ASIA-PACIFIC FORESTRY SECTOR OUTLOOK STUDY II

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MALAYSIA FORESTRY OUTLOOK STUDY

by

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INFORMATION NOTE ON THE ASIA-PACIFIC FORESTRY SECTOR OUTLOOK STUDY

The Asia-Pacific Forestry Sector Outlook Study (APFSOS) is a wide-ranging initiative to gather information on, and examine, the evolution of key forestry issues as well as to review important trends in forests and forestry. The main purpose of the study is to provide a better understanding of the changing relationships between society and forests and thus to facilitate timely policy reviews and reforms in national forest sectors. The specific objectives are to:

1. Identify emerging socio-economic changes impacting on forest and forestry
2. Analyze probable scenarios for forestry developments to 2020
3. Identify priorities and strategies to address emerging opportunities and challenges

The first APFSOS was completed in 1998, with an outlook horizon to 2010. During its twenty-first session, held in Dehradun, India, in April 2006, the Asia-Pacific Forestry Commission (APFC) resolved to update the outlook extending the horizon to 2020. The study commenced in October 2006 and is expected to be completed by September 2009.

The study has been coordinated by the Food and Agriculture Organization of the United Nations (FAO), through its regional office in Bangkok and its headquarters in Rome, and implemented in close partnership with APFC member countries with support from a number of international and regional agencies. The Asian Development Bank (ADB), the International Tropical Timber Organization (ITTO), and the United Kingdom's Department for International Development (DFID) provided substantial financial support to implement the study. Partnerships with the Asia-Pacific Association of Forest Research Institutes (APAFRI) and the Secretariat of the Pacific Community (SPC) supported the organizing and implementing of national focal points' workshops and other activities, which have been crucial to the success of this initiative. The contributions of many other individuals and institutions are gratefully acknowledged in the main APFSOS report.

Working papers have been contributed or commissioned on a wide range of topics. These fall under the following categories: country profiles, sub-regional studies and thematic studies. Working papers have been prepared by individual authors or groups of authors and represent their personal views and perspectives; therefore, opinions expressed do not necessarily reflect the views of their employers, the governments of the APFC member countries or of FAO. Material from these working papers has been extracted and combined with information from a wide range of additional sources to produce the main regional outlook report.

Working papers are moderately edited for style and clarity and are formatted to provide a measure of uniformity, but otherwise remain the work of the authors. Copies of these working papers, as well as more information on the Asia-Pacific Forestry Sector Study, can be obtained from:

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EXECUTIVE SUMMARY

Introduction

In preparing the paper in accordance with the Terms of Reference for the Consultancy, data were collected and information assembled from a number of departments and agencies, such as the Forestry Departments of Peninsular Malaysia, Sabah and Sarawak, the Malaysian Timber Industry Board (MTIB), and the Malaysian Timber Council (MTC), as well as information received through the Asia-Pacific Forestry Sector Outlook Study: The Future of Asia-Pacific Forests' Questionnaires (Country Worksheets) from, among others, the Forestry Departments of Peninsular Malaysia, Sabah and Sarawak; MTIB; World Wide Fund for Nature (WWF)-Malaysia; the Malaysian Timber Certification Council (MTCC); and the Forest Research Institute, Malaysia (FRIM); and from the two-day Multi-stakeholder Dialogue on the Outlook of the Malaysian Forestry Sector in the Year 2020, held from 28-29 August 2007, which was attended by 44 participants and where a total of 13 papers, including the draft of this paper, were presented for deliberation.

The paper will examine the key factors impacting the forestry sector in Malaysia, both inside and outside the sector; the past trends and current state of the forests and the sector; the development of the forest industries; forest ecosystem services; the increasing roles of forest in the conservation of biological diversity, and in mitigating climate change; as well as in meeting the changing societal demands placed on forest, for example in the protection of watersheds and environmentally sensitive areas.

State of the forestry sector

Background

Malaysia is a federation of thirteen States and three Federal Territories with eleven of the States and the Federal Territories of Kuala Lumpur and Putrajaya located in Peninsular Malaysia, while the State of Sabah together with the Federal Territory of Labuan and the State of Sarawak are located in the island of Borneo respectively.

