peta protein menunjukkan ketekalan dan kebolehulangan yang tinggi dengan tompok protein yang jelas apabila diulang. Tahap ketulenan protein dapat dihasilkan menerusi perbandingan dengan peta protein piawai yang telah dihasilkan pada kajian proteomik yang terdahulu. Kesemua protokol serta unsur utama dikumpulkan di dalam satu kit yang dipanggil kit proteomik sehenti. Kaedah yang dibangunkan boleh dipercayai, mudah digunakan dan telah disahkan secara saintifik untuk penentuan kualiti ekstrak yang terdapat di pasaran.

Dengan pembangunan protokol kit proteomik sehenti ini untuk penyaringan ekstrak E. *longifolia* dan C. *asiatica*, pengeluar produk tongkat ali dan pegaga boleh menentukan kualiti ekstrak yang dibeli daripada pembekal serta dapat mengesahkan bahawa ekstrak ini memenuhi spesifikasi ketulenan.

The use and consumption of Eurycoma longifolia and Centella asiatica extracts have increased in Malaysia and neighbouring countries due to the increased scientific understanding of their therapeutical benefits. Many food products for example coffee and tonic drinks incorporate these extracts. With greater demand for these products, the price of these extracts in the market has increased. However, extracts available in the market vary in quality as reliable quality control monitoring is currently unavailable.

The purity of E. longifolia and C. asiatica extracts in a given commercial product can be determined through proteomic studies vis-à-vis Two-Dimensional Gel Electrophoresis (2DE). This technique involves the separation of proteins that reflects the quality of E. longifolia and C. asiatica present in a product. FRIM has taken the initiative to develop a standard protein map of water-soluble extracts of E. longifolia and C. asiatica via this 2DE technique.

Further to the development of the standard protein map of these extracts, a protocol was developed to test the purity of commercial products containing E. longifolia and C. asiatica extracts. The protocol involved taking one milligram of the water-soluble extracts and mixing it with a sample buffer and a rehydration solution. After passive rehydration, the proteins were separated based on their isoelectric points (pI). The proteins were further separated based on their molecular weights. These separated proteins were then stained with a silver solution and a protein map obtained. The protein map showed high consistency and reproducibility with good visibility of protein spots when repeated. The level of purity of the proteins can then be established through a comparison with the standard protein map developed in earlier proteomic studies. The whole protocol together with key constituents was bundled together in a kit called a One-stop Proteomic Kit. The method developed was found to be reliable, easy to use and scientifically valid for determining the quality of extracts available in the market.

With the development of the protocol for screening extracts of E. longifolia and C. asiatica using the One-stop Proteomic Kit, producers of Tongkat ali and Pegaga products would be able to determine the quality of the extracts purchased from their suppliers and to verify that the extracts meet their specifications in terms of purity.

Penentuan piawaian bagi ujian biji benih tropika
Establishment of standards for testing tropical seeds

Makmal Teknologi Biji Benih FRIM telah berjaya menentukan suatu piawai pengujian ke atas biji benih pokok tropika. Sebagai permulaan, penumpuan telah diberikan ke atas dua belas spesies iaitu *Acacia mangium, Sindora echinocalyx, Intsia palembanica, Peltophorum pterocarpum, Tectona grandis, Swietenia macrophylla, Dyera costulata, Koompassia malaccensis, Shorea leprosula, Shorea parvifolia, Shorea ovalis* dan *Shorea macroptera*. Melalui kajian ke atas piawaian ini, bilangan biji benih yang minimum dapat menentukan tahap nilai dan kualiti biji benih sebelum ditanam. Sehingga kini, piawai tersebut telah dijadikan sebagai rujukan dalaman bagi Makmal Teknologi Biji Benih yang telah diakreditasikan MS ISO 9001:2000 sejak tahun 2002. Bagi penggunaan secara meluas, piawaian ini juga boleh digunakan oleh agensi-agensi lain seperti Jabatan Perhutanan, sektor perladangan swasta, tapak semaian swasta, sektor pertanian, agensi kerajaan yang bertanggungjawab dalam pengawalan biji benih dan lain-lain yang berkenaan. Dengan demikian, ia dapat dijadikan piawai kebangsaan bagi pengujian kualiti biji benih spesies balak tropika. Usul piawai ini akan dicadangkan kepada pihak *International Seed Testing Association* (ISTA) untuk dijadikan piawai kebangsaan bagi pengujian kualiti biji benih pokok tropika seluruh dunia. Dengan kewujudan piawai tersebut, FRIM dapat memperkenal dan mengkomersialkan perkhidmatan pengujian biji benih pokok tropika selaras dengan kehendak MS ISO 9001:2000.

The seed technology laboratory of FRIM successfully established the seed testing standard for testing tropical tree seeds with first focusing on twelve tropical tree species namely Acacia mangium, Sindora echinocalyx, Intsia palembanica, Peltophorum pterocarpum, Tectona grandis, Swietenia macrophylla, Dyera costulata, Koompassia malaccensis, Shorea leprosula, Shorea parvifolia, Shorea ovalis and Shorea macroptera. With the development of this standard, the value and quality of seeds (moisture content and germination capacity) before planting can be determined without sacrificing a large number of seeds. Nevertheless this standard now acts as in-house reference for the Seed technology laboratory of FRIM. In wider application this standard can be used by other agencies such as the Forest Department, private plantation sector, private nurseries, agricultural sector, government agency responsible for seed control and etc. and thus being the national standard for testing tropical tree seeds. This standard will also be proposed to the International Seed Testing Association (ISTA) as a standard for tropical timber seeds. With the existence of this standard, FRIM will be able to commercialize the seed testing services in line with the MS ISO 9001:2000.

PERHIMPUNAN AGUNG YANG KEENAM, SIMPOSIUM ISME DAN BENGKEL GLOMIS

ISME SIXTH GENERAL ASSEMBLY, SYMPOSIUM AND GLOMIS WORKSHOP

Perhimpunan Agung yang Keenam, Simposium Persatuan Ekosistem Hutan Paya Laut Antarabangsa (ISME) dan Bengkel GLOMIS telah diadakan dari 22 hingga 26 Ogos di Hotel Pan Pacific Kuala Lumpur, dan dianjurkan oleh ISME dan FRIM. ISME ditubuhkan pada tahun 1990 bagi menggalakkan penyelidikan, pemuliharaan, pengurusan dan penggunaan ekosistem hutan paya laut secara mampan. Pada tahun 1992 satu piagam ekosistem paya laut yang menggariskan prinsip-prinsip umum, fungsi dan pelaksanaan pemuliharaan, pengurusan dan pembangunan secara mampan hutan paya laut dunia telah diguna pakai.

Lapan puluh orang delegasi dari Perancis, Jepun, Ghana, Indonesia, Thailand, Vietnam, New Zealand, Fiji, China (Hong Kong) dan Malaysia telah hadir. Lima ratus peserta tempatan dari Jabatan Perhutanan, pusat-pusat pengajian tinggi dan badan-badan bukan-kerajaan (NGO) yang terlibat dengan penyelidikan hutan paya laut serta orang awam turut hadir sebagai peserta. Perhimpunan Agung dan Simposium telah dirasmikan oleh Ketua Setiausaha, Kementerian Sumber Asli dan Alam Sekitar, Y.Bhg. Datuk Dr. Isahak Yeop Mohamad Shar. Dalam ucapan pembukaannya, beliau menekankan tentang kepentingan pembangunan dan pengurusan hutan paya laut dan sumber-sumber pantai secara mampan demi memenuhi keperluan ekonomi, ekologi, budaya, manusia dan sosial bagi generasi sekarang dan akan datang. Dialog media yang melibatkan wakil-wakil dari ISME, UNDP-GEF, Wetlands International dan GLOMIS bersama-sama wakil-wakil media telah diadakan selepas majlis perasmian untuk menerangkan tentang kepentingan hutan paya laut dan sumber-sumber pantai. Dr. Chan Hung Tuck, Pengarah Bahagian Pengurusan Penyelidikan, FRIM telah dilantik sebagai salah seorang daripada Naib Presiden Lembaga Eksekutif ISME.

Tema simposium hutan paya laut ialah "*The Importance of Mangrove and Other Coastal Ecosystems in Mitigating Tsunami Disasters*". Simposium ini adalah selaras dengan projek ITTO yang bertajuk,"*Revised World Atlas of Mangrove for the Conservation and Restoration of Mangrove Ecosystems*". Dua ucaptama yang dibentangkan pada simposium ini menyentuh tentang sebab-sebab terjadinya tsunami secara umum dan kesan tsunami pada 26 Disember 2004 ke atas sumber-sumber pantai dan pemulihan sumber-sumber ini di pelbagai negara di sekitar Lautan Hindi. Aktiviti Simposium tersebut termasuklah sesi serentak yang membincangkan tentang isu-isu pengurusan pantai secara bersepadu serta kerosakan akibat tsunami dan pemulihannya. Sebelas kertas kerja telah dibentangkan dalam sesi serentak ini. Pameran poster yang memperinci keputusan dan cadangan daripada penyelidikan hutan paya laut dari Vietnam, Indonesia, Thailand dan Malaysia telah diadakan sempena Simposium ini.

Ketua Setiausaha NRE menyampaikan ucapan perasmian
Secretary General of the NRE, giving the opening address

Bengkel Pangkalan Data dan Sistem Maklumat Hutan Paya Laut Dunia (GLOMIS) telah diadakan semasa perhimpunan agung dan simposium. GLOMIS yang merupakan projek ISME dengan pembiayaan Pertubuhan Antarabangsa Kayu-Kayan Tropika (ITTO) mempunyai empat pusat serantau yang terletak di Brazil, Fiji, Ghana dan Malaysia (FRIM) masing-masing mewakili Amerika Latin, Oceania, Afrika dan Asia. Isu-isu yang timbul daripada laporan oleh empat pusat serantau beserta perbincangan tentang masa depan GLOMIS telah diadakan semasa bengkel tersebut. Isu-isu lain seperti pengumpulan data bagi pangkalan datanya, penyemakan semula perkataan utama (*Keyword*), analisis jurang dan publisiti untuk GLOMIS turut dibincangkan.

Presiden ISME Dr. Aprilani Soegiarto menyampaikan ucapan pada Simposium
President of ISME, Dr. Aprilani Soegiarto addressing the Symposium

Peserta sedang melawat pameran poster
Participants viewing the poster presentations

Satu lawatan lapangan ke Hutan Paya Laut Matang di Perak telah diadakan pada 25 Ogos. Lawatan tersebut diabadikan melalui majlis menanam pokok hutan paya laut iaitu *Rhizophora stylosa* dan *Avicennia lanata* di Arboretum Hutan Matang oleh pegawai-pegawai ISME. Pelawat turut dibawa ke hutan paya laut Hutan Simpanan Hutan Dara (VJR), kawasan pemulihan hutan, kawasan tebangan hutan, kawasan pembiakan ikan dan kerang serta tanur arang.

Pihak delegasi ternyata begitu berpuas hati dengan penganjuran perhimpinan agung, simposium dan Bengkel GLOMIS ini. Kerjasama dan sumbangan Jabatan Hutan Perak, UNDP-GEF, Wetland International, ITTO dan agensi Perhutanan yang lain sangatlah dihargai.

The International Society for Mangrove Ecosystems (ISME) Sixth General Assembly, Symposium and GLOMIS workshop was successfully organized from the 22 to 26 August at the Pan Pacific Hotel in Kuala Lumpur, Malaysia. The event was jointly organized by ISME and FRIM. ISME was established in 1990 to promote research, conservation, rational management and sustainable use of mangrove ecosystems and in 1992 a charter for mangrove ecosystems was adopted setting out general principles, functions and means of implementations for the conservation and management and sustainable development of mangroves in the world.

A total of 80 delegates representing countries from France, Japan, Ghana, Indonesia, Thailand, Vietnam, New Zealand, Fiji, China (Hong Kong) and Malaysia were in attendance. About 500 local participants from the Forestry Department, various Universities and Non-governmental organization (NGO'S) engaged in mangrove research and members of the general public were also represented. The General Assembly and Symposium were officially opened by the Secretary General of the Ministry of Natural Resources and the Environment (NRE), Y.Bhg. Datuk Dr. Isahak Yeop Mohamad Shar. His opening address emphasized the importance of sustainable development and management of mangroves and coastal resources for the economic, ecological, cultural, human and social needs of present and future generations. A Media dialogue was held after the opening ceremony and involved representatives from ISME, UNDP-GEF, Wetlands International and GLOMIS together with members of the press to highlight the importance of mangroves and coastal resources. In addition, Dr. Chan Hung Tuck, Director of the Research Management Division, FRIM was also appointed to one of the two new positions of Vice President of ISME Executive Council.

The theme of the mangrove symposium was "The Importance of Mangrove and other Coastal Ecosystems in Mitigating Tsunami Disasters". This Symposium was in line with the ITTO project entitled "Revised World Atlas of Mangrove for the Conservation and Restoration of Mangrove Ecosystems". Two keynote addresses presented at the symposium dealt with the causes of tsunamis in general and the effect of the 26 December 2004 tsunami on coastal resources and its rehabilitation in the various nations surrounding the Indian Ocean. Activities of the symposium included concurrent sessions dealing with issues of integrated coastal management and tsunami damage and rehabilitation. A total of 11 papers were presented in the concurrent sessions. A poster exhibition detailing results and recommendations from research in mangroves from Vietnam, Indonesia, Thailand and Malaysia was held in conjunction with the event.

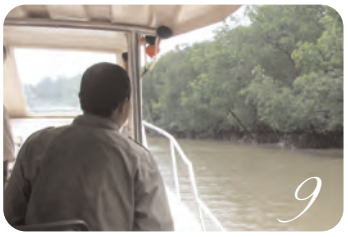
A Global Mangrove Database and Information System (GLOMIS) workshop was conducted during the general assembly and symposium. GLOMIS which is an on-going project of ISME with financial support from the International Tropical

Dr. Chan Hung Tuck menyampaikan ucapan pada majlis
Dr. Chan Hung Tuck addressing the delegates

Timber Organisation (ITTO) has four regional centres located in Brazil, Fiji, Ghana and Malaysia (FRIM) covering the Latin Americas, Oceania, Africa and Asia respectively. Issues arising from the reports from the four regional centres with general discussions on the future of GLOMIS and its sustainability were held during the workshop. Other issues such as data collection for the database, review of keywords, gap analysis and publicity for GLOMIS were also discussed.

A field excursion to the Matang Mangroves in Perak was organized on the 25 August. The visit was commemorated in a planting ceremony of Rhizophora stylosa and Avicennia lanata mangrove plants in the Matang forest arboretum by ISME officials. The visit included stops at the Matang Virgin Jungle Reserve (VJR) mangrove forest, forest rehabilitation areas, forest harvesting areas, fish and cockle culture areas and a charcoal kiln situated nearby.

The general assembly, symposium and GLOMIS workshop was regarded by many as one of the best ever held and the event left a memorable impression on the delegates. In this context the assistance and contributions of the Forestry Department of Perak, the UNDP-GEF and other forest related agencies are gratefully acknowledged.



1 Pelantar jalan di Matang memberi banyak maklumat tentang jenis pokok yang terdapat di kawasan paya laut
The board-walk at Matang has lots of information on the kinds of trees found in the mangrove area

2 Pelantar jalan yang membawa peserta ke tempat acara menanam pokok
Board-walk leading to the tree planting ceremony

3 Menteri NRE Y.B. Dato' Seri Hj. Adenan Hj. Satem di hutan paya laut Matang
Minister of the NRE Y.B. Dato' Seri Hj. Adenan Hj. Satem at the Matang mangroves

4 Chris Gordon, Penyelaras antarabangsa GLOMIS menyertai acara menanam pokok
Chris Gordon, GLOMIS International Coordinator participating in the planting ceremony

5 Dr. Salif Diop bakal Presiden ISME sedang menanam pokok
Dr. Salif Diop, incoming President of ISME participating in the planting ceremony

6 Bilet kayu bakau dipunggah ke jeti untuk dihantar ke tanur arang berdekatan
Bakau billets loaded at a makeshift jetty for the charcoal kilns situated nearby

7 Kultur ikan dalam sarang terapung
Fish culture in floating cages

8 Tanur arang dinyalakan untuk membuat arang
A charcoal kiln being fired up to make charcoal

9 Menyusuri hutan paya laut Matang menggunakan bot
Participants touring Matang mangroves by boat

10 Menternak kerang di hutan paya laut Matang
Harvesting cockles in Matang mangroves

PETUNJUK PRESTASI UTAMA
KEY PERFORMANCE INDICATORS

Objektif

- Menjana pengetahuan dan membangunkan teknologi yang bersesuaian untuk pemuliharaan, pengurusan, pembangunan dan penggunaan sumber-sumber hutan
- Menyediakan perkhidmatan berasaskan penyelidikan yang memenuhi keperluan pelanggan
- Mengkomersialkan hasil-hasil penyelidikan dan pembangunan
- Memperoleh serta menyebar maklumat
- Meningkatkan kesedaran terhadap peranan alam sekitar dan pemuliharaan hutan
- Mencapai kecemerlangan dan memperoleh kepimpinan dalam penyelidikan hutan tropika

Petunjuk Prestasi Utama

- Pemindahan teknologi kepada industri perhutanan melalui seminar, kursus dan bengkel
- Peningkatan perkhidmatan teknikal kepada industri perhutanan untuk menghasilkan produk yang berkualiti
- Pengkomersialan hasil penyelidikan melalui khidmat perundingan dan projek kerjasama
- Penggalakan kesedaran peranan hutan dan kepentingan pemeliharaan hutan
- Peningkatan prestasi dan kecekapan kakitangan melalui program pembangunan sumber manusia yang berterusan

Objectives

- *To acquire knowledge and to develop technology that is pertinent to the conservation, management, development and utilisation of forestry resources*
- *To meet the needs of clients through extension of services based on research*
- *To commercialise R&D findings*
- *To obtain and disseminate knowledge*
- *To promote awareness on the role of environment and forestry conservation*
- *To achieve excellence and to gain leadership in tropical forestry research*

Key Performance Indicators

- *Technology transfer to forestry based industries through seminars, courses and workshops*
- *Extension of technical services to enable the manufacture of quality products by the forestry based industries*
- *Commercialisation of research findings through consultancy*
- *Services and collaborative projects*
- *Promotion of awareness on the role of forests and the importance of forestry conservation*
- *Improvement of staff performance and efficiency through continuous human resource development*

PETUNJUK PRESTASI UTAMA
KEY PERFORMANCE INDICATORS

Pencapaian *Achievement*	2003	2004	2005
Jumlah projek penyelidikan IRPA *Total number of IRPA projects*	79	111	32
Jumlah penerbitan yang dihasilkan *Total number of publications*	563	588	665
Tesis *Theses*	2	13	9
Dialog dengan industri *Dialogues with the industries*	0	14	1
Seminar dan bengkel *Seminars and workshops*	33	72	76
Bilangan kilang perusahaan kecil yang menerima faedah daripada R&D *Number of factories SMI's that benefited from R&D*	31	38	14
Bilangan kilang yang menggunakan mesin atau teknologi FRIM *Number of factories that used FRIM's equipment or technology*	239	139	212
Ladang hutan yang ditubuhkan dengan khidmat nasihat FRIM *Forest plantations established using FRIM's advisory services*	12	0	1
Kuantiti biji benih spesies hutan yang dikutip (kg) *Quantity of forest tree seeds collected (kg)*	500	727	771
Latihan teknikal *Number of technical training*	26	40	26
Bilangan paten dan inovasi *Number of patents and innovations*	3	18	3
Bilangan ujian yang dijalankan ***Number of tests conducted***			
• Pintu rintangan api *Fire doors*	15	13	11
• Perabot *Furniture*	250	286	0
• Awetan kayu *Wood preservation*	1,771	1,295	2,920
• Ujian keteguhan kayu *Plywood testing*	39	15	12
• Kenal pasti kayu *Wood identification*	2,025	1,253	1036
• Ujian komposit kayu *Wood composite test*	-	-	175
• Ujian fungi *Fungus test*	-	-	5
• Ujian ubatan herba *Medicinal herbs test*	-	-	172
Khidmat perundingan *Consultancy services*	14	94	16
Bilangan projek penyelidikan dengan agensi luar *Number of research projects with external agencies*	28	35	20
Pameran *Exhibitions*	10	14	2
Jumlah pelawat ke FRIM *Total number of FRIM visitors*	70,000	52,640	61,902

ANUGERAH DAN PELANTIKAN
AWARDS AND APPOINTMENTS

ANUGERAH BINTANG KEBESARAN
HONORARY AWARDS

Pada tahun ini, Dr. Mohd. Nor Yusof, Pengarah Program Kimia Kayu, Bahagian Pembangunan Produk telah menerima pingat Kesatria Mangku Negara (KMN) manakala En. Md. Nasir Dayat menerima Pingat Pangkuan Negara (PPN) daripada Seri Paduka Baginda Yang di-Pertuan Agong pada 4 Jun 2005.

During the year Dr. Mohd. Nor Yusof, Director of Wood Chemistry Programme of the Product Development Division received the Kesatria Mangku Negara (KMN) award while En. Md. Nasir Dayat received the Pingat Pangkuan Negara (PPN) from his Majesty Seri Paduka Baginda Yang di-Pertuan Agong on 4 June 2005.

Dr. Mohd. Nor Yusof sedang menerima pingat KMN daripada Seri Paduka Baginda Yang di-Pertuan Agong
Dr. Mohd.. Nor Yusof was conferred KMN by His Majesty Seri Paduka Baginda Yang di-Pertuan Agong

En. Md. Nasir Dayat sedang menerima pingat PPN daripada Seri Paduka Baginda Yang di-Pertuan Agong
En. Md. Nasir Dayat was conferred PPN by His Majesty Seri Paduka Baginda Yang di-Pertuan Agong

En. Lim Seng Choon sedang menerima pingat AMP daripada DYMM Paduka Seri Sultan Perak Darul Ridzuan
Mr. Lim Seng Choon was conferred the AMP by His Majesty DYMM Paduka Seri Sultan of Perak Darul Ridzuan

Sempena Hari Keputeraan Paduka Seri Sultan Perak Darul Ridzuan pada 18 Jun 2005, baginda telah menganugerahi dua orang pegawai FRIM, En. Lim Seng Choon dan En. Abdul Halim Jawi masing-masing pingat Ahli Mahkota Perak (AMP) dan Darjah Ahli Cura Si Manja Kini (ACM). Manakala seorang kakitangan Kumpulan Sokongan, Pn. Dasima Ramudin dianugerahi Pingat Jasa Kebaktian (PJK).

His Majesty Paduka Seri Sultan of Perak Darul Ridzuan in commemoration of his birthday on the 18 June 2005 awarded the Ahli Mahkota Perak (AMP) and Darjah Ahli Cura Si Manja Kini (ACM) to two officers, Mr. Lim Seng Choon and En. Abdul Halim Jawi respectively. Pn. Dasima Ramudin a supporting staff was also awarded the Pingat Jasa Kebaktian (PJK).

ANUGERAH TOKOH PEKERJA KEBANGSAAN
NATIONAL OUTSTANDING EMPLOYEE AWARD

Dr. Rahim Sudin menerima anugerah daripada YAB Perdana Menteri
Dr. Rahim Sudin receiving the award from the Honourable Prime Minister

FRIM turut berbangga apabila Dr. Rahim Sudin, Pengarah Program Pembinaan dan Perlindungan Kayu, Bahagian Pembangunan Produk diberi penghormatan untuk menerima Anugerah Tokoh Pekerja Lelaki sempena sambutan Hari Pekerja pada 7 Mei 2005 daripada Perdana Menteri Malaysia, YAB Dato' Seri Abdullah Ahmad Badawi di Stadium Nasional Bukit Jalil.

It was a proud moment for FRIM when Dr. Rahim Sudin, Director of the Timber Construction and Wood Preservation Programme of the Product Development Division in FRIM received the honored Anugerah Tokoh Pekerja Lelaki during the Labour Day Celebrations held on the 7 May 2005 from the Honourable Prime Minister at the Bukit Jalil Stadium.

ANUGERAH INOVASI
INNOVATION AWARDS

Saintis FRIM turut memenangi beberapa anugerah inovasi di peringkat tempatan dan antarabangsa pada tahun 2005 iaitu:

A number of local and international innovation awards were won by FRIM scientists in 2005:

Kategori Pingat Perak / *Silver Awards Category*

- *Mohd. Ilham, A., Mohd. Radzi, A., Abu Said, A. and Abdull Rashih, A. B3A-1: Multipurpose applicator. 16th International, Invention, Innovation, Industrial Design and Technology Exhibition (ITEX), Putra World Trade Centre (PWTC), 19 to 21 May 2005*

- *Abdul Hamid, S., Hashim, W.S., Zaihan, J. and Puad, E. Laminated furniture component from oil palm trunk. 16th International, Invention, Innovation, Industrial Design and Technology Exhibition (ITEX), Putra World Trade Centre (PWTC), 19 to 21 May 2005*

- *Abdul Hamid, S., Zulkifli, A., Zaihan, J., Hashim, W.S., Syarmiza Anuar, A.R., Arshad, O. and Ab. Jalil, M. Multi-design of furniture of Oil Palm LVL. 16th International, Invention, Innovation, Industrial Design and Technology Exhibition (ITEX), Putra World Trade Centre (PWTC), 19 to 21 May 2005*

- *Mohamad Omar, M.K. Non-destructive testing systems based on ear-brain analogy. 16th International, Invention, Innovation, Industrial Design and Technology Exhibition (ITEX), Putra World Trade Centre (PWTC), 19 to 21 May 2005*

- *Nurhanan Murni, Y., Mohd. Ilham, A., Rafedah, A., Mohd. Radzi, A. and Abdull Rashih, A. Standardised extract of Centella asiatica (SECA-5) for industrial application. 16th International, Invention, Innovation, Industrial Design and Technology Exhibition (ITEX), Putra World Trade Centre (PWTC), 19 to 21 May 2005*

- *Amin, I., Ruzaidi, A.M.M., Azizah, O., Faizul, H.A., Nawalyah, A.G., Asmah, R., Hamid, M., Zulkhairi, A., Mohamad Taufik, H.B. and Mohd. Ilham, A. Cocoa polyphenols-rich extract: a source of nutraceuticals and food antioxidants. 16th International, Invention, Innovation, Industrial Design and Technology Exhibition (ITEX), Putra World Trade Centre (PWTC), 19 to 21 May 2005*

- *Wan Asma, I., Rosenani, A.B., Wan Rasidah, K. and Aminuddin, H. Conversion of oil palm empty fruit bunches into a mulch mat for establishment of forest species on sandy soils. UPM, Serdang, Selangor. Invention, Research and Innovation Exhibition 2005, UPM, 16 to 17 March*

Kategori Pingat Gangsa / Bronze Awards *Category*

- *Hashim, W.S., Puad, E., Zaihan, J, Chuah, K.H. and Mohd. Dahlan, J. Non structural laminated veneer lumber from oil palm trunks. 16th International, Invention, Innovation, Industrial Design and Technology Exhibition (ITEX), Putra World Trade Centre (PWTC), 19 to 21 May 2005*

- *Mastura, M., Mazurah, M.I., Saiful Azmi, J., Mailina, J. and Hannan, A.W. 3 in 1 NaturaPreservative. 16th International, Invention, Innovation, Industrial Design and Technology Exhibition (ITEX), Putra World Trade Centre (PWTC), 19 to 21 May 2005*

- *Saeid Reza, D.J., Mastura, M., Mazurah, M.I., Saiful Azmi, J., Nor Datiakma, M.A., Hannan A.W. and Marzalina, M. Sayonara MRSA. 16th International, Invention, Innovation, Industrial Design and Technology Exhibition (ITEX), Putra World Trade Centre (PWTC), 19 to 21 May 2005*

- *Ahmad Shakri M.S. and Zaihan, J. Bentwood products for joinery and furniture components. R&D from IPTA Exhibition. PWTC, 30 September to 2 October 2005*

- *Nor Azah, M.A., Mawardi, R., Abdul Manaf, A. and Khozirah, S. Chemical and biological properties of some Cinnamomum species. Invention, Research and Innovation Exhibition 2005, UPM, 16 to 17 March 2005*

- *Kodi Isparan, K. Tropicalised plant-weaning system for the acclimatizing tissue-culture derived plantlets. 33rd International Invention and Innovation Exhibition 2005, Geneva, Switzerland, 6 to 10 April 2005*

Anugerah AIPB / *AIPB Award*

- *Choo, K.T., Tan, Y.E., Sik, H.S. and Ramzul Ikhlas, A.L. Accelerated drying system for production of eco-friendly rubberwood stock with minimum preservative requirement for furniture export market. Anugerah Inovasi Penyelidikan Bersama Antara Sektor Awam dan Sektor Swasta (AIPB), 17 to 18 November 2005*

ANUGERAH KUALITI
QUALITY AWARDS

Anugerah MS ISO9001:2000 Sijil Akreditasi
MS ISO 9001:2000 Certificate of Accreditation Award

Pada Julai 2005 Makmal Genetik, Bahagian Bioteknologi telah mendapat sijil akreditasi MS ISO 9001:2000 daripada SIRIM QAS.

Manakala Makmal Teknologi Biji Benih, dari Bahagian yang sama telah diberi lanjutan sijil akreditasi MS ISO9001:2000 hingga September 2008. Akreditasi ini pertama kali diberi pada September 2002.

In July 2005 the Genetics Laboratory, of the Biotechnology Division was awarded the MS ISO 9001:2000 certificate of accreditation from SIRIM QAS.

Similarly, the Seed Technology Laboratory in the same division was awarded an extension of its certificate of accreditation for MS ISO9001:2000 to September 2008. The accreditation was originally awarded in September 2002.

Sijil MS ISO 9001:2000 daripada SIRIM QAS untuk Makmal Teknologi Biji Benih
MS ISO9001:2000 Certificate of accreditation from SIRIM QAS for Seed Technology Laboratory

Sijil MS ISO 9001:2000 daripada SIRIM QAS untuk Makmal Genetik
MS ISO 9001:2000 certificate of accreditation from SIRIM QAS for the Genetics Laboratory,

Anugerah Sijil Akreditasi MS ISO/IEC 17025
MS ISO/IEC 17025 Certificate of Accreditation Award

Pada bulan Jun dan September 2005, Makmal Ujian Komposit Kayu dan Makmal Perlindungan Api FRIM masing-masing menerima sijil akreditasi MS ISO/IEC 17025:2001 daripada Skim Akreditasi Makmal-Makmal Malaysia (SAMM), Jabatan Standard Malaysia. Kedua-dua akreditasi adalah untuk tahun 2005 hingga 2008.

In June and September 2005 the Wood Composites Testing Laboratory and Fire Protection Laboratory of FRIM were respectively awarded the MS ISO/IEC 17025:2001 certificates of accreditation by Skim Akreditasi Makmal-Makmal Malaysia (SAMM), Department of Standards Malaysia. The accreditations were for the years 2005 to 2008.

Sijil Anugerah Kepujian bagi Makmal Kimia IKM
Certificate of the IKM Laboratory Excellence Award

Anugerah Kepujian Kualiti IKM
IKM Excellent Quality Award

Pemenang-pemenang Anugerah Kepujian Kualiti IKM
Winners of the IKM Excellence Awards

Makmal Ujian Komposit Kayu dan Makmal Analisis Awetan Kayu FRIM telah menerima Anugerah Kepujian Kualiti IKM daripada Institut Kimia Malaysia masing-masing bagi tahun kedua dan kesebelas berturut-turut. Anugerah ini diberi kepada makmal-makmal kimia yang telah mematuhi standard ISO/IEC 17025. Ia mengiktiraf amalan baik kimia dari segi keselamatan, alam sekitar, pengendalian dan pelupusan bahan kimia serta penyimpanan rekod yang kemas kini.

For the second and eleventh consecutive year the Wood Composites Testing Laboratory and Wood Preservative Analytical Laboratory have been awarded the IKM Laboratory Excellence Awards from the Malaysian Institute of Chemistry respectively. These awards were given to chemical laboratories which have complied to the exacting standards of the ISO/IEC 17025. The awards recognised good laboratory practices in terms of safety, environment, chemical handling and disposal including systematic and updated record keeping.

1 Kumpulan projek Sayonara MRSA pemenang pingat gangsa ITEX 2005
Sayonara MRSA project team wins the bronze award of ITEX 2005

2 Kumpulan projek SECA-5 pemenang pingat perak ITEX 2005
SECA-5 project team wins the silver award of ITEX 2005

3 Kumpulan projek B3-A1 multi-purpose applicator pemenang pingat perak ITEX 2005
B3-A1 multi purpose applicator project team wins the silver award of ITEX 2005

4 Kumpulan projek multi-design bagi LVOP pemenang pingat perak ITEX 2005
LVOP multi-design project team wins the silver award of ITEX 2005

PEMINDAHAN TEKNOLOGI
TECHNOLOGY TRANSFER

Pada tahun ini, FRIM terus menumpukan usaha dalam bidang pemindahan teknologi. Selaras dengan objektif institut, maklumat tentang pengurusan dan pembangunan perhutanan, hasil hutan dan penggunaannya telah disebarkan melalui kursus, seminar, bengkel, persidangan, simposium, dan pameran.

Aktiviti pemindahan teknologi ini dianjurkan oleh FRIM dan juga anjuran secara kerjasama dengan agensi lain termasuklah organisasi kerajaan dan bukan-kerajaan. FRIM juga banyak terlibat dalam program yang dikendalikan oleh agensi lain.

During the year, FRIM continued to focus its efforts in technology transfer. In line with the objectives of the institute, information regarding the management and development of forestry, forest products and their utilisation was disseminated through Dialogues, Training Courses, Seminars, Workshops, Conferences, Symposia and Exhibitions.

Many of these activities for technology transfer were either organised solely by FRIM or jointly with other collaborative agencies comprising government and non-government organisations. In some cases, FRIM also participated in events organised by other agencies.

Dialog
Dialogue

- *Round Table Dialogue on Public Participation in Natural Resource Management. FRIM, Kepong, Selangor, 20 September, FRIM, UPM and DANIDA*

Pameran
Exhibitions

- *Pameran Reka Cipta dan Inovasi. Serdang, Selangor, 1 to 19 March, UPM*
- *Sixteenth International Invention, Innovation, Industrial Design and Technology Exhibition, ITEX '05. PWTC, Kuala Lumpur, 19 to 21 May*
- *Let Leaves Live. Leaf Exhibition. FRIM, Kepong, Selangor. 28 May to 12 June, FRIM*
- *International Exhibition Herbal Asia. Mid Valley Mega Mall, Kuala Lumpur, 15 to 18 September, FRIM*

Gerai pameran FRIM di Pameran Herbal Asia
FRIM's booth at the Herbal Asia Exhibition

Ketua Pengarah FRIM merasmikan bengkel IRPA
FRIM General Director officiated the IRPA seminar

Kursus Latihan
Training Courses

- Kursus Pengurusan Landskap (Modul Asia). Bukit Kiara, Kuala Lumpur. 17 to 21 January, FRIM and INTAN
- Kursus Landskap Dan Penyelenggaraan Pokok. FRIM, Kepong, Selangor. 4 to 5 February, FRIM.
- Kursus Dalaman Penerimaan Bijih Benih. FRIM, Kepong, Selangor. 21 February, FRIM.
- Kursus Dalaman Pemprosesan dan Ujian Bijih Benih. FRIM, Kepong, Selangor. 8 March, FRIM.
- Kursus Kem Penyelidikan Sains . FRIM, Kepong, 11 to 15 April, FRIM.
- Kursus Landskap Dan Penyelenggaraan Pokok. FRIM, Kepong, Selangor. 14 to 18 March, FRIM.
- Plant Cryopreservation Master Class. Universit Malaya, Kuala Lumpur. 16 March, FRIM and UM
- Latihan Dalaman Penyimpanan Bijih Benih. FRIM, Kepong, Selangor. 29 March, FRIM
- Kursus Landskap. Bintulu, Sarawak. 4 to 7 April, FRIM, UPKB Sarawak and Bahagian Pembangunan Usahawan Kementerian Kerja Raya
- Kursus Perolehan Biji Benih dan Tapak Semaian. Lentang, Pahang. 11 to 15 April, FRIM and JPNP
- Training course on Fireflies for boat operators of Kampung Kuantan Firefly Park, Kuala Selangor. De Palma Inn, Kuala Selangor. 24 April, FRIM and MDKS
- Kursus Penjagaan Tanaman Balak, Danum Valley, Sabah, 26 to 28 April
- Local Governments Environmental Planning and Management Course. INTAN, 9 May
- 1st Arborist Certification Programme In Malaysia. Rainforest Academy, Universiti Putra Malaysia, Selangor. 24 May to 26 June, FRIM, UPM, DBKL and FLD (Denmark)
- Kursus Pengurusan Tapak Semaian. Bidor, Perak. 14 to 16 June, FRIM and Forest Department of Perak
- Course on Quality Control of Wood Composite Manufacture Technology. FRIM, Kepong, 4 to 8 July, FRIM
- Kursus Tapak Semaian dan Pembiakan Tampang. FRIM, Kepong, Selangor. 5 to 8 July, FRIM and ULP
- Kursus Pengenalan Sains tanah. FRIM, Kepong, Selangor. 2 to 4 August, FRIM
- Kursus Landskap. Kuching, Sarawak. 23 to 25 August, FRIM, UPKB Sarawak and Bahagian Pembangunan Usahawan Kementerian Kerja Raya
- Training Course on Herbal Plantation & Processing Technology, 5 September to 18 November, FRIM
- Kiln Drying, FRIM, Kepong, Selangor. 5 to 24 September, FRIM
- Penanaman dan Pengeluaran Tanaman Herba. Program Peningkatan Kemahiran Siswazah dan Program Usahawan Herba. FRIM, Kepong, Selangor. 19 to 20 September, FRIM
- Kursus Landskap Dan Penyelenggaraan Pokok. FRIM, Kepong, Selangor. 26 to 30 September, FRIM
- Liquid Chromatography Mass Spectrometer Training. FRIM, Kepong, Selangor. 14 to 18 November, FRIM
- Determination and Analysis of Formaldehyde Emission from Wood Composite Products. FRIM, Kepong, Selangor. 28 to 30 November, FRIM
- Kursus Landskap. Kuching, Sarawak. 9 to 25 December, FRIM, UPKB Sarawak and Bahagian Pembangunan Usahawan Kementerian Kerja Raya

Seminar, Bengkel, Persidangan dan Simposium
Seminars, Workshops, Conferences and Symposia

- Workshop on developing sustainable timber harvesting guidelines for peat swamp forests. Kuantan, Pahang, 11 January, Forestry Department Pahang and DANIDA
- 2DE Proteomic Course. FRIM, Kepong, Selangor. 26 to 28 January, FRIM.
- Bengkel Pemantauan Projek Hasil Kajian IRPA RMK-8. A'Famosa, Malacca. 1 to 3 February, FRIM
- Environmental Education Programme Workshop. FRIM, Kepong, Selangor. 10 February, FRIM, SJK (C) Kew Min, Batu Caves, Selangor
- Seminar on DNA and Protein Microarray. FRIM, Kepong, Selangor. 16 February, FRIM
- Workshop on Economic Valuation of Forest Goods and Services. Residence Hotel, UNITEN, Bangi, Selangor. 23 February, FRIM, UPM and DANIDA
- Phasing out methyl bromide-Possible alternatives. Marriot Hotel, Putra Jaya. 24 February, FRIM, JPM, JASM, IPM and UNDP
- Environmental Education Programme Workshop. FRIM, Kepong, Selangor. 26 February, FRIM, SJK (T) Batu Caves, Selangor
- 2DE Proteomic Course. FRIM, Kepong, Selangor. 8 to 10 March, FRIM
- Third USM-JIRCAS International Symposium 2004. Lignocellulose: Materials for the future from tropics. JIRCAS Working Report No. 39. Penang, 9 to 10 March, USM, JIRCAS
- Environmental Education Programme Workshop. FRIM, Kepong, Selangor. 12 March, FRIM, SRK Taman Setia, Gombak, Selangor
- Workshop on Future of Nature Conservation Education in Malaysia. Pan Pacific Hotel, Kuala Lumpur, 24 March
- Quality Assurance Scheme (QAS) for CCA Treatment for Timber Treaters. FRIM, Kepong, Selangor. 30 March, FRIM, MTIB and MWPA
- Malaysian Science & Technology Congress 2005 (MSTC 2005): Toward excellence in Science and Technology Research, Cititel Hotel, Midvalley, Kuala Lumpur 18 to 20 April, COSTAM
- Kursus Penjagaan Tanaman Balak, Danum Valley, Sabah. 26 to 28 April, FRIM
- Bengkel Pembiakan Tanaman Herba. FRIM, Kepong, Selangor. 26 April, FRIM
- Fourth Malaysian International Conference On Essential Oils and Fragrance And Flavour Materials 2005. Putra Palace, Kangar, Perlis. 8 to 11 May, MICEOFF4
- Balancing Sustainable Utilization and Conservation of Natural Resources at Gunung Aais Forest Reserve Seminar. FRIM, Kepong, Selangor. 10 May, FRIM
- Workshop on minimization of wood waste from construction sites and recycling potential. IOI Palm Garden Hotel, Putrajaya, 10 May, FRIM, CIDB & Lestari UKM
- Sixth National Congress on Genetics. Crown Princess Hotel, Kuala Lumpur, 12 to 14 May, Persatuan Genetik Malaysia
- Third Technical Review Meeting on Research and Development of Kenaf Production for Animal Feed and Fibre 2004. Kota Bharu, 25 to 26 May, MARDI
- Quality Assurance Scheme (QAS) for CCA Treatment: Towards meeting QAS for the list of certified timber suppliers and treaters. FRIM, Kepong, Selangor. 13 to 14 June, FRIM, MTIB and MWPA
- Eighth Applied Biology Symposium on Advances in Life Sciences: Improving the Quality of Life 2005. Marriot Hotel, Putrajaya, 22 to 23 June
- Assessment of Wetland Educational Kit for School Teachers Workshop. FRIM, Kepong, Selangor. 25 to 26 June, FRIM and Wetland Inc.
- Seminar on the Status of Biological Diversity in Malaysia and Workshop on Threat Assessment of Plant Species in Malaysia. FRIM, Kepong, 28 to 30 June, FRIM
- Fourth National Seed Symposium: Towards a Viable Seed Industry, Kuala Lumpur, 28 to 29 June
- Acacia Research in Malaysia: Current updates on Acacia genomics and Breeding. Marriot Hotel, Putra Jaya. 12 July, FRIM
- 2DE Proteomic Course. FRIM, Kepong, Selangor. 12 to 14 July, FRIM.
- Sarawak Medicinal Herbs and Spices Seminar 2005. Kuching, Sarawak, 17 July
- Hands-on Workshop on Greenhouse Gas (GHG) Modelling. Palm Garden Hotel, Putrajaya, 19 July

Seminar, Bengkel, Persidangan dan Simposium
Seminars, Workshops, Conferences and Symposia

- Bengkel Pemantauan Projek Hasil Kajian IRPA RMK-8. FRIM Kepong. 25 to 26 July, FRIM
- Symposium on Tropical Rainforest Rehabilitation & Restoration: Existing Knowledge and Future Directions. Shangrila Hotel, Kota Kinabalu, Sabah, 26 to 28 July
- Malaysia Sciences Association Golden Jubilee International Science Congress 2005 (ISC): Science for Humanity, Module on Natural Products and Medicinal Chemistry. PWTC, Kuala Lumpur, 3 to 6 August, MSA
- Best of Both Worlds Conference: Environmental Education for Sustainable Development. Pan Pacific Hotel, Kuala Lumpur. 6 to 8 August, FRIM, JPSM, UPM, DBKL, MNS and Kementerian Pelajaran
- Bengkel Pengendalian Bijih Benih. FRIM, Kepong, Selangor. 10 to 11 August, FRIM
- Pulp and Paper Conference 2005: Plantation, Recycled and Non-wood fibres-The way forward. Hilton Hotel, Kuala Lumpur. 16 to 18 August, FRIM, FFPRI, MPPMA and APPITA
- The Importance of Mangrove and other Coastal Ecosystems in Mitigating Tsunami Disasters Symposium and General Assembly. Pan Pacific Hotel, Kuala Lumpur. 22 to 26 August, FRIM and ISME
- Global Database for Mangrove Informations Systems Workshop. Pan Pacific Hotel, Kuala Lumpur.
  23 to 26 August, FRIM and ISME
- International Federation of Parks and Recreation Administration (IFPRA) 2005. PWTC, Kuala Lumpur, 28 August to 3 September
- Herbal Technology Programme. FRIM, Kepong, Selangor. 5 September to 18 November, FRIM, INSEP/MIGHT METEOR
- Best of Both Worlds Conference: Environmental Education for Sustainable Development, Pan Pacific Hotel, Kuala Lumpur, 6 to 8 September. FRIM
- Fourteenth Malaysian Forestry Conference. Kota Kinabalu, Sabah, 12 to 16 September
- Seminar on Medicinal and Aromatic Plants. Harnessing Cures from Nature: Trends and Prospects. Cititel Mid Valley Hotel, Kuala Lumpur, 13 to 14 September, FRIM
- Konvensyen Kumpulan Meningkat Mutu Kerja Kebangsaan Ke-22 dan Anugerah Inovasi Perkhidmatan Awam 2005 (AIPB) 2005. Genting International Convention Centre Genting Highlands, Pahang. 17 to 18 November, AIPB
- Twenty-First Annual Seminar of the Malaysian Natural Products Society: NATURAL PRODUCT MALAYSIA 2005. Palm Garden Hotel, Putrajaya, 22 to 23 November
- National Workshop on Economic Valuation for Conservation Management. Johore Baru, Johore, 22 to 24 November
- Conference on Forestry and Forest Products Research (CFFPR): Investment for Sustainable Heritage and Wealth. Pan Pacific Hotel, Kuala Lumpur. 22 to 24 November, FRIM
- Seminar Ekspedisi Saintifik Kepelbagaian Hayat Hutan Simpan Gunung Jerai, Kedah, 27 to 29 November. FRIM
- Technical Workshop/Meeting for Forest Quality Assessment and Classification, Promenade Hotel, Kota Kinabalu, 1 to 2 December, Sabah, WWF-Malaysia
- International Conference on Medicinal Plants 2005
  Dynasty Hotel, Kuala Lumpur, 5 to 7 December
- Seminar Pengurusan Tanaman Hiasan Untuk Majlis Rasmi
  Dan Protokol. Bukit Kiara, Kuala Lumpur. 13 to 14 December, FRIM and INTAN
- Bengkel Pemantauan Projek Hasil Kajian IRPA RMK-8. Identifying Potential Commercial Collaborations. FRIM, Kepong, 14 to 15 December, FRIM
- Oil Palm Tree Utilisation Conference (OPTUC 2005): Development of oil palm biomass industry. 15 to 17 December, Kuala Lumpur
- Workshop Tanaman Jati Selepas Tanaman. SPL, Perlis, 22 to 23 December, FRIM
- 2DE Proteomic Course. FRIM, Kepong, Selangor. 27 to 29 December, FRIM

Perasmian seminar Gunung Aais
Opening ceremony of the Gunung Aais seminar

Perasmian Pameran Herbal Asia
Opening ceremony of the Herbal Asia Exhibition

Perasmian Expo NATPRO
Opening ceremony of the NATPRO Expo

Peserta Kursus Landskap dan Penyelenggaraan Pokok di FRIM
Participants of Landscape and Tree Maintenance Course held in FRIM

Y.B. Dato' Sazmi Miah merasmikan *Seminar on Medicinal and Aromatic Plants*
Y.B. Dato' Sazmi Miah officiated the opening ceremony of the Seminar on Medicinal and Aromatic Plants

KHIDMAT PERUNDINGAN DAN HAL EHWAL ANTARABANGSA DAN UNDANG-UNDANG
CONSULTANCY SERVICES AND INTERNATIONAL AND LEGAL AFFAIRS

KHIDMAT PERUNDINGAN
CONSULTANCY SERVICES

Pada tahun 2005, FRIM mengendalikan sebanyak 13 perundingan yang bernilai RM187,000. Daripada perundingan ini, FRIM menerima sebanyak RM72,800 sebagai bayaran pengurusan dan pentadbiran.

In 2005, FRIM conducted 13 consultancies worth RM187,000. From these consultancies, RM72,800 were due to FRIM as charges for management and administration.

Bidang *Field of Work*	Pengurus *Project Manager*	Pelanggan *Client*
Identification of wood borers species	Roszaini Kadir	Apexjaya Industries Sdn. Bhd.
Forest Management auditor	Dato' Dr. Wan Razali Wan Mohd.	ASIA PRIMA RCF Sdn. Bhd.
Upgrading Landscaping Work	Adnan Mohammad	Ambang Wira Sdn. Bhd.
Field test on the chemical used for termite attack	Roszaini Kadir	PROTIM SOLIGNUM OSMOSE Sdn. Bhd.
Forest nursery establishment and maintenance work	Dr. Aminah Hamzah	Persatuan Orang asli Pulau Carey
Field resistance test on wood polymer from fungi attack	Dr. Salmiah Ujang	VicPlas Holding Pte. Ltd.
Technical advice on botany and horticulture for Taman Bandaran, Putrajaya	Adnan Mohammad	Tetuan PAG Consult Sdn. Bhd.
Report on pest and disease outbreaks in monoculture forest and to recommend control measures	Dr. Lee Su See	Chemsain Konsultant Sdn. Bhd.
To conduct Second Surveillance visit of Perak State Forest Department	Dr. Lim Hin Fui	SIRIM QAS International Sdn. Bhd.
Wood quality and structural check on building trusses	Salamah Selamat	Taman Botanik, Klang
Evaluating the health of trees at Andaman Resort, Langkawi	Dr. Elizabeth Philip	Jamie Case, Andaman Resort
Investigating the type of timber used for boardwalk at Pulau Langkawi	Lim Seng Choon	Rebak Island Marina Bhd.
Assessment and documentation of Flora at Cameron Highlands and Batang HEP Scheme	Ismail Harun	Seri Mega Construction Sdn. Bhd.

HAL EHWAL ANTARABANGSA DAN UNDANG-UNDANG
INTERNATIONAL AND LEGAL AFFAIRS

Pendahuluan
Introduction

Unit Hal Ehwal Antarabangsa telah ditubuhkan pada bulan April 2005 dengan pelantikan Dr. Norini Haron sebagai Ketua Unit. Unit ini berfungsi sebagai pusat rujukan dalam semua aspek perhutanan terutama sekali berkaitan dengan perjanjian pelbagai hala alam sekitar (MEA).

Antara MEA tersebut ialah Protokol Kyoto yang mendefinisi tiga mekanisme inovatif yang anjal untuk mengurangkan kos keseluruhan dalam mencapai pengeluaran emisinya. Salah satu mekanisme inovatif yang berkaitan dengan Malaysia ialah Mekanisma Pembangunan Bersih (CDM). CDM membolehkan negara-negara annex 1 menjalankan projek yang boleh mengurangkan pengeluaran emisi GHG, di negara bukan annex 1 dan menggunakan CER (*Certified Emission Reduction*) yang dihasilkan untuk memenuhi sasaran negara annex 1 tersebut.

Secara rasmi, FRIM telah dilantik sebagai sekretariat kepada CDM Perhutanan mulai 28 April 2005 dengan mesyuarat Jawatankusa Teknikalnya yang sama pada hari tersebut. Tugas sekretariat ini dipertanggungjawabkan kepada Unit Hal Ehwal Antarabangsa. Unit ini kini dikenali sebagai Unit Hal Ehwal Antarabangsa dan Undang-Undang.

The International Affairs Unit was established in April 2005 with the appointment of Dr. Norini Haron as the Unit Head. The Unit functions as a focal point for all aspects of international forestry matters with emphasis on related Multilateral Environmental Agreements (MEA).

Amongst the MEAs is the Kyoto Protocol that defines three innovative "flexibility mechanisms" to lower the overall costs of achieving its emissions targets. One of the "flexibility mechanisms" relevant to Malaysia is the Clean Development mechanism (CDM). CDM provides for Annex I Parties to implement project activities that reduce emissions of green house gases (GHG) in non-Annex I Parties, in return for Certified Emission Reductions (CERs). The CERs generated by such project activities can be used by Annex I Parties to help meet their emissions targets.

FRIM was officially appointed as the secretariat for CDM forestry on 28 April, 2005 with the first Technical Committee Meeting held on the same day. This secretariat function is entrusted to the International Affairs Unit. Later when the Legal Unit was merged with the International Affairs Unit, it became known as The International and Legal Affairs Unit.

Memorandum Persefahaman
Memorandum of Understanding

Salah satu fungsi Unit Hal Ehwal Antarabangsa dan Undang-Undang ialah menyelaras dan menyelia semua projek kerjasama sama ada di dalam atau di luar negara. Lembaga dalam mesyuaratnya pada 24 Februari 2005 telah memutuskan untuk memperkemas prosedur mengadakan projek usahasama antara FRIM dengan agensi luar. Satu jawatankuasa kecil telah ditubuhkan untuk mengkaji setiap cadangan projek usahasama tersebut sebelum dimajukan kepada Lembaga untuk kelulusan.

Sehubungan dengan itu juga, satu set kriteria telah dirangka untuk memastikan rakan kongsi tersebut sesuai dan menepati aspirasi FRIM. Kriteria-kriteria tersebut ialah:

- Status dan ekuiti rakan kongsi
- Kekukuhan sumber dan pengurusan
- Komitmen tinggi
- Rekod prestasi cemerlang
- Mempunyai strategi korporat jangka panjang
- Sedia mematuhi terma-terma perkongsian
- Mempunyai rangkaian perniagaan dengan vendor-vendor lain
- Memerlukan kadar pengawalseliaan yang rendah selepas kontrak dimeterai

Pada tahun 2005 Jawatankuasa Kecil Lembaga ini telah bermesyuarat sebanyak tiga kali dan sebanyak 15 projek telah diluluskan. Penyelarasan projek yang ditandatangani sebagai MoU merupakan tanggungjawab Unit Hal Ehwal Antarabangsa dan Undang-Undang, manakala perjanjian lain yang ditandatangani untuk tujuan komersialisasi di bawah pengawalseliaan Unit Komersialisasi dan Geran

Penyelidikan. Pada tahun 2005, Unit Hal Ehwal Antarabangsa dan Undang-Undang telah merumus atau menyemak tiga puluh dokumen undang-undang daripada pelbagai kategori. Unit ini sedang mengkaji semula Akta 319 MFRDB untuk memastikan agar FRIM terus relevan terhadap keperluan masa kini dan masa akan datang.

One of the functions of the International and Legal Affairs Unit is to coordinate and monitor all local and international collaborative projects. The MFRDB in its meeting on 24 February 2005 made recommendations to streamline procedures for joint collaborative projects between FRIM and external agencies. A sub-committee was then formed to study and vet proposals of joint collaborative projects before these were brought forward to the Board for consideration and final approval.

A set of criteria was formalised to ensure that collaborators and their projects meet with the aspiration of the institute. The criteria are as follows:

- *Status and equity of collaborators*
- *Soundness of resources and management*
- *High commitment level*
- *Excellent track record*
- *Possess long term corporate strategy*
- *Willingness to observe the various terms of the collaboration*
- *Establish business network with other vendors*
- *Require minimal supervision after the contract is signed.*

A total of three meetings were held in 2005 and 15 projects were approved. The coordination of projects signed as an MoU is the responsibility of the International and Legal Affairs Unit, while other agreements signed for the purpose of commercialisation are under the purview of the Commercialisation and Research Grant Unit. In 2005, the International and Legal Affairs Unit formulated or reviewed thirty legal documents of various categories. The Unit is currently reviewing the MFRDB Act 319 to ensure that FRIM stays relevant to present and future needs.

Perjanjian Pelbagai Hala Alam Sekitar
Multilateral Environmental Agreements

Sejajar dengan fungsi ini, sekretariat perhutanan untuk Mekanisme Pembangunan Bersih (CDM) telah mula berfungsi mulai April 2005. Sehubungan dengan itu, beberapa ahli bersekutu yang terdiri daripada saintis FRIM yang pakar dalam isu-isu yang terkandung dalam MEA telah dilantik. Ahli-ahli bersekutu ini diberi peluang untuk menghadiri persidangan dan kursus latihan bagi meningkatkan kemahiran dan keupayaan mereka.

Selain penubuhan sekretariat, antara perkembangan penting dalam pelaksanaan MEA ialah pelantikan FRIM sebagai agensi yang bertanggungjawab untuk perkongsian maklumat dalam Konvensyen Kepelbagaian Biologi (CBD) melalui Mekanisme Gedung Penjelasan *(Clearing House Mechanism*)

Menepati semangat CITES untuk melindungi kepupusan fauna dan flora yang disebabkan oleh perdagangan spesies yang terancam, draf pertama "*Malaysian Protocol for threat assessment based on IUCN Red List*" telah disiapkan.

Tiga puluh lima spesies yang telah disenaraikan dalam IUCN berjaya dikutip dari hutan liar dan ditanam di kawasan FRIM.

In line with this function, the CDM forestry secretariat was operationalised in April 2005. Capacity building activities for the secretariat involved the appointing of FRIM scientists as associate members of the secretariat and who had relevant expertise to address issues in the various MEAs. These associate members were given the opportunity to attend various conferences and training courses in order to enhance their skills and abilities.

Apart from the establishment of the secretariat, another important development in the implementation of the MEAs is the appointment of FRIM as the agency responsible for information sharing under the Clearing House Mechanism of the Convention on Bio Diversity (CBD).

In accordance to the spirit of CITES to protect fauna and flora from extinction caused by unscrupulous trade in threatened species, the first draft of the Malaysian Protocol for threat assessment based on IUCN Red List was completed.

Thirty-five species identified in the IUCN list were collected from the wild and planted in FRIM's compound.

PERJAWATAN
ESTABLISHMENT

PELANTIKAN
APPOINTMENTS

Pada tahun 2005, seramai 37 orang pegawai baru dari Kumpulan Pengurusan dan Profesional telah dilantik. Tiga puluh lima orang dilantik ke Gred Q41 manakala dua dilantik ke Gred N41. Tiga orang dari Kumpulan Sokongan, iaitu Norhusaini Abdullah, Ilyani Mazlan dan Hasrina Hasnor Kamaruzaman, masing-masing dilantik ke Gred J29, W27 dan W17.

In 2005, a total of 37 new Research Officers, under the Management and Professional Category, were appointed. Thirty five Research Officers were appointed to Q41 while two were appointed to grade N41. Three others from the supporting staff namely Norhusaini Abdullah, Ilyani Mazlan and Hasrina Hasnor Kamaruzaman were appointed to grades J29, W27 and W17 respectively.

Pegawai Penyelidik / *Research Officers*

Bil. / *No.*	Nama / *Name*	Tarikh Pelantikan / *Date of Appointment*
	Pegawai Penyelidik Gred Q41	
1	Maizurah Ishak	17 October
2	Dr. Ng Chin Hong	17 October
3	Mazura Md. Pisar	17 October
4	Siti Syarifah Mohd Mutalip	17 October
5	Norhayati Ismail	17 October
6	Nada Badruddin	17 October
7	Noraliza Alias	17 October
8	Hamidah Mamat	17 October
9	Nor Ezzawanis Abdullah Thani	17 October
10	Sreetheran a/l Maruthaveeran	17 October
11	Maria Zura Mohd Zain	17 October
12	Shawn Cheng	17 October
13	Mohamad Nasir Mat Arip	17 October
14	Lili Sahira Husin	17 October
15	Raja Saadiah Raja Shariff	17 October
16	Huda Farhana Mohamad Muslim	17 October
17	Hada Masayu Ismail @ Dahlan	17 October
18	Azian Mohti	17 October
19	Syahida Emiza Suhaimi	17 October
20	Ummul Nazrah Abdul Rahman	17 October
21	Mahanim Sarif @ Mohd Ali	17 October
22	Saidatul Husni Saidin	17 October
23	Rafidah Jalil	17 October
24	Tariq Mubarak Husin	17 October
25	Elango a/l Velautham @ Krishnan	17 October
26	Chew Ming Yee	17 October
27	Sik Huei Shing	17 October
28	Phoon Sook Ngoh	17 October
29	Chang Li Yen	17 October
30	Kho Lip Khoon	17 October
31	Latifah Jasmani	17 October
32	Fauziah Abdullah	16 November
33	V. Jeyanny a/p Vijayanathan	16 November
34	Nadiah Salmi Nadzri	16 November
35	Noor Rasyila Mohamed Noor	16 November
	Pegawai Tadbir Gred N41	
1	Mohd. Asmawee Ismail	03 January
2	Zamri Mohd. Zangi	03 January

PENERIMA ANJAKAN GAJI
PAY INCREMENT AWARDEES

Lima belas Pegawai Penyelidik dan dua puluh enam Kakitangan Sokongan telah menerima anjakan gaji dalam tahun 2005.

Fifteen Research Officers and twenty six Supporting Staff received pay increments in the year 2005.

Bil. / *No.*	Nama / *Name*
	Kumpulan Pengurusan dan Profesional
1	Dr. Saw Leng Guan
2	Dr. Aminah Hamzah
3	Norhayati Nordin
4	Mohamad Zaki Mohd. Isa
5	Nor Azman Hussein
6	Wan Mohd. Shukri Wan Ahmad
7	Lee Chai Ting
8	Asiah Osman
9	Sarifah Kunju Ahmad
10	Dr. Norwati Adam
11	Nurhanan Murni Yunos
12	Zaihan Jalaludin
13	Ismail Parlan
14	Nur Hajar Zamah Shari
15	Roszaini Kadir
	Kumpulan Sokongan
1	Ruziah Ripin
2	Normah Basir
3	Samsuri Toh Harun
4	Mohamad Shapiei Jusoh
5	Samsor Saleh
6	Zarah Bacik
7	Amran Haron
8	Halim Man
9	Maznan Mohamad
10	Shukor Mohd. Arif
11	Sukeri Don
12	Zaidi Azis
13	Zaidi Hamid
14	Azizah Ariffin
15	Rosli Izhar
16	Roslan Abdullah
17	Fesal Johan
18	Sahrol Ablah
19	Amir Sabri Baharom
20	Azman Shah Ramlee
21	Zaisatul Khairy Salleh
22	Hamidi Abas
23	Mohd. Zain Mazlan
24	Mohamad Azmi Omar
25	Mohd. Zaini Adam
26	Shahudin Sulong

PELETAKAN JAWATAN
RESIGNATION

Pada tahun 2005, seorang Pegawai Penyelidik, Mohd. Azmi Mohd. Idris dan empat orang kakitangan Kumpulan Sokongan telah meletak jawatan.

In 2005, one Research Officer Mohd. Azmi Mohd. Idris and four staff members from the Supporting Group resigned from the Institute.

Kakitangan / *Staff*	Tarikh peletakan jawatan / *Date of resignation*
Khairul Anuar Abdul Shukor	3 May
Mohd. Azmi Mohd. Idris	1 November
Jai Effendy Asis	8 March
Yuzaidi Othman	15 June
Asmawi Baharudin	1 August

PERSARAAN
RETIREMENT

Pada tahun 2005, seorang Pegawai Penyelidik, Mohd. Rasol Abd. Manaf dan tiga belas orang kakitangan Kumpulan Sokongan telah bersara.

One Research Officer Mohd. Rasol Abd. Manaf and thirteen other staff members of the Supporting Group retired in the year 2005.

Persaraan / *Retirement*	Tarikh / *Date*
Persaraan wajib *Mandatory retirement*	
Roseli Jaapor	17 January
Hasan Mahmud	9 February
Zaharudin Maen	2 April
Abdullah Manap	19 April
Abd. Rahim Abd. Rahman	27 April
Rajendran A/L Pavadai	17 May
Aziz Md. Nor	2 July
Dasima Ramudin	18 August
Zabidah Muhammad	26 September
Jaaffar Ahmad	15 December
Mohd. Yusoff Hashim	18 December
Persaraan pilihan sendiri *Optional retirement*	
Abu Hamid	1 January
Mohd. Rasol Abd. Manaf	1 July
Ng Tian Peng	1 July

LATIHAN
TRAINING

LATIHAN AKADEMIK
ACADEMIC TRAINING

Pada tahun ini, lapan orang pegawai berjaya menamatkan pengajian mereka sama ada dari universiti tempatan mahupun luar negara. Ijazah yang diperoleh termasuklah enam Ph.D. dan dua Sarjana Sains. Manakala sejumlah sepuluh orang pegawai telah mendaftarkan pengajian peringkat ijazah lanjutan pada tahun 2005.

During the year, eight officers successfully completed their academic training from local or overseas universities. The degrees included six Ph.D. and two M.Sc. Meanwhile, a total of ten officers registered for post-graduate studies in 2005.

Nama *Name*	**Ijazah** *Degree*	**Bidang** *Field*	**Universiti** *University*
Wan Tarmeze Wan Ariffin	Ph. D.	Numerical Analysis	University of Birmingham
Muhamad Omar Khaidzir	Ph. D.	Automatic Control and Systems Engineering	University of Sheffield
Norwati Adnan	Ph. D.	Biotechnology	Universiti Kebangsaan Malaysia
Kevin Ng Kit Siong	Ph. D.	Genetics	University of Malaya
Jayanti Nadarajan	Ph. D.	Cryo-preservation	University of Abertay Dundee
Ahmad Fauzi Puasa	Ph. D.	Natural Resources and Environmental Economics	University Putra Malaysia
Suffian Misran	M. Sc.	Wood Sciences	University Putra Malaysia
Abd. Hamid Salleh	M. Sc.	Wood and Furniture Technology	Universiti Technology MARA

Latihan Akademik *Academic Training*	**Luar Negeri** *Overseas*		**Dalam Negeri** *Local*		**Jumlah** *Total*	
	2004	**2005**	**2004**	**2005**	**2004**	**2005**
Ph. D.	10	1	21	2	31	3
M. Sc.	-	-	13	7	13	7
B. Sc.	-	-	1	-	1	-
Jumlah / *Total*	**10**	**1**	**35**	**9**	**45**	**10**

LATIHAN BUKAN AKADEMIK
NON-ACADEMIC TRAINING

Pada tahun 2005, sejumlah 390 orang pegawai telah mengikuti latihan bukan akademik. Bagi pegawai dari Kumpulan Pengurusan dan Profesional, 43 orang telah mengikuti latihan sama ada di dalam mahupun di luar Negara manakala 289 orang telah menghadiri persidangan, seminar dan bengkel.

In 2005 a total of 390 officers had undergone non-academic training. For officers in the Management and Professional Category, 43 had undergone courses both locally and overseas while 289 attended conferences, seminars and workshops both locally and abroad.

Latihan Bukan Akademik *Non-Academic Training*	**Pengurusan & Profesional** *Management & Professional*		**Kumpulan Sokongan** *Supporting Group*		**Jumlah** *Total*	
	2004	**2005**	**2004**	**2005**	**2004**	**2005**
Kursus *Course*						
Luar Negeri *Overseas*	9	9	1	1	10	10
Tempatan *Local*	503	34	214	31	717	65
Persidangan *Conference*						
Luar Negeri *Overseas*	92	102	1	1	93	103
Tempatan *Local*	131	187	4	25	135	212
Jumlah / *Total*	**735**	**332**	**220**	**58**	**955**	**390**

HARI ANUGERAH DAN ULANG TAHUN KE-20 FRIM
FRIM'S AWARDS DAY AND 20TH ANNIVERSARY

Hari Anugerah dan Ulang Tahun ke-20 FRIM telah diadakan di Dewan Alwy, Unit Latihan Perhutanan pada 9 Disember 2005. Y.B. Dato' Sazmi Miah, Setiausaha Parlimen Kementerian Sumber Asli dan Alam Sekitar telah merasmikan majlis tersebut. Kemuncak sambutan termasuklah penyampaian anugerah Pekerja Terbaik Tahunan, Khidmat Cemerlang (individu dan kumpulan), anugerah Khidmat Setia dan anugerah Penerbitan Terbaik. Tiada penerima bagi anugerah Khidmat Masyarakat pada tahun tersebut.

FRIM's Awards Day and 20th Anniversary was held at Dewan Alwy, Unit Latihan Perhutanan on 9 December 2005. Y.B. Dato' Sazmi Miah the Parliamentary Secretary of the Ministry of Natural Resources and Environment officiated the occasion. Highlights of the event included presentations of awards for Annual Best Employee, Excellent Service (individual and group), Long Service and Outstanding Publications and Best Theses awards. There were no awardees for Community Service awards.

Y.B. Dato' Sazmi Miah merasmikan majlis
Y.B. Dato' Sazmi Miah officiated the occasion

Dif-dif kehormat di majlis Hari Anugerah dan Ulang Tahun ke-20 FRIM
VIP at the opening ceremony of FRIM's awards day and 20th Anniversary celebrations

ANUGERAH PEKERJA TERBAIK TAHUNAN
ANNUAL BEST EMPLOYEE AWARD

Tahun ini, Anugerah Pekerja Terbaik Tahunan telah diterima oleh En. Mohd. Zaki Mohd. Isa dari Kumpulan Pengurusan dan Profesional dan En. Asmar Hj. Hassan dari Kumpulan Sokongan.

This year's Annual Best Employee Award for the Management and Professional and Supporting Staff categories were presented to En. Mohd. Zaki Mohd. Isa and En. Asmar Hj. Hassan respectively.

ANUGERAH KHIDMAT CEMERLANG
EXCELLENT SERVICE AWARD

Individu
Individual

Pegawai Penyelidik
Research Officers

Penerima / *Awardees*

Marzalina Mansor
Ahmad Fauzi Puasa
Woon Weng Chuen
Norain Mohd. Arif
Mohd. Zamshari Abd. Rahman
Hashim Wan Samsi
Wan Rasidah Wan A. Kadir
Zaridah Mohd. Zaki
Norlia Basherudin

Marzalina Mansor menerima anugerah khidmat cemerlang Pegawai Penyelidik kategori individu
Marzalina Mansor receiving the Research Officers excellent service award in the individual category

Mohd. Zamshari Abd. Rahman menerima anugerah khidmat cemerlang Pegawai Penyelidik kategori individu
Mohd.. Zamshari Abd.. Rahman receiving the Research Officers excellent service award in the individual category

Abdul Jabbar Sabli daripada kumpulan Cawangan Latihan menerima anugerah khidmat cemerlang kategori kumpulan 1
Abdul Jabbar Sabli from the Training Branch group receiving the excellent service group category award

Asmar Hj. Hassan menerima Anugerah Pekerja Terbaik Tahunan (kategori Kumpulan Sokongan) 2
Asmar Hj. Hassan receiving the Annual Best Employee Award (Supporting Staff category)

Mohd. Zaki Mohd. Isa menerima Anugerah Pekerja Terbaik Tahunan (kategori Kumpulan Pengurusan dan Profesional) 3
Mohd. Zaki Mohd. Isa receiving the Annual Best Employee Award (Management and Professional category)

Pegawai Sokongan
Supporting Staff

Penerima / *Awardees*

Mohd. Rozmi Mohamed Arif
Mohd. Nizal Salehin
Mohd. Hahazemi Md. Tahar
Che Mohd. Shamsuddin Che Seman
Mohd. Shahid Mohd. Mustafa
Abdul Razak Abdul Rahman
Abu Bakar Razali
Abdul Hamid L. Hassan
Abu Husin Harun
Rajendran Pavadai
Zuraida Zainun
Jaaffar Ahmad
Azahari Mohd. Yusoff
Zawawi Kassim
Ong Tai Hock
Ang Khoon Cheng
Jalali Salleh
Chong Yoon Thai
Sharifah Maulana
Mariam Din
Mohd. Azmi Hashim
Asmar Hassan
Zaiton Mohd. Zain
Norhayate Puteh Mahbob
Mazli Abdul Wahab
Asnah Hashim
Mohamad Aidil Noordin
Tanjong Abdullah
Mashilah Mior Ismail
Mohammad Faridz Zollpatah
Rozidah Khalid
Rohani Abdullah
Rohayu Yunus
Norridah Aziz
Siti Roshidan Saidin
Aziz Md. Noh
Mohd. Rosdy Mohd. Taher
Nor Azni Jaafar
Wan Zahari Wan Yaacob
Yusof Darus
Muhammad Kamaruzzaman Nawawi
Shahar Wagio
Shaari Jantan
Roslin Badu
Mohammad Bohari Ehwan
Sellamah Ponnampalam

Kumpulan
Group

Unit Gaji
Salaries Unit

Norhayate Puteh Mahbob
Norashikin Mohd. Zabri
Rashidah Abd. Razak
Sailesuze Mohd. Salim

Cawangan Latihan
Training Branch

Abdul Jabbar Sabli
Liza Ismail
Ruziah Ripin
Mohd. Norin Nizan Mohd. Janah
Che Rohani Che Wil
Arshad Anuar

Mahmudin Saleh daripada kumpulan EOPR menerima anugerah khidmat cemerlang kategori kumpulan
Mahmudin Saleh from the EOPR team receiving the excellent service group category award

Rohimah Abdullah menerima anugerah khidmat setia
Rohimah Abdullah receiving the long service award

E-OPR / *E-OPR*

Mahmudin Saleh
Mohd. Nor Yusof
Puad Elham
Wan Asma Ibrahim
Wan Rasidah Wan A. Kadir
Rahim Sudin
Koh Mok Poh
Suffian Misran
Shaharuddin Hashim
Sharmiza Adnan
Rafeadah Rusli
Latifah Jasmani
Suhana Rafidah Md. Yusof

Anugerah Khidmat Setia
Long Service Awards

Penerima / *Awardees*

Wan Rahmah Wan A. Raof
Ab. Rasip Ab. Ghani
Hashim Md. Nor
Azman Hassan
Mohd. Arshad Saru
Ashaari Mohd. Amin
Nur Supardi Mohd. Nor
Muhd. Nazak Mohd. Nasir Husin
Khairuddin Kamaruddin
Roszalli Mohd.
Md. Nasir Dayat
Jalali Salleh
Ahmad Shahar Mohmad Yusof
Wan Zamani Wan Yusof
Ab. Jalil Muhammad
Mat Yaacob Che Wan
Mahat Mijan
Mohd. Zahari Mohd. Nor
Ibharim Hashim
Saimin Basir
Kamarudin Saleh
Mariam Din
Siti hasanah Mat Said
Mukhtar Ismail
M. Markandan
Damahuri Sabari
Saripah Barom
Asmar Hassan
Rohimah Abdullah
Zaiton Mohd. Zain
Norhayate Puteh Mahbob
Abdul Wahid Abd. Aziz
Mohd. Ehlas Hassan
Zainab Salim
Zaiton Saleh
Shuhaimi Sulaiman
Yusof Darus
Abdul Molok Abd. Ghani
Salehin Jantan
Rosman Ibrahim
Maskom Peseri
Mohd. Yatim Abdul Aziz
Norziah Salleh
Mohd. Yusoff Abd. Razak
Mohd. Saad Mat Som
Shahar Wagio
Ali Johar
Abd. Saman Latif
Ab. Wahid Mohamad
Mohd. Yunus Hitam
Jaafar Sulaiman
Mustapha Data

Lee Soon Leong pemenang Pertama kategori kertas teknikal
Lee Soon Leong First Prize winner for the technical paper award category

Wan Mohd. Shukri Wan Ahmad pemenang Pertama kategori separa/bukan-teknikal
Wan Mohd. Shukri Wan Ahmad Prize winner of the semi/non technical paper award category

Anugerah Penerbitan
Publication Awards

Anugerah ini diberikan kepada pegawai penyelidik yang telah menghasilkan penerbitan yang terbaik pada tahun ini. Pemenang bagi pelbagai kategori penerbitan adalah seperti yang berikut:

These awards were conferred to research officers for their outstanding publications for the year. Winners of the various categories of publications in 2005 were as follows:

Penerbitan Teknikal / *Technical Papers*

Pertama / *First*
Spatial structure and genetic diversity of two tropical tree species with contrasting breeding systems and different ploidy levels. Molecular Ecology 13(3):657-669
Ng, K.K.S., Lee, S.L. and Koh, C.L.

Kedua / *Second*
Conservation status of *Hopea subalata* (Dipterocarpaceae) in Peninsular Malaysia. Journal of Tropical Forest Science 16(3):271-282
Chua, L.S.L., Nurulhuda, H.M., and Saw, L.G.

Ketiga / *Third*
A revision of the rattan-feeding genus, *Zela de Niveville* (Lepidoptera:Hesperidae). Malayan Nature Journal 56(4):317-367
Kirton, L.G. and Eliot, J.N.

Penerbitan Separa/Bukan Teknikal / *Semi/Non-Technical Papers*

Pertama / *First*
An evaluation of impacts of the implementation of Malaysia criteria and indicators (MC&I) logging specifications on residual stands. Proceedings of KUSTEM 3rd Annual Seminar on Sustainability, Science and Management
Wan Mohd. Shukri, W.A., Samsudin, M., Ismail, H. and Nur Hajar, Z.S.

Kedua / *Second*
Diseases and potential threats to *Acacia mangium* plantations in Malaysia. Unasylva 217(55):31-35
Lee Su See

Ketiga / *Third*
Timber versus steel roof trusses in the Malaysian construction industry. Pp 295-307 in Lee, S.S., Aminah, H., Norini, H., Lim, S.C. and Lim, H.F. (Eds.). Proceedings of the Conference on Forestry and Forest Products Research 2003 (CFFPR 2003) Forest and Society. Kuala Lumpur, 6 to 8 October, 2003, FRIM
Norini, H. and Mohd. Azmi, M.I.

Anugerah Tesis Terbaik
Best Thesis Award

Berikut ialah pemenang anugerah tesis terbaik bagi kategori Ph.D dan Sarjana:

The following were awardees of the best thesis award for Ph.D and M.Sc. categories:

Penerima / ***Awardees***

Kategori Ph.D. / ***Ph.D. Category***

Pertama / ***First***
An *in-vitro* study on the potential anti-plaque effect of *Piper betle* and *Pisidium guajava*
Fathilah, A.R.

Kedua / ***Second***
Chemical constituents and biological activities of selected *Cinnamomum* species (Lauraceae) and *Melicope* cf. hookeri T.G. Hartley (Rutaceae)
Nor Azah, M.A.

Kategori M.Sc. / ***M.Sc. Category***

Pertama / ***First***
Determination of primary specifications of an oil palm biomass processing machine through quality function deployment
Mahmudin, S.

Kedua / ***Second***
Bioassay guided studies on *Andrographis paniculata*
Nor Hayati, A.

Anugerah Penyelidikan Terbaik
Best Research Award

Penerima / ***Awardee***

Furniture components made from laminated veneer oil palm (LVOP)
Abdul Hamid, S., Zulkifli, A., Zulhaimi, H., Hashim, W.S., Zaihan, J., Puad, E., Ab. Jalil, M., Arshad, O., Syarmiza Anuar, A.R.

Perasmian Rumah Terengganu FRIM
Official opening of Rumah Terengganu

Sempena Hari Anugerah dan Ulang Tahun ke-20 FRIM, Setiausaha Parlimen Kementerian Sumber Asli dan Alam Sekitar, Y.B. Dato' Sazmi Miah turut merasmikan Rumah Terengganu FRIM pada 9 Disember 2005.

Rumah Terengganu ini asalnya terletak di Pulau Rusa, Terengganu. Rumah tersebut berusia lebih daripada 100 tahun. Ia dirombak dengan berhati-hati di Pulau Rusa dan dipasang kembali di FRIM pada 1987 menggunakan kaedah dan bahan tradisional.

Y.B. Dato' Sazmi Miah merasmikan pembukaan Rumah Terengganu
Y.B. Dato' Sazmi Miah officiated the opening of Rumah Terengganu

Rumah Terengganu bertiang tradisional
Rumah Terengganu with traditional supporting pillars

Pengikat kayu menyambung pelbagai bahagian rumah tanpa menggunakan paku atau skru
Wooden fasteners join the various parts of the house together instead of nails or screws

Gentian singgora dari Thailand Selatan menyamarkan persekitaran di dalam rumah
South Thailand Singgora clay tiles cool the house

Reka bentuk Rumah Terengganu mengikut struktur rumah tradisional yang dikenali sebagai "Rumah Tiang Dua Belas", iaitu dua belas tiang kayu menyokong keseluruhan struktur. Tiang ini diperbuat daripada kayu cengal *(Neobalanocarpus heimii)*, sejenis kayu keras tempatan yang terbaik dan tahan lama walaupun tanpa rawatan. Bahagian-bahagian di dalam rumah disambung tidak menggunakan skru atau paku, sebaliknya menggunakan pengikat atau penyambung kayu. Bumbungnya dibuat daripada gentian singgora dari selatan Thailand. Gentian ini menyamankan persekitaran di dalam rumah tersebut. Rumah ibu dikhususkan untuk tempat tidur anggota keluarga yang masih bujang sewaktu majlis keramaian. Para tetamu diraikan di serambi atau selesar, iaitu beranda yang terbuka di bahagian hadapan rumah.

Rumah ini merupakan tambahan kepada himpunan rumah tradisional bagi mempamerkan reka bentuk tradisional daripada kayu-kayan Malaysia. Usia rumah tersebut merupakan satu bukti ketahanan cengal sebagai bahan binaan.

In conjunction with FRIM's Awards Day and Anniversary, the Parliamentary Secretary of the Ministry of Natural Resources and Environment Y.B. Dato' Sazmi Miah also officiated the launching of Rumah Terengganu FRIM on the 9 December 2005.

Originally Rumah Terengganu was located in Pulau Rusa about 50 m from Sungai Terengganu. The age of the house is in excess of a hundred years old. The house was carefully dismantled from Pulau Rusa and reassembled in FRIM in 1987 using traditional methods and materials.

The design of Rumah Terengganu follows the traditional house structure known as "Rumah Tiang Dua Belas" where a total of twelve solid timber posts in three rows of four, supports the whole structure. These posts are of chengal (Neobalanocarpus heimii) one of the best local hardwoods which is durable even without treatment. The various parts of the house were jointed together by wooden fasteners or connectors instead of nails or screws. The roof is made of Singgora clay tiles traditionally from South Thailand. These tiles make the house cool. The main house (Rumah Ibu) was reserved for social ceremonies and served as a sleeping area for unmarried members of the house. Guests were entertained in an open verandah at the front of the house called Serambi or Selesar.

FRIM has added this house into its collections of traditional houses to showcase traditional indigenous designs of Malaysian timber. The age of the house is a testament to the durability of chengal as a building material.

PERISTIWA LAIN
OTHER EVENTS

Persidangan Penyelidikan Perhutanan dan Keluaran Hutan (CFFPR 2005)
Conference on Forestry and Forest Products Research (CFFPR 2005)

Persidangan Penyelidikan Perhutanan dan Hasil Hutan (CFFPR 2005) telah diadakan dari 22 hingga 24 November 2005 di Kuala Lumpur. Persidangan ini merupakan anjuran FRIM bersama-sama National Institute for Environmental Studies (NIES), Jepun dan Projek Hutan Paya Gambut di bawah pembiayaan UNDP/GEF. Tema persidangan pada kali ini ialah *Investment for Sustainable Heritage and Wealth.*

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Persidangan yang diadakan dua tahun sekali ini dirasmikan oleh Setiausaha Parlimen, Kementerian Sumber Asli dan Alam Sekitar, Y.B. Dato' Sazmi Miah. Dua ucaptama telah disampaikan oleh Datu Dr. Michael Dosim Lunjew (Ketua Setiausaha Kementerian Perusahaan Perladangan dan Komoditi) dan Dato' Mohd. Nazuri Hashim Shah (Ketua Pengarah Lembaga Industri Kayu-Kayan Malaysia). Lebih daripada 240 orang peserta telah menghadiri persidangan ini.

Persidangan ini dibahagikan kepada enam sesi, iaitu Perhutanan dan Pemuliharaan, Bioteknologi dan Produk Semula Jadi, Pengurusan Ekosistem Landskap Tropika, Ekosistem Hutan Paya Gambut, Hutan Tanaman serta Hasil Hutan dan Perkhidmatan. Sebanyak 53 kertas kerja dibentangkan, 38 poster dipamerkan serta tayangan video dipersembahkan semasa persidangan. Penganjur persidangan juga turut mengadakan lawatan selepas-persidangan yang bertajuk *From Plantation to Pencils, Staedtler Leads the Way* dan *Rubber Wood Means Revenue for Robin Resource.*

The Conference on Forestry and Forest Products (CFFPR 2005), held on 22 to 24 November 2005 at the Pan Pacific Hotel in Kuala Lumpur, was jointly organized by FRIM, National Institute for Environmental Studies (NIES) of Japan and Peat Swamp Project, UNDP/GEF Funded (MAL/99/G31). The theme of the conference was Investment for Sustainable Heritage and Wealth.

Y.B. Dato' Sazmi Miah, the Parliamentary Secretary of the Ministry of Natural Resources and the Environment, officiated the biannual conference. Two keynote addresses were delivered, one by Datu Dr. Michael Dosim Lunjew (Secretary General, Ministry of Plantation Industries and Commodities) and the other by Dato' Mohd. Nazuri Hashim Shah (Director General, Malaysian Timber Industries Board). The conference was attended by over 240 participants.

1 Ketua Pengarah FRIM menyampaikan ucapan alu-aluan pada majlis perasmian CFFPR
The General Director of FRIM giving the welcoming speech at the opening ceremony of the CFFPR

2 Y.B. Dato' Sazmi Miah merasmikan CFFPR
Y.B. Dato' Sazmi Miah officiated the opening ceremony of the CFFPR

3 Peserta yang menghadiri majlis perasmian CFFPR
Participants at the CFFPR opening ceremony

The conference had six sessions, namely Forestry & Conservation, Biotechnology & Natural Products, Ecosystem Management in Tropical Landscapes, Peat Swamp Forest Ecosystems, Planted Forests and Forest Products & Services. A total of 53 oral papers, 38 posters and one short video film were presented during the conference. Two post-conference tours entitled "From Plantation to Pencils, Staedtler Leads the Way and Rubber Wood Means Revenue for Robin Resources were also conducted.

Persidangan Pulpa dan Kertas
Pulp and Paper Conference

Persidangan Pulpa dan Kertas telah diadakan di Kuala Lumpur dari 16 hingga 18 Ogos 2005 yang bertemakan "Plantation, Recycled and Non-Wood Fibres - The Way Forward". Persidangan ini dirasmikan oleh Setiausaha Parlimen Kementerian Sumber Asli dan Alam Sekitar, YB. Dato' Sazmi Miah. Persidangan anjuran FRIM ini turut dibantu oleh FFPRI, Jepun, Persatuan Pengeluar Pulpa dan Kertas Malaysia (MPPMA) dan *The Technical Association of the Australian and New Zealand Pulp and Paper Industry Inc. (APPITA).* Paper Asia ialah majalah rasmi persidangan.

Sebanyak 167 persatuan daripada 11 buah negara telah menghadiri persidangan ini. Ia telah berjaya menghimpunkan ramai penyelidik dunia yang terkenal dalam bidang pulpa dan kertas seperti Dr. Eric Xu dari Andritz, Amerika Syarikat, Dr. Ian Parker dari Universiti Monash, Australia dan Dr. Ryohei Tanaka dari FFPRII, Jepun. Empat syarikat telah mempamerkan produk dan perkhidmatan mereka. Ucaptama yang bertajuk *"Economics and Market Status of the Pulp and Paper Industry in South East Asia"* telah disampaikan oleh Setiausaha Agung Persatuan Pengeluar Pulpa dan Kertas Malaysia (MPPMA), Tuan Hj. Mas'ut A. Samah.

Persidangan dibahagikan kepada lima sesi, iaitu Bahan-Bahan Mentah; Tahap Pencapaian Teknologi; Penyelidikan dan Pembangunan dan Produk Baru; Status Ekonomi dan Pasaran serta Isu-Isu Alam Sekitar dalam Pengeluaran Pulpa dan Kertas. Lima puluh kertas kerja dan poster telah dibentangkan di samping dua persembahan multimedia tentang "Potensi Sumber bagi Pulpa dan Kertas" dan "Industri Pulpa dan Kertas di Malaysia".

The Pulp and Paper Conference was held in Kuala Lumpur from 16 to 18 August 2005 with the theme "Plantation, Recycled & Non-Wood Fibres - The Way Forward". The conference was officiated by the Parliamentary Secretary of the Ministry of Natural Resources and Environment, YB. Dato' Sazmi Miah. The conference which was organized by FRIM was supported by the Forestry and Forest Products Research Institute (FFPRI), Japan, Malaysia Pulp and Paper Manufacturers Association (MPPMA) and The Technical Association of the Australian and New Zealand Pulp and Paper Industry Inc. (APPITA). The magazine called Paper Asia was the official magazine for the conference.

A total of 167 participants from 11 countries attended the conference. The conference has successfully gathered several renown researchers in the pulp and paper field such as Dr. Eric Xu from Andritz, USA, Dr. Ian Parker from Monash University, Australia and Dr. Ryohei Tanaka from FFPRI, Japan. Four companies also exhibited their products and services during the conference. The keynote address entitled "Economics and Market Status of the Pulp and Paper Industry in South East Asia" was delivered by the Secretary General of the Malaysia Pulp and Paper Manufacturers Association (MPPMA), Tuan Hj. Mas'ut A. Samah.

The conference was divided into five sessions, namely Raw Materials, State-of-the-Art Technologies, R&D and New Products, Economics and Market Status and Environmental Issues in the Production of Pulp and Paper. A total of 50 papers and posters were presented during the conference. Apart from that two multimedia presentations on the topics of Potential Resources for Pulp and Paper as well as Pulp and Paper Industry in Malaysia were shown to the participants.

Persidangan *Best of Both Worlds:* Pendidikan Alam Sekitar dan Pembangunan Lestari

Best of Both Worlds Conference: Environmental Education for Sustainable Development

Persidangan anjuran Bahagian Perhutanan dan Pemuliharaan, FRIM ini telah diadakan dari 6 hingga 8 September 2005 di Kuala Lumpur dan dirasmikan oleh Setiausaha Parlimen, Y.B. Dato' Sazmi Miah bagi pihak Menteri Sumber Asli dan Alam Sekitar. Persidangan ini merupakan anjuran bersama Dewan Bandaraya Kuala Lumpur, Universiti Putra Malaysia, Jabatan Perhutanan Semenanjung Malaysia, Persatuan Pencinta Alam Malaysia, Jabatan Hidupan Liar dan Taman Negara, Jabatan Alam Sekitar, Pusat Perkembangan Kurikulum dan Bahagian Pendidikan Guru, Kementerian Pelajaran Malaysia. Persidangan ini telah menarik 80 peserta dari dalam dan luar negara iaitu Afrika Selatan, Kanada, Amerika Syarikat, Denmark dan Jepun.

Dalam ucapan perasmiannya, Dato' Sazmi menyatakan tentang kepentingan persidangan ini dalam meningkatkan kefahaman antara pihak yang berkepentingan, sektor awam dan swasta mengenai pendidikan alam sekitar, pengukuhan dan pelaksanaan polisi. Persidangan seumpama ini menyediakan platform untuk pertukaran idea dan maklumat di samping dapat mewujudkan jaringan kerja. NRE sedar akan kepentingan meningkatkan kesedaran awam terutamanya golongan muda dalam isu alam sekitar. Agensi-agensi di bawah NRE digalakkan mengadakan program-program yang melibatkan penyertaan orang awam, di samping menyebarkan maklumat melalui penerbitan dan seminar.

Ucaptama oleh Profesor Callie Loubser
Keynote address by Professor Callie Loubser

Sebanyak 22 kertas kerja telah dibentangkan, sembilan poster dipamerkan dan empat bengkel dijalankan. Isu yang dibangkitkan termasuklah kesedaran pendidikan alam sekitar di bandar, pendidikan alam sekitar dalam kurikulum sekolah dan masyarakat, di samping merapatkan jurang antara teori akademik dan penggunaannya. Penyampai ucaptama, Profesor Callie Loubser dari University of South Africa menekankan tentang kepentingan kesedaran alam sekitar dan alam semula jadi penduduk di bandar. Profesor Callie turut menggariskan strategi pendidikan alam sekitar di kawasan bandar.

Peserta dibahagikan kepada empat kumpulan untuk mengadakan percambahan fikiran tentang pelbagai topik pengurusan dalam penubuhan pusat pendidikan alam semula jadi di kawasan bandar. Tiga bengkel secara amali dijalankan serentak dengan bimbingan tiga orang pakar iaitu aktiviti pendidikan alam semula jadi di bandar oleh Profesor Callie Loubser, teknik penilaian oleh Dr. Shawn Morford dan pendidikan tentang kelawar oleh Dr. Tigga Kingston. Tiga belas orang peserta pula memilih untuk mengikuti lawatan selepas-persidangan ke titian sudur FRIM.

The three day conference was organised by the Forestry and Conservation Division from 6 to 8 September 2005, Kuala Lumpur. The function was officiated by Y.B. Dato' Sazmi Miah, Parliamentary Secretary, on behalf of the Minister of Natural Resources and Environment. The co-organising agencies were Kuala Lumpur City Hall, Universiti Putra Malaysia, Forestry Department of Peninsular Malaysia, Malaysian

In his opening address, the Parliamentary Secretary highlighted the importance and usefulness of the conference in enhancing better understanding between stakeholders, public and private sectors, with regards to environmental education (EE), policy enhancement and implementation. Such conferences provide an avenue to exchange ideas, information and create networks. NRE acknowledges the importance of public awareness especially the young ones on environmental issues. Agencies under the NRE were encouraged to enhance their public participation programmes and to disseminate information through publications and seminars.

Twenty-two oral papers were presented, nine posters exhibited and four workshops conducted. The topics or issues discussed included urban EE awareness, EE in school curriculum and community, and the bridging of gaps between academic theories and applications. The keynote speaker, Professor Callie Loubser of the University of South Africa, highlighted the importance of the urban and the natural environment to urbanites. Professor Callie also suggested a strategy for EE in cities beyond isolated awareness strategies.

Participants were divided into four groups in the indoor workshop, to brainstorm on various management topics on establishing nature education centres in urban areas. Three concurrent hands-on workshops conducted by three experts on the last day were Professor Callie Loubser (practical urban EE activities), Dr. Shawn Morford (evaluation techniques) and Dr. Tigga Kingston (bat education). Thirteen participants opted for the post-conference tour to FRIM's canopy walkway tour after lunch.

Bengkel Pemantauan Projek IRPA
IRPA Project Evaluation Workshop

Dalam Rancangan Malaysia Kelapan (RMK-8), FRIM telah berjaya mendapat pembiayaan IRPA bagi 78 projek penyelidikan berjumlah RM 13 juta. Selaras dengan polisi IRPA di bawah Kementerian Sains, Teknologi dan Inovasi, tiga bengkel pemantauan projek IRPA telah dianjurkan oleh Bahagian Pengurusan Penyelidikan, FRIM. Bengkel Pemantauan Projek IRPA yang pertama telah diadakan pada 1 hingga 3 Februari 2005 di A'Famosa Resort, Alor Gajah, Melaka. Bengkel ini terdiri daripada dua sesi yang dijalankan secara serentak. Sesi pertama melibatkan penilaian 69 projek penyelidikan oleh lima panel yang dikategorikan di bawah tajuk Agroindustri, Alam Sekitar, Pembuatan dan Pembinaan, Sains dan Kejuruteraan, dan Ekonomi. Serentak dengan itu, satu sesi pembentangan yang melibatkan 64 projek penyelidikan turut diadakan.

Sebahagian peserta bengkel
Some participants of the workshop

Lanjutan daripada bengkel ini, dua lagi bengkel turut diadakan di FRIM iaitu pada 25 dan 26 Julai serta 14 dan 15 Disember 2005. Kedua-dua bengkel ini diadakan bagi menilai kemajuan projek penyelidikan IRPA yang telah dinilai pada awal tahun.

During the period of the Eighth Malaysian Plan, FRIM managed to obtain 78 IRPA projects with a combined financial total of RM 13 million. In line with IRPA policy under the aegis of the Ministry of Science and Technology and Innovation (MOSTI) three monitoring workshops were organized by the Research Management Division, FRIM. The first IRPA evaluation workshop was held on the 1 to 3 February at the Alor Gajah A'Famosa Resort in Melaka for FRIM's IRPA projects. The format of the workshop involved two major sessions run concurrently. The first was an evaluation session where five panels categorized under Agro-industry, Environmental, Manufacturing and Construction, Science and Engineering and Economics were involved in evaluating a total of 69 projects. A concurrent session of project presentations was also held in the form of a seminar. A total of 64 projects were presented.

Subsequent to this workshop two other workshops, were held on 25 to 26 July and 14 to 15 December respectively within FRIM. These workshops were organized to chart the progress of the IRPA projects evaluated at the beginning of the year.

A'Famosa Resort, Melaka, tempat bengkel diadakan
A'Famosa Resort, Melaka, where the workshop was held

Ekspidisi Botani ke Gunung Menkobo, Ranau, Sabah
Botanical Expedition to Gunung Menkobo, Ranau, Sabah

Ekspedisi botani ke Gunung Menkobo di daerah Ranau telah dianjurkan bersama-sama oleh FRIM dan Jabatan Perhutanan Sabah di bawah projek "Tree Flora of Sabah and Sarawak" (TFSS). Ekspedisi ini diketuai oleh Encik John Sugau dan disertai seramai 30 orang pegawai penyelidik dan kakitangan sokongan dari Jabatan Perhutanan Sabah, FRIM, Jabatan Perhutanan Sarawak, UPM dan Sabah Parks. Objektif ekspedisi ini adalah untuk menjalankan kajian lapangan famili tumbuh-tumbuhan yang sedang dikaji oleh ahli botani yang terlibat dengan projek TFSS dan untuk membuat pengutipan khusus dan am spesimen herbarium dari lokasi yang kurang diketahui dari segi botaninya di Borneo.

Gunung Menkobo terletak di bahagian tengah Sabah, kira-kira 100 km ke arah barat Sandakan. Ia dikelaskan dalam kelas II iaitu hutan simpan komersial di bawah pengurusan TSH Resources Berhad. Hutan di sekitar Gunung Menkobo terdiri daripada hutan campuran dipterokarpa, hutan riparian dan hutan pergunungan rendah. Koleksi spesimen tumbuhan dibuat di sekitar Sungai Kiberibi hingga ke puncak Gunung Menkobo dan Ulu Sungai Tungud pada julat 5 hingga 12 km radius dari tapak perkhemahan. Tapak perkhemahan didirikan berhampiran Sungai Kiberibi, yang terletak pada kedudukan 05° 51.16' N dan 116° 59.15' E.

Sebanyak 738 nombor koleksi herbarium telah dikutip, terdiri daripada spesies pokok berkayu dari famili Annonaceae, Dipterocarpaceae, Euphorbiaceae, Fagaceae, Lauraceae, Rubiaceae dan Theaceae dan tumbuhan tidak berkayu dari famili Begoniaceae, Melastomataceae, Nepenthaceae, Orchidaceae, Palmae dan Zingiberaceae. Berdasarkan contoh tumbuhan yang dikutip, antara famili yang mempunyai spesies terbanyak ialah Orchidaceae, Rubiaceae, Euphorbiaceae, Zingiberaceae, Annonaceae, Anacardiaceae, Melastomataceae, Palmae, Leguminosae, Verbenaceae, Fagaceae dan Theaceae.

Jumlah koleksi dan jumlah spesies yang dikutip adalah kurang daripada yang dijangkakan disebabkan musim berbunga dan berbuah yang baru berlalu. Ini dapat dilihat dengan terdapatnya buah-buah yang reput di atas lantai hutan. Permerhatian-permerhatian lain yang ketara semasa ekspedisi ini ialah kehadiran *Gymnostoma sumatranum* dan *Phyllocladus hypophyllus* pada altitud rendah (600-1200 m). Selain pengutipan spesimen herbarium, tumbuh-tumbuhan hidup juga dikutip semasa ekspedisi ini untuk ditanam di Arboretum Sepilok untuk tujuan pemuliharaan *ex-situ*.

A botanical expedition to Gunung Menkobo in Ranau district was jointly organized by FRIM and Forestry Department of Sabah under the Tree Flora of Sabah & Sarawak (TFSS) Project. The expedition led by Mr. John Sugau comprised a total of 30 Research Officers and supporting staff from FRIM, Sabah Forest Department, Sarawak Forest Department, UPM and Sabah Parks. The objectives of the expedition were to conduct field studies of tree families currently under the investigation by botanists involved in the TFSS project and to make specialized as well as general herbarium specimen collections from this botanically little known area in Borneo.

Gunung Monkobo is located in the central part of Sabah, about 100 km west of Sandakan. It is within the class II, commercial forest reserve managed by the TSH Resources Berhad. The forests around Gunung Monkobo comprise of mixed dipterocarp, riparian and lower montane forests. The collection was made at Sungai Kiberibi up to the summit of Gunung Monkobo and Ulu Sungai Tungud at the range of 5 to 12 km radius from the base camp. The Base Camp was established near Sungai Kiberibi, located about 05° 51.16' N and 116° 59.15' E.

Peserta ekspedisi
Participants of the expedition

Puncak Gunung Menkobo
Summit of Gunung Menkobo

Hutan gunung di bahagian yang lebih rendah, berhampiran Gunung Menkobo
Lower montane forest on the approaches to Gunung Menkobo

A total of 738 herbarium collection numbers were made, comprising specimens of tree species of the Annonaceae, Dipterocarpaceae, Euphorbiaceae, Fagaceae, Lauraceae, Rubiaceae and Theaceae, and non-tree specimens of different genera and families e.g., Begoniaceae, Melastomataceae, Nepenthaceae, Orchidaceae, Palmae and Zingiberaceae. Based on the specimens collected, among the speciose families are the Orchidaceae, Rubiaceae, Euphorbiaceae, Zingiberaceae, Annonaceae, Anacardiaceae, Melastomataceae, Palmae, Fagaceae and Theaceae.

The number of collection and thus number of species documented is less than expected because flowering and fruiting seasons were just over. This was evident from the rotten fruits observed on the forest floor. Other noteworthy observations made during the expedition include: the presence of Gymnostoma sumatranum as well as Phyllocladus hypophyllus at low altitudes (600-1200 m). In addition to herbarium specimens, live plants were also collected during the expedition to be planted at the Sepilok Arboretum for ex-situ conservation.


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Program Pensijilan Arborist
Arborists Certification Programme

Cawangan Hutan Bandar dan Landskap di bawah Program Hutan Bandar dan Rekreasi Hutan sering menganjurkan Kursus Landskap dan Penyenggaraan Pokok untuk kakitangan majlis perbandaran dan agensi swasta semenjak tahun 1995. Dalam memenuhi keperluan perkembangan semasa untuk melahirkan kalangan profesional yang berkelayakan dalam pemeliharaan pokok, berpengetahuan, berkemahiran dan mempunyai tahap kecekapan yang tinggi dalam bidang pemeliharaan pokok, FRIM telah memperkenalkan buat julung-julung kalinya kursus lanjutan dalam penyenggaraan pokok yang dikenali sebagai Program Pensijilan Arborist. Program ini mendapat akreditasi dan pensijilan daripada Pertubuhan Arborikultur Antarabangsa. Kursus ini dianjurkan bersama-sama Universiti Putra Malaysia (UPM), Forest and Landscape of Denmark (FLD) dan Danish International Development Agency (DANIDA) di bawah inisiatif Program Kerjasama Kerajaan Malaysia dan Denmark. Program ini telah diadakan di Akademi Hutan Hujan, Universiti Putra Malaysia pada 24 Mei hingga 23 Jun 2005.

1 Buah muda *Dipterocarpus oblongifolius* (Dipterocarpaceae)
Young fruits of Dipterocarpus oblongifolius (Dipterocarpaceae)

2 Bunga *Sterculia* sp. (Sterculiaceae)
Flowers of Sterculia sp. (Sterculiaceae)

3 Pokok *Syzygium* sp. (Myrtaceae)
A plant of Syzygium sp. (Myrtaceae)

4 Buah *Lithocarpus pulcher* (Fagaceae)
Fruits of Lithocarpus pulcher (Fagaceae)

5 Hutan riparian di Sungai Kiberibi
Riparian forest at Sungai Kiberibi

Kursus ini bertujuan untuk menyediakan program pendidikan yang dapat meningkatkan kecekapan teknikal di kalangan mereka yang terlibat dalam industri pemeliharaan pokok. Proses untuk mendapatkan sijil dan kenaikan pangkat merupakan insentif kepada individu untuk meneruskan pengembangan kerjaya profesional mereka. Dr. William Fountain, seorang profesor berpengalaman dari University Kentucky, Amerika Syarikat merupakan tenaga pengajar utama dan beliau telah dibantu oleh Profesor Thomas Randrup dari The Royal Veterinary and Agriculture, Denmark serta En. K. Ganeson dari National Park Board, Singapura. Kursus ini telah disertai seramai 30 peserta dari sektor kerajaan dan institusi swasta. Dari jumlah tersebut, seramai 23 orang telah lulus dalam peperiksaan berkaitan dan merupakan kumpulan pertama yang dianugerahkan pensijilan arborist di Malaysia.

The Urban Forestry and Landscape branch in the Urban Forestry and Forest Recreation Programme have been conducting Landscape and Tree Maintenance Courses to municipality staff and private agencies since 1995. In view of the growing need for qualified tree care professionals that are knowledgeable, skillful and with a high level of competency in the field of tree care, FRIM has introduced for the first time an advanced course in tree maintenance known as the Arborist Certification Programme. This course is accredited and certified by the International Society of Arboriculture and is jointly organized by FRIM, Universiti Putra Malaysia (UPM), Forest & Landscape, Denmark (FLD) and the Danish International Development Agency (DANIDA) under the initiative of the Urban Forestry and Urban Greening Twinning Programme between Malaysia and Denmark. The first programme was held at the Rainforest Academy, Universiti Putra Malaysia from 24 May to 23 June 2005.

The objective of the course was to improve technical competency in the tree care industry through accreditation and certification of skills. This process of becoming certified would provide incentives for individuals to develop their careers professionally. Dr William Fountain, a professor from University of Kentucky, U.S.A. was the chief resource person and he was assisted by Prof. Thomas Randrup from the Royal Veterinary and Agriculture, Denmark and Mr K. Ganeson from the National Park Board, Singapore. The course successfully attracted 30 participants from governments and private institutions and out of these, 23 participants passed the examinations and became the first batch of the certified arborists in Malaysia.

LAWATAN RASMI
OFFICIAL VISITS

Tarikh / *Date*	Pelawat / *Visitor*
26 January	Visitors from the Arab Academy For Science, Technology and Maritime Transport of Cairo. (TPM-ACADEMY SDN. BHD.)
1 March	Delegation from the Royal Forestry Department of Thailand
8 March	Delegation from the Secretariat of the MATRADE Outreach Program & Market Development Grant
1 April	Delegations from Agensi Angkasa Negara Malaysia & Russia
12 May	Delegation from the Korea Forest Research Institute
30 May	Study Visit of H.E. Prof. Dr. Bountiem Phissamay, Minister in the Prime Minister's Office, President of STEA and Vice Chairman of the National Environment Committee in the People's Democratic Republic of Laos
22 June	Y.Bhg. Tan Sri Dr. Yusof Nor and Directorate of FELDA
27 June	Mr. Tony Neilson, Publisher of In Wood International, New Zealand
6 July	Delegation from the European Timber Trade Representative
2 August	Visitors from the MTCC Staff Training Program (Malaysia, London, Dubai)
17 August	Visitors from Vietnam
25 August	Participants from the Malaysian Technical Cooperation Programme
19 September	Delegation from the EU VERIFOR Project (Overseas Development Institute)
20 September	Delegation from the Asian Development Bank (Forest Sector Project Tour)
24 October	Visitors from France
16 December	Faculty members from the Kehutanan Institut Pertanian Bogor, Indonesia

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Tropical Forest Biodiversity Centre

Pengarah
Director

Dr. Saw Leng Guan
B. Sc. For. (UPM)
M. Sc., Ph. D. (Reading)

Pegawai Penyelidik
Research Officers

Dr. Lillian Chua Swee Lian
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Dr. Richard Chung Cheng Kong
B. Sc. (Hons.), M. Sc., Ph. D. (UM)

Ahmad Che Abd. Salam
B. Eng. (UPM)
Post Grad. Dip. (Italy)
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Noorsiha Ayop
B. Sc. (Hons.) (UM)

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B. Agric. Sc., M. Agric. Sc.(UPM)

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B. Sc. Biol. (California State)
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B. Sc. (Hons.) Biol. (UKM)
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Hamidah Mamat
B. Sc. Geoinform. (UTM)
(From October 2005)

Phoon Sook Ngoh
B. Sc. (Hons.) Biol., M. Sc. (UPM)
(From October 2005)

Ummul Nazrah Abdul Rahman
B. Sc. Ed. (Hons.), M. Sc. (UKM)
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Chew Ming Yee
B. Sc. For. (UPM)
(From October 2005)

Elango Velautham
B. Sc. (Hons.) Hort. (UPM)
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B. Sc. Bio-indus. (UPM)

Program Pengurusan dan Ekologi Hutan
Forest Management and Ecology Programme

Pengarah
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Dip. For., B. Sc. For. (UPM)

Nur Fadzliza Kamarulbahrin
B. Sc. For. (UPM)

Muhammad Ezhar Yusuf @ Antik

Mohd. Aswad Ramlan

Mohd. Suhaimi Mohd. Noor

Penolong Pegawai Penyelidik
Assistant Research Officers

Shahrulzaman Idris
Dip. For. (UiTM)

Mohd. Md. Sahat

Nazaruddin Ramli
Dip. Agric. (UPM)

Rodziah Hashim
Dip. Sc. (UiTM)

Mohd. Azhan Shah Idris
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Sadali Sahat

Harfendy Osman
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Program Hutan Bandar dan Rekreasi
Urban Forestry and Recreation Programme

Pengarah
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M. Sc. Res. Mgmt. & Policy (New York)
Ph. D. (UPM)

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Research Officers

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Ph. D. Plant Physiology (UM)

Adnan Mohamad
B. Town & Country Plan. (UTM)
M. Sc. Lands. Ecl. Des. & Mgmt. (London)

Ahmad Azaruddin Mohd. Noor
B. Sc. Hort. (UPM)

Zalani Abd. Kadir
B. Lands. Des. (Washington)
(On study leave)

Ahmad Nazarudin Mohd. Roseli
B. Sc. Hort. (UPM)

Sreetheran Maruthaveeran
B. Sc. Cons. Bio. (UMS)
M. Sc. Trop. For. Mgmt. (UPM)

Kho Lip Khoon
B. Sc. Env. (UPM)
M. Sc. Soil Chem. (UNIMAS)

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M. Sc. For. (UPM)

Arkitek Landskap Kontrak
Contract Landscape Architect

Nik Adlin Nik Mohamed Sukri
B. Lands. Des. (UTM)

Pegawai Perancang Bandar dan Desa Kontrak
Contract Town Planning Officer

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Assistant Research Officers

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Azahari Hj. Mohd. Yusoff
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Mohd. Rizal Mohd. Kassim
Dip. Plant. Mgmt. (UiTM)

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Dip. For. (UPM)
B. Sc. For. (UPM)

Penolong Pegawai Perancang Bandar
Assistant Town Planning Officer

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Penolong Pegawai Penyelidik Kontrak
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Siswazah Penyelidikan
Graduate Research Assistantship

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B. Sc. For. (UPM)

Chong Mew Im
B. Sc. For. (UPM)

BAHAGIAN PEMBANGUNAN PRODUK
PRODUCT DEVELOPMENT DIVISION

Pengarah Kanan
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B. Sc. (Hons.), M. Sc. App. Sc. (UKM)
Ph. D. (Aston)

Program Kimia Kayu
Wood Chemistry Programme

Pengarah
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B. Sc. For. (Louisiana)
M. Sc. For. Prod. (Virginia)
Ph. D. (Manchester)

Pegawai Penyelidik
Research Officers

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B. Sc. For. (Montana)
M. Sc. (UPM),
Ph. D. (Manchester)

Salamah Selamat AMIC, MIQ
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B. Sc. Chem (Kansas State),
M. Sc. Chem (Missouri-Rolla)
Ph. D. (UPM)

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B. Chem. Eng. (Vanderbilt)

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B. Sc., M. Sc. Chem. Eng. (USM)

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B. Sc. Analytical Chem. (USM)

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B. Sc., M. Sc. Chem. Eng. (UKM)

Pegawai Penyelidik Kontrak
Contract Research Officers

Tumirah Khadiran
B. Sc., M. Sc. Chem. (UKM)

Penolong Pegawai Penyelidik
Assistant Research Officers

Zaitun Said
Dip. Wood Tech. (UiTM)

Azizi Abdul Jalil
Dip. Wood Tech. (UiTM)

Noraidah Subakin
Dip. Sc. (UiTM)
B. Sc. Mat. Sc. (UKM)

Program Pembinaan dan Perlindungan Kayu
Timber Construction and Protection Programme

Pengarah
Director

Dr. Mohd. Dahlan Jantan
B. Sc. For. (UPM),
M. Agric. Dev. (Ghent),
Ph. D. (Portsmouth)
(Until May 2005)

Dr. Rahim Sudin, AMIC, AMSA
B. Sc. (Hons.) (UKM)
M. Sc. (USM)
Ph. D. (Sheffield)
(From May 2005)

Pegawai Penyelidik
Research Officers

Hj. Mohd. Shukari Midon, AMN
B. Sc. Mech. Eng. (Strathclyde)

Dr. Gan Kee Seng
Dip. Mech. Eng.(UTM)
B. Sc. Mech. Eng.,
Ph. D. (Strathclyde)

Dr. Koh Mok Poh, AMIC
B. Sc. (Hons.) (London)
Ph. D. (Du Maine)

Dr. Mohamad Omar Mohamad Khaidzir
Dip. Civil Eng. (UTM)
B. Sc. Civil Eng. (CBU Memphis)
M. Sc. (British Columbia)
Ph. D (Sheffield)

Dr. Salmiah Ujang
Dip. Wood Tech.(UiTM),
B. Sc., M. Sc. (Mississippi State)
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B. Sc. (Hons.) (UKM)
M. Sc. (UPM)

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B. Sc. (Hons.) (UPM)
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B. Sc. (Hons.) (USM),
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Mohamad Jani Saad
B. Tech (Hons.) (USM)
M. Sc. (USM)

Maria Zura Mohd. Zain
B. E. Civil Eng. (Hons.) (USM)

Penolong Pegawai Penyelidik
Assistant Research Officers

Habibah Mohamad
Dip. Ind. Chem. (UiTM)

Rozaida Latip
Dip. Wood Tech. (UiTM)

Nor Azian Mohd. Kasby
Dip. Civil Eng. (UTM)

Baharuddin Kamaruddin
Dip. Wood Tech. (UiTM)
B. Sc. Wood. Tech. (UPM)

Roszalli Mohd.

Program Pemprosesan dan Teknologi Kayu
Timber Processing and Technology Programme

Pengarah
Director

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Ph. D. (Brighton)

Pegawai Penyelidik
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B. Sc. (Hons.), M.Sc. (Wales)
Ph. D. (Reading)

Dr. Wan Tarmeze Wan Ariffin
B. Sc. Mech. Eng. (Portland)
M. Sc. Mech. & System Eng. (UPM)
Ph. D Civil Eng (Birmingham)

Mohd. Arshad Saru
Dip. Mech. Eng.(UTM)
B. Eng. (Sunderland)

Lim Seng Choon PPN., AMP
Dip. Timb. Stud. (Bucks.)
M. Sc. (Wales)

Mohd. Tamizi Mustafa
Dip. Wood Tech. (UiTM)
B. Sc. For. (UPM)

Abdul Hamid Saleh
B. Ind. Design (UiTM)
B. Sc. (Hons) Fur. Tech. (UiTM)
M. Sc. Fur. Design Strength (UiTM)

Norul Hisham Hamid
B. Sc. For. (UPM)
M. Sc. (USM)

Ong Chee Beng
B. Sc. (Hons) (UPM)

Mohd. Khairun Anwar Uyup
B. Sc. For., M. Sc. For. (UPM)

Khairul Awang
Dip. Plant Mgmt. (UiTM)
B. Sc. (Hons.) Fur. Tech. (UiTM)
M. Sc. WPC (USM)

How Seok Sean
B. Sc. For. (UPM)
M. Sc. Inf. Tech. (UPM)

Sik Huei Shing
B. Sc. For. (UPM)

Pegawai Penyelidik Kontrak
Contract Research Officers

Choo Kheng Ten AMN
B. Sc. (Hons.) UM

Zulkifli Ahmad
B. Furn. Tech. (UiTM)

Thi Bee Kin
B. Sc. Gen. (UKM)

Penolong Pegawai Penyelidik
Assistant Research Officers

Zawawi Kassim
Dip. Sc.(UiTM)

Siti Rafidah Mahmud
Dip. Wood Tech.(UiTM)

Ahmad Ismail

Siswazah Bantuan Penyelidikan
Graduate Research Assistantship

Zulhazmi Ahmed
B. Sc. Int. Design (UiTM)

BAHAGIAN BIOTEKNOLOGI
BIOTECHNOLOGY DIVISION

Pengarah Kanan
Senior Director

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Ph.D. (UPM)

Program Hutan Ladang
Forest Plantations Programme

Pengarah
Director

Dr. Ab. Rasip Ab. Ghani
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B. Sc., M. Sc. (Texas)
Ph. D. (UKM)

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Research Officers

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Ph. D. (Wales)

Ahmad Zuhaidi Yahya
Dip. For. (UiTM)
B. Sc. Res. Econ. (UPM)
M. Sc. For. (Aberdeen)

Rosdi Koter
Dip. For., B. Sc. For. (UPM)

Pegawai Penyelidik
Research Officers

Dr. Adzmi Yaacob
B. Sc. (UM)
M. Sc. (Kent)
Ph. D. (Aberystwyth, Wales)

Dr. Wan Rasidah A. Kadir
B. Sc. (Hons.), M. Sc. (UKM)
Ph. D. (Ghent)

Dr. Ang Lai Hoe
B. Sc. For. (UPM)
M. Sc. (UPLB)
Ph. D. (Aberdeen)

Dr. Gary William Theseira
B. Sc., M. Sc. (Southern Illinois)
Ph. D. (Mississippi State)

Dr. Tsan Fui Ying
B. Sc. Agric., Ph. D. (UPM)
(until 1 June)

Mohd. Ghazali Hassan
Dip. Agric., B. Sc. (UPM)
M. Sc. (UPM)
(from 2 January)

Ho Wai Mun
B. Sc. Env. Mgmt. (UMS)
M. Sc. (UKM)

Dr. Laurence G. Kirton
B. Sc. (Hons.) (USM)
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M. Sc. (UPM)
Ph. D. (Aberdeen)

Mohd. Farid Ahmad
B. Sc. For., M. Sc. (UPM)

Lok Eng Hai
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B. Sc. (Hons.) (UM), M. Sc. (UKM)

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Program Tumbuhan Ubatan
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M.Sc. Plant Syst. (UPM)

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B.Sc. Biotech (UPM)
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Fauziah Abdullah
B.Sc. (Hons) Chem. (UKM)
M.Sc. Chem. (UKM)

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B. Sc. (Hons.) Appl. Chem. (UiTM)

Pin Kar Yong
B. Chem. Eng. (UPM)

Fadzureena Jamaluddin
B.Sc. Biomedic. (UM)

Penolong Pegawai Penyelidik
Assistant Research Officers

Abdull Rashih Ahmad

Mohd. Radzi Ahmad
Dip. MLT (UKM)

Siti Asha Abu Bakar

Nuziah Hashim
Dip. Ind. Chem. (UiTM)

Salbiah Man
Dip. Ind. Chem. (UiTM)

Rohana Sahdan
Dip. Microbiol. (UiTM)

Mazurah Mohamed Isa
Dip. Microbiol. (UiTM)

Halimatus Saadiah Mohamed Emran
Dip. Comp. Sc. (UPM)

Abdul Majid Jalil
Dip. Chem. Eng. (UTM)

Penolong Pegawai Penyelidik Kontrak
Contract Assistant Research Officer

Abu Said Ahmad

Program Bioteknologi Hutan
Forest Biotechnology Programme

Pengarah
Director

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Ph. D. (UKM)

Pegawai Penyelidik
Research Officers

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B. Sc. Agric. (UPM)
M. Sc. For. (Goettingen)
Ph. D. (Edinburgh)

Dr. Lee Soon Leong
B. Sc. (Hons.) (UKM)
M. Phil. (UM)
Ph. D. (UKM)

Dr. Mohd. Ilham Adenan
B. Sc. (Hons.), M. Phil. (UM)
Ph. D. (Okayama)

Dr. Norwati Mohamad
B. Sc. (Hons.), M. Sc. (UKM)
Ph. D. (Reading)

Mohd. Rosli Harun
B. Sc. (Hons.) (UM)
M. Sc. (UKM)

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Dip. Agric., B. Sc. Agric. (UPM)

Asiah Osman
B. Sc. Biotech (UPM)
M. Sc. Conserv. Biol. (UKM)

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B. Sc. (Hons.) (UM)
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M. Sc. Conserv. Biol. (UKM)

Haliza Ismail
B. Sc. (Hons.) (UM)
M. Sc. (UPM)

Dr. Kevin Ng Kit Siong
B. Sc (Hons.) (UMS)
Ph. D. (UM)

Lee Chai Ting
B. Sc. (Hons.) (UKM)
M. Sc. (UKM)

Nashatul Zaimah Noor Azman
B. Sc. (Hons.) (USM)
M. Sc. (London)

Nor Asmah Hassan
B. Sc. (Hons.), M. Sc (UKM)

Nor Hasnida Hassan
B. Sc. (Hons.), M. Sc. (UKM)

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B. Sc. Biotech., M. Sc. (UPM)

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Siti Salwana Hj. Hashim
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Dr. Ng Chin Hong
B. Sc. (Hons), M. Sc., Ph. D. (UKM)

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Norhayati Ismail
B. Sc. (Hons.) Microbiol. (UPM)

Siti Syarifah Mohd. Mutalip
B. Sc. (Hons.) Microbiol. (UPM)

Chang Li Yen
B. Sc. Biotech, M. Sc. Mol. Biol.
(UPM)

Pegawai Penyelidik Kontrak
Contract Research Officers

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M. Sc., Ph. D. (London)

Dr. Saeid Reza Doust Jalali
B. Sc. (Hons.) Microbiol. (Delhi)
M. Sc. Biochem. (Manipal)
Ph. D. (UM)

Rozihawati Zahari
Dip. For. (UPM)
B. Sc. For. (UPM)

Rosilah Ab. Aziz
B.Sc. Biotech. (UMS)

Siti Suhaila Abdul Rahman
B. Sc. Biotech. (UPM)
M. Sc. Biotech. (UPM)
(Until May 2005)

Suria Aziz
M. Sc. Biotech. (London)
(Until June 2005)

Besek Intan Zafina Basok
B. Sc. For., M. Sc. Info. Tech. (UPM)

Nor Datiakma Mat Amin
B. (Hons.) Biotech. (UMS)

Sun Wan Fong
B. Sc. Indus. Biol. (UTM)

Penolong Pegawai Penyelidik
Assistant Research Officers

Ang Khoon Cheng

Siswazah Penyelidikan
Graduate Research Assistantship

Tnah Lee Hong
B. Sc. Indus. Biol. (UTM)

BAHAGIAN PENGURUSAN PENYELIDIKAN
RESEARCH MANAGEMENT DIVISION

Pengarah
Director

Dr. Chan Hung Tuck KMN
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Ph. D. (Aberdeen)

Pegawai Penyelidik
Research Officers

Dr. Sim Heok Choh
B. Eng. (Hons.) (UM)
M. Sc., Ph. D. (Idaho)
(Seconded to APAFRI)

Norhara Hussein
B. Sc. (Hons.) (USM)

Nor Azman Hussein
Dip. Agric. (UPM)
B. Sc. (Louisiana)
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Dip. For. (UiTM)
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Dip. Mass Comm. (UiTM)
M. Sc. Corp. Comm. (UPM)

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Contract Research Officers

Veronica Sarojini Poopathy
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Roshamida Ruslan
B. Sc. (Hons.) Info. Sys. Mgmt.
(UiTM)

PENERBITAN
PUBLICATIONS

Pada tahun 2005, sebanyak 24 judul diterbitkan. Jumlah ini termasuklah dua judul yang diulang cetak atas permintaan ramai iaitu Pocket Checklist of Timber Trees dan Nature's Choice to Wellness: Antioxidant Vegetables/Ulam.

Dua puluh empat judul yang diterbitkan pada tahun 2005 ialah empat keluaran Journal of Tropical Forest Science Vol. 17, tiga keluaran FRIM in Focus, FRIM Reports 82 hingga 84, Timber Technology Bulletin No. 31 hingga 37, Laporan Tahunan 2004, Research Report 2004 dan lima prosiding. Prosiding tersebut ialah Current Trends and Perspectives: Proceedings of the Seminar on Medicinal and Aromatic Plants, Utilisation of Oil Palm Tree: Development of Oil Palm Biomass Industry, Conference on Forestry and Forest Products Research 2003 (dalam CD), Proceedings of the Workshop on Treatment of Timber with Boron Preservative dan Prosiding Seminar Hasil Kajian IRPA RMK-8 2004.

In 2005, a total of 24 publications were produced. This number included the reprints of two popular titles, i.e. Pocket Checklist of Timber Trees and Nature's Choice to Wellness: Antioxidant Vegetables/Ulam.

The 24 publications published were four issues of Volume 17 of the Journal of Tropical Forest Science, three issues of FRIM in Focus, FRIM Reports 82 to 84, Timber Technology Bulletin No. 3 1to 37, Annual Report 2004, Research Report 2004 and five seminar proceedings. The proceedings are Current Trends and Perspectives: Proceedings of the Seminar on Medical and Aromatic Plants, Utilisation of Oil Palm Tree: Development of Oil Palm Biomass Industry, Conference on Forestry and Forest Products Research 2003 (in CD), Proceedings of the Workshop on Treatment of Timber with Boron Preservative and Prosiding Seminar Hasil Kajian IRPA RMK-8 2004.

Penerbitan / *Publication*	**2004**	**2005**
Journal of Tropical Forest Science	4	4
Malaysian Forest Records	2	0
FRIM Technical Information Handbook	1	0
Siri Alam dan Rimba	1	0
FRIM Reports	2	3
Timber Technology Bulletin	2	7
Proceedings	1	5
Annual Report	1	1
Research Report	1	1
FRIM in Focus	4	3
Research Pamphlets	1	0
FRIM Technical Information	0	0
FRIM Special Publication	0	0
Tree Flora of Sabah and Sarawak	1	0
Jumlah / *Total*	**21**	**24**

BUKU / *BOOKS*

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2. DOMINY, N.J., LUCAS, P.W., SUPARDI, M.N. Primate sensory systems and foraging behavior. Pp. 930-961 in Hohmann, G., Robbins, M., Boesch, C. (Eds.). Chapter 19. Feeding Ecology in Apes and other Primates. Cambridge University Press:Cambridge, U.K.

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KERTAS KERJA / *WORKING PAPERS*

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2. ABD. RAHMAN, K., SHAMSUDIN, I., RAJA BARIZAN, R.M., SAMSUDIN, M. & ISMAIL, H. Managing tropical forest intensive for timber production and biodiversity conservation. Paper presented at XXII IUFRO World Congress. Forests in the Balance: Linking Tradition and Technology, Brisbane, Australia, 7 to 15 August
3. ABD. RAZAK, O. Taburan buluh, ekspedisi botanikal Gunung Aais. Paper presented at the Seminar on Balancing Sustainable Utilization and Conservation of Natural Resources at Gunung Aais Forest Reserve. FRIM, Kepong, 10 May
4. ABDUL RAHIM, N. & CHUNG, R.C.K. Towards the inventory of forest biodiversity in Malaysia with special emphasise in riverine vegetation. Paper presented at the Persidangan Tahunan Pengurus Kanan Jabatan Pengairan dan Saliran Malaysia (JPS) Malaysia: Pengurusan Sumber Asli dan Alam Sekitar. Bukit Merah Laketown Resort, Perak, 24 to 26 August
5. ABDUL RAHIM, N. SCHIPPERIJN, J., ADNAN, M., & KONIJNENDIJK, C.C. Twinning for urban forestry research and development: The Malaysia-Denmark experience. Paper presented at XXII IUFRO World Congress. Forests in the Balance: Linking Tradition and Technology, Brisbane, Australia, 7 to 15 August
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7. ABDUL RAZAK, M.A. & NORINI, H. Research and Development (R&D) in Forestry- An ever-challenging field. Paper presented in Proceedings of the Malaysian Science & Technology Congress 2005 (MSTC 2005): Toward excellence in Science and Technology Research, Cititel Hotel, Midvalley, Kuala Lumpur 18 to 20 April, COSTAM
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9. ABDUL RAZAK, M.A., NORINI, H. & KRISHNAPILLAY, B. Forestry research and education in Malaysia. Paper presented at the Seminar on Forestry Research and Education. Seoul, 12 October
10. ADACHI, M., YASHIRO, Y., WAN RASIDAH, K., OKUDA, T. & KOIZUMI, H. Seasonal variation in soil r espiration in tropical forests and agroforests, Malaysia. Paper presented at the Annual Meeting of the Ecological Society of America. Montreal, Canada, 7 to 14 August, ESA
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13. ADNAN, M., MOHD. AFENDI, H. & SAM, Y.Y. Spesies hutan berpotensi untuk hiasan dalaman. Paper presented at Seminar Pengurusan Tanaman Hiasan Untuk Majlis Rasmi dan Protocol. INTAN, Kuala Lumpur, 13 to 14 December
14. AHMAD AZARUDDIN, M.N., ADZMI, Y., ADNAN, M., MUSTAFA KAMAL, M.S., MOHD. FAUZI, R. & ANUAR, A.R. The effect of different fertilizer regimes on the growth of *Hopea odorata* established for ornamental purposes. Paper presented at IRPA Projects Monitoring Workshop 2005: Identifying Potential Commercial Collaborations. FRIM, Kepong, 14 to 15 December, FRIM
15. AHMAD FAUZI, M.S. Pengurusan dan amalan di tapak semaian. Paper presented at the ULP Nursery Course. FRIM, Kepong, 6 to 7 July, FRIM, JPSM, 32 pp.
16. AHMAD FAUZI, M.S., ADNAN, M. & MOHD. AFENDI, H. Kepelbagaian tanaman hiasan untuk hiasan majlis. Paper presented at Seminar Pengurusan Tanaman Hiasan Untuk Majlis Rasmi dan Protocol. INTAN, Kuala Lumpur, 13 to 14 December
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20. AHMAD ZUHAIDI, Y. Konsep dan pembangunan hutan tani (Agroforestry) Di Felda. Paper presentd at the Kursus Penjagaan Tanaman Balak, Danum Valley, Sabah, 26 to 28 April
21. AHMAD ZUHAIDI, Y. Rasional pemilihan spesis Khaya, Jati dan Mahogani sebagai sebagai tanaman perladangan hutan balak di Felda. Paper presentd at the Kursus Penjagaan Tanaman Balak, Danum Valley, Sabah, 26 to 28 April
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24. AHMAD ZUHAIDI, Y., AHMAD FAUZI, S., MOHD. AZIAH, Y. & ROSDI, K. Evaluating the performance of planting experiment *Dyera costulata* using tissue-culture materials. Paper presented at the Conference on Forestry and Forest Products (CFFPR 2005): Investment for Sustainable Heritage and Wealth, Pan Pacific Hotel, Kuala Lumpur, 22 to 24 November, FRIM, NIES, UNDP/GEF
25. AHMAD ZUHAIDI, Y., HASHIM, M.N. & ROSDI, K. Penyelenggaraan tanaman Jati: Pemantauan, pemilihan pokok, pemangkasan dan penjarangan. Paper presented at the Workshop Tanaman Jati Selepas Tanaman. SPL, Perlis, 22 to 23 December
26. AMINAH, H. Kompos sebagai salah satu komponen program kitar semula. Paper presented at the Kursus Pengurusan Tapak Semaian. Bidor, Perak, 14 June, Forest Department Cikus
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30. AMINAH, H. Teknik-teknik pengendalian bahan tanaman herba di tapak semaian. Penanaman dan pengeluaran tanaman herba, Module 2. Program Peningkatan Kemahiaran Siswazah dan Program Usahawan Herba. FRIM, Kepong, 19 to 20 September, UPM
31. AMINAH, H., HAMZAH, M., BESEK INTAN ZARAFINA, B. & NOOR RATUL MALEKA, S. Production of planting stocks of several dipterocarp species through rooting of stem cuttings. Paper presented at IRPA Projects Monitoring Workshop 2005: Identifying Potential Commercial Collaborations. FRIM, Kepong, 14 to 15 December, FRIM
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40. ANWAR, U.M.K, PARIDAH, M.T, HAMDAN, H., SITI RAFIDAH, M. & MAT YAACOB, C.W. Effect of pre-weathering on wettability and chemical properties of *Dipterocarpus* spp - A preliminary study. Paper presented at the Conference on Forestry and Forest Products (CFFPR 2005): Investment for Sustainable Heritage and Wealth, Pan Pacific Hotel, Kuala Lumpur, 22 to 24 November, FRIM, NIES, UNDP/GEF
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43. AZYYATI, A.K., MOHD. AZMI, M.I. & NOOR AZLIN, Y. Analisa pengunjung Taman Rekreasi Gua Kelam: Prospek pembangunan ekopelancongan. Paper presented at Konferensi & Bengkel Penglibatan Pengusaha Kecil dan Sederhana (PKS) dalam Sektor Ekopelancongan di Malaysia (EcoNet1). Perhentian Island Resort, Terengganu, 13 to 15 September
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218. ZAINON, A.S. Konservasi genetik tumbuhan ubatan di Pulau Sah Kecil, Tasik Kenyir. Paper presented at the Seminar on Medicinal and Aromatic Plants: Harnessing Cures from Nature: Trends and Prospects. Cititel Hotel, Kuala Lumpur, 13 to 14 September
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225. ZARIDAH, M.Z., NOR AZAH, M.A., ABU SAID, A., ABD. MAJID, J., MOHD. FARIDZ, Z.P. & SITI ASHA, A.B. Larvicidal and repellency properties from essential oil of *citrus aurantifolia* and *Citrus hystrix* and their chemical analysis. Paper presented at the Forty-first Annual Scientific Seminar of the Malaysian Society of Parasitology & Tropical Medicine 2005. Grand Season Hotel, Kuala Lumpur, 10 to 11 March, MSPTM

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7. AHMAD NAZARUDIN, M.R. Kesan perencat pertumbuhan pokok (paclobutrazol dan uniconazole) terhadap tumbesaran pokok hiasan *Ficus microcarpa*. Report submitted to Majlis Perbandaran Seremban
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9. ANG, L.H. Conservation of tree species on hill slopes on lot PT 18190, Mukim and District of Bentong, Pahang. Final Report submitted to client (January). 150 pp.
10. CHENG, S. Report on insect attack on ornamental Palms in Glenmarie Court, Shah Alam, for Aura Pest Control Sdn. Bhd. 2 pp.
11. CHENG, S. Report on Stored Product Pests in animal feed (Corn in palette and grain forms) for Pest Dynamics (M) Sdn. Bhd. 2 pp.
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13. FLETCHER, S.C. & MOHD. NASIR, H. Laporan Kedua Jawatankuasa Teknikal Penyelidikan dan Pembangunan (R&D) Projek Penanaman Bakau dan Spesies Sesuai di Persisiran Pantai Negara.Mesyuarat Pasukan Petugas Khas Jawatankuasa Operasi Menanam pokok-pokok Bakau dan spesies-spesies yang sesuai di Persisiran Pantai Negara Bil.2/ April
14. FLETCHER, S.C. & MOHD. NASIR, H. Laporan Pertama Jawatankuasa Teknikal Penyelidikan dan Pembangunan (R&D) Projek Penanaman Bakau dan Spesies Sesuai di Persisiran Pantai Negara. Mesyuarat Pasukan Petugas Khas Jawatankuasa Operasi Menanam pokok-pokok Bakau dan spesies-spesies yang sesuai di Persisiran Pantai Negara Bil.2/ April
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POSTER / *POSTERS*

1. ABD. MAJID J., NOR AZAH, M.A., ABU SAID, A., NOORSIHA, A. & MOHD. FARIDZ, Z.P. Essential oil constituents of five Citrus species from Peninsular Malaysia. Poster presented at the Fourth Malaysian International Conference On Essential Oils And Fragrance And Flavour Materials 2005. Putra Palace Kangar, Perlis. 8 to 11 May, MICEOFF
2. ABD. RAZAK, O. Nursery needs to raise tissue culture plantlets of *Gigantochloa levis*. Poster presented at IRPA Projects Monitoring Workshop 2005: Identifying Potential Commercial Collaborations. FRIM, Kepong, 14 to 15 December, FRIM
3. AHMAD NAZARUDIN, M.R. & MOHD. FAUZI, R. SEM Study of the Kelat Paya *(Syzygium campanulatum)* leaf and stem treated with paclobutrazol. A premilinary study. Poster presented at the Conference on Forestry and Forest Products (CFFPR 2005): Investment for Sustainable Heritage and Wealth, Pan Pacific Hotel, Kuala Lumpur, 22 to 24 November, FRIM, NIES, UNDP/GEF
4. AHMAD NAZARUDIN, M.R. & NOR AZAH, M.A. Medicinal plants for ornamental uses. Poster presented at the Seminar on Medicinal and Aromatic Plants: Harnessing Cures from Nature: Trends and Prospects. Cititel Hotel, Kuala Lumpur, 13 to 14 September
5. AHMAD NAZARUDIN, M.R. & NORAZAH, M.A. Medicinal plants for ornamental uses. Poster presented at the Seminar on Medicinal and Aromatic Plants: Harnessing Cures from Nature: Trends and Prospects. Cititel Hotel, Kuala Lumpur, 13 to 14 September
6. AHMAD NAZARUDIN, M.R. & PHILIP, E. Plant growth regulators: A labour saving method in landscape maintenance. Poster presented at the Sixteenth International Invention, Innovation, Industrial Design and Technology Exhibition, ITEX '05. PWTC, Kuala Lumpur, 19 to 21 May
7. AHMAD NAZARUDIN, M.R., MOHD. FAUZI, R., MUSTAFA KAMAL, M.S. & TSAN, F.Y. Controlling the growth and crown compactness of *Syzygium campanulatum* by the application of gibberellin inhibitors. Poster presented at Malaysian Sixteenth Plant Physiology Conference 2005 (MSPPC): Advanced Techniques and Instrumentation in Plant Science. Crystal Crown Hotel, Port Klang, Selangor, 27 to 29 September
8. AHMAD SHAKRI, M.S. & ZAIHAN, J. Bentwood products for joinery and furniture components. Poster presented at the R&D of IPTA Malaysia Exposition. PWTC, Kuala Lumpur, 30 September to 2 October
9. ANG, L.H., HO, W.M., ADI FADZLY, A.K., TANG, L.K. & LIM, K.S. Effects of rubber glove industrial effluent sludge (RGIES) on the vegetative growth of two selected timber species and ground water quality. Poster presented in the Malaysian Science & Technology Congress 2005 (MSTC 2005): Toward excellence in Science and Technology Research, Cititel Hotel, Midvalley, Kuala Lumpur 18 to 20 April, COSTAM
10. ANG, L.H., TANG, L.K. & THE, S.H. Penanaman Kenaf di bekas lombong pasir di Bidor, Perak. Poster presented at Pameran Agensi/Jabatan Kerajaan sempena hari peladang, penternak dan nelayan negeri Perak. Ladang Infoternak, Sungai Siput, Perak, 13 to 16 August
11. CHANG, Y.S., LEE, S.S. & NORASWATI, M.N.R. Traditional knowledge about mushrooms among the minor tribes of Bateq and Che Wong in Peninsular Malaysia. Poster presented at the Conference on Forestry and Forest Products (CFFPR 2005): Investment for Sustainable Heritage and Wealth, Pan Pacific Hotel, Kuala Lumpur, 22 to 24 November, FRIM, NIES, UNDP/GEF
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13. CHEE, C.F, LEE, H.B., NORDIN, L., KHOZIRAH, S., RASADAH, M.A., LING, S.K., VIKINESWARY, S. ABDULLAH, N., ONG, H.C & HO, A.S.H. Photodynamic therapy for cancer: A new avenue for natural products research. Poster presented at the Malaysia Sciences Association Golden Jubilee International Science Congress 2005 (ISC): Science for Humanity, Module on Natural Products and Medicinal Chemistry. PWTC, Kuala Lumpur, 3 to 6 August, MSA

14. FLETCHER, S.C. Integrating wildlife conservation in forest management. Paper presented at XXII IUFRO World Congress. Forests in the Balance: Linking Tradition and Technology, Brisbane, Australia, 7 to 15 August
15. GAN, K.S & LIM, S.C. Sound absorption coefficient of plantation timbers-*Acacia mangium* and rubberwood. Poster presented at XXII IUFRO World Congress. Forests in the Balance: Linking Tradition and Technology, Brisbane, Australia, 7 to 15 August
16. GAN, K.S. & LIM, S.C. Sound absorption coefficient of Acacia mangium and Rubberwood. Poster presented at the Conference on Forestry and Forest Products (CFFPR 2005): Investment for Sustainable Heritage and Wealth, Pan Pacific Hotel, Kuala Lumpur, 22 to 24 November, FRIM, NIES, UNDP/GEF
17. GAN, K.S. & LIM, S.C. Sound absorption coefficient of *Acacia mangium* and Rubberwood. Poster presented at the Conference on Forestry and Forest Products (CFFPR 2005): Investment for Sustainable Heritage and Wealth, Pan Pacific Hotel, Kuala Lumpur, 22 to 24 November, FRIM, NIES, UNDP/GEF
18. GETHA, K & VIKINESWARY, S. Antiphytopathogenic activity of an actinomycete strain isolated from coastal mangrove habitat. Poster presented at the Conference on Forestry and Forest Products (CFFPR 2005): Investment for Sustainable Heritage and Wealth, Pan Pacific Hotel, Kuala Lumpur, 22 to 24 November, FRIM, NIES, UNDP/GEF
19. GETHA, K., LEE, S.S., NUMATA, K., WONG, J.H.J., CHUA, R.L.Y. & FUN, S.Y. Bioactive metabolites from tropical basidiomycetes. Poster presented at the Seminar on Medicinal and Aromatic Plants: Harnessing Cures from Nature: Trends and Prospects. Cititel Hotel, Kuala Lumpur, 13 to 14 September
20. HASHIM, W.S., ABD. HAMID, S., ZAIHAN, J., PUAD, E., ZULKIFLE, A., CHUAH, K.K., CHUAH, K.H. & SIM, W.S. Laminated furniture component from Oil Palm veneer. A poster presented at the Sixteenth International Invention, Innovation, Industrial Design and Technology Exhibition, ITEX '05. PWTC, Kuala Lumpur, 19 to 21 May
21. HAZREENA, H. & SREETHERAN, M. Aromatic medicinal plants: Guidance for the visually impaired. A poster presented at the Seminar on Medicinal and Aromatic Plants: Harnessing Cures from Nature: Trends and Prospects. Cititel Hotel, Kuala Lumpur, 13 to 14 September
22. HO, W.M., ANG, L.H. & LEE, D.K. A green house experiment on effects of fertilizer and water on the growth and gas exchange of kenaf (*Hibiscus cannabinus* L.). Poster presented at the Conference on Forestry and Forest Products (CFFPR 2005): Investment for Sustainable Heritage and Wealth, Pan Pacific Hotel, Kuala Lumpur, 22 to 24 November, FRIM, NIES, UNDP/GEF
23. HUI, E. & ANG, L.H. Penanam pegaga (*Centella asiatica*) di Malaysia: Tanamam berpotensi. Poster presented at Pameran Agensi/Jabatan Kerajaan sempena hari peladang, penternak dan nelayan negeri Perak. Ladang Infoternak, Sungai Siput, Perak, 13 to 16 August
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25. ISMAIL, P. Restoration of logged-over peat swamp forests in Malaysia. Paper presented at XXII IUFRO World Congress. Forests in the Balance: Linking Tradition and Technology, Brisbane, Australia, 7 to 15 August
26. ISMARIAH, A., MARIA ZURA, M.Z. & MOHD. DAHLAN, J. Recycling solid wood waste from construction sector. Poster presented at Best of Both Worlds Conference: Environmental Education for Sustainable Development, Pan Pacific Hotel, Kuala Lumpur, 6 to 8 September. FRIM
27. KANDASAMY, K.I. & SUN, W.F. Weaning of tissue-cultured plantlets of selected forest species with commercial potential (Dyera costulata, *Aquilaria malaccensis*, and *Endospermum malaccense*). Paper presented at the Conference on Forestry and Forest Products (CFFPR 2005): Investment for Sustainable Heritage and Wealth, Pan Pacific Hotel, Kuala Lumpur, 22 to 24 November, FRIM, NIES, UNDP/GEF
28. KHO, L.K., PHILIP, E., & ABDUL RAHIM, N. Carbon budget of plant biomass for Greenhouse Gas (GHG) Inventory in Peninsular Malaysia: Inventory Application of the IPCC1996GL. A poster presented at Malaysian Sixteenth Plant Physiology Conference 2005 (MSPPC): Advanced Techniques and Instrumentation in Plant Science. Crystal Crown Hotel, Port Klang, Selangor, 27 to 29 September
29. KHO, L.K., PHILIP, E., & ABDUL RAHIM, N. Climate change and the role of forests as carbon sinks. A poster presented at Best of Both Worlds Conference: Environmental Education for Sustainable Development, Pan Pacific Hotel, Kuala Lumpur, 6 to 8 September. FRIM
30. KHOO, M.G.H & RASADAH, M.A. Cytotoxicity studies of *Garcinia atroviridis*. A poster presented at the Seminar on Medicinal and Aromatic Plants: Harnessing Cures from Nature: Trends and Prospects. Cititel Hotel, Kuala Lumpur, 13 to 14 September
31. KHOO, M.G.H, NALINA, K.V. & NUZIAH, H. Toxicity evaluation of selected species of medicinal plants by cell cytotoxicity assay. A poster presented at the Conference on Forestry and Forest Products (CFFPR 2005): Investment for Sustainable Heritage and Wealth, Pan Pacific Hotel, Kuala Lumpur, 22 to 24 November, FRIM, NIES, UNDP/GEF
32. KHOO, M.G.H, SITI ASHA, A.B., & NUZIAH, H. Cytotoxic activity of some Malaysian medicinal plants. A poster presented at the Seminar on Medicinal and Aromatic Plants: Harnessing Cures from Nature: Trends and Prospects. Cititel Hotel, Kuala Lumpur, 13 to 14 September
33. KINGSTON, T., ZUBAID, A., SAHIR, O., SIVANATHAN, E. & FLETCHER, S.C. Research capacity building and education. The Malaysian Bat Conservation Research Unit. A poster presented at the R&D of IPTA Malaysia Exposition. PWTC, Kuala Lumpur, 30 September to 2 October

34. LAU, K.H., IMIN, K., NOORSIHA, A. & THESEIRA, G.W. Aktiviti pengutipan koleksi tumbuhan hidup di Hutan Simpan Gunung Jerai, Kedah. Plant Introduction Programme at Taman Botani Kepong, FRIM Project. Poster presented at Seminar Ekspedisi Saintifik Kepelbagaian Hayat Hutan Simpan Gunung Jerai, Kedah, 27 to 29 November. FRIM
35. LEE, C.T., LEE, S.L. FARIDAH, Q.Z., SIRAJ, S.S. NORLIA, B., NG, K.K.S., NORWATI, A. & NORWATI, M. Development of microsatellite markers in an important timber species *Koompassia malaccensis* (Leguminosae), preliminary results. Poster presented at XXII IUFRO World Congress. Forests in the Balance: Linking Tradition and Technology, Brisbane, Australia, 7 to 15 August
36. LEE, S.L., NG, K.K.S., SAW, L.G., LEE, C.T. & NORWATI, M. Conservation strategies for rare dipterocarps: autecology and genetics of *Shorea lumutensis* in Peninsular Malaysia. Poster presented at XXII IUFRO World Congress. Forests in the Balance: Linking Tradition and Technology, Brisbane, Australia, 7 to 15 August
37. LEM, Y.K., ONG, B.K., ZAMREE, M.S., MOHD. SHAHIDAN, M.A., ABDULL RASHIH, A., MOHD. RADZI, A. & RASADAH, M.A. Acute toxicity evaluation of *Vitex negundo* leaf extract. Poster presented at the Seminar on Medicinal and Aromatic Plants: Harnessing Cures from Nature: Trends and Prospects. Cititel Hotel, Kuala Lumpur, 13 to 14 September
38. LIM, S.C., GAN, K.S., TAN, Y.E & THI, B.K. Sapwood in plantation-grown teak in Peninsular Malaysia. Poster presented at XXII IUFRO World Congress. Forests in the Balance: Linking Tradition and Technology, Brisbane, Australia, 7 to 15 August
39. LING, S.K., LAU, S.H., LAM, K.W. & RASADAH, M.A. Iridoids from *Lasianthus attenuatus* Jack. Poster presented at the Conference on Forestry and Forest Products (CFFPR 2005): Investment for Sustainable Heritage and Wealth, Pan Pacific Hotel, Kuala Lumpur, 22 to 24 November, FRIM, NIES, UNDP/GEF
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85. RUSHDAN, I. From waste to wealth. A poster presented at the Mesyuarat KEBBP. FRIM, Kuala Lumpur, 13 September
86. SAEID REZA, D.J., MASTURA, M., MAZURAH, M.I., SAIFUL AZMI, J., NOR DATIAKMA, M.A., HANNAN, A.W. & MARZALINA, M. Sayonara MRSA. Poster presented at the Sixteenth International Invention, Innovation, Industrial Design and Technology Exhibition, ITEX '05. PWTC, Kuala Lumpur, 19 to 21 May
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