The total land area of Malaysia is estimated to be 32.83 million ha with Peninsular Malaysia, Sabah and Sarawak having 13.16 million ha, 7.37 million ha, and 12.30 million ha respectively. Peninsular Malaysia is separated from Sabah and Sarawak by 720 km of the South China Sea, giving the country a coastline of almost 4,830 km.

Policy and legislation

Under the Malaysian Constitution, forestry comes under the jurisdiction of the respective State Governments. As such, each State is empowered to enact laws on forestry and to formulate forestry policy independently. The executive authority of the Federal Government only extends to the provision of advice and technical assistance to the States, training, the conduct of research, and in the maintenance of experimental and demonstration stations.

In order to facilitate the adoption of a coordinated and common approach to forestry, as well as reconcile cross-sectoral policies that interface with the forestry sector, the National Forestry Council (NFC) was established in December 1971 to enable the Federal and the State Governments to discuss and resolve common problems and issues relating to forestry policy, administration and management, as well as to enhance cooperation between the Federal and State Governments, so as to ensure a coordinated approach in the implementation of policies and programs related to forestry.

A National Forestry Policy 1978 was formulated and approved by the NFC which is currently being implemented by all the States in Peninsular Malaysia, while the objectives of this Policy are also being implemented in Sabah. In Sarawak, the Forest Policy 1954 which has very similar provisions to the National Forestry Policy remains the basis for forestry practices. In this regard, the National Forestry Policy calls for the establishment of a Permanent Forest Estate (Permanent Reserved Forests) to be classified and managed under four major functions, namely, Protection Forest, Production Forest, Amenity Forest, and Research and Education Forest.

To ensure effective forest management and the implementation of the National Forestry Policy in Malaysia, various forestry enactments and ordinances were formulated and enforced by the respective State authorities since the early 1900s. These enactments and ordinances were further uniformized and strengthened in areas of forest management planning and operations through the adoption of the National Forestry Act 1984. This Act provides provisions for forest planning, management and development, as well as for safeguarding and protecting the forest resources from encroachment and illegal forest harvesting activities.

Forest resources

At the end of 2005, total land under forests in Malaysia was estimated to be 18.31 million ha or 55.8 percent of its total land area; lands under perennial agricultural tree crops such as rubber, oil palm, cocoa and coconut, and those under other land usage such as for settlements and infrastructural development totaled 5.55 million ha or 16.9 percent and 8.97 million ha or 27.3 percent of its total land area respectively. Hence, at the end of 2005, Malaysia had a total tree cover of 23.86 million ha or 72.7 percent of its total land area.

In terms of major forest types, it was estimated that in 2005 Malaysia had 15.97 million ha of dry inland forest, 1.36 million of swamp forest, 0.58 million ha of mangrove forest, and 0.40 million ha of forest plantation, with the proportion of forest areas much higher in Sabah and Sarawak than in Peninsular Malaysia which is more developed.

Of the total forested areas, Malaysia has designated a total of 15.30 million ha as Permanent Reserved Forests (PRFs) which is under sustainable management. Approximately 12.19 million ha are production forests with the remaining 3.11 million ha being protection forests.

At the end of 2005, the total growing stock in the natural forests for all trees of 10 cm diameter at breast height (dbh) and above in Malaysia was estimated to be 4,426.77 million m^3 while the total merchantable volume of all trees having 45 cm dbh and above, excluding mangrove forests, was estimated to be 2,332.60 million m^3. In addition, the total growing stock of the current 0.40 million ha of forest plantations in Malaysia is estimated to be 58 million m^3, with 50 percent of the growing stock in Sabah.

In terms of biomass in the natural forests, at the end of 2005, Malaysia had a total of 4,780.91 million tonnes of above-ground biomass, while below-ground biomass and dead wood biomass were estimated to be 1,147.42 million tonnes and 889.25 million tonnes respectively.

The total carbon stock in the natural forests in Malaysia at the end of 2005 was estimated to be 3,442.33 million tonnes, with the Peninsula, Sabah and Sarawak having 1,138.71 million tonnes, 751.63 million tonnes and 1,551.99 million tonnes respectively.

Forest management practices

In Peninsular Malaysia, under the 30-year cutting cycle of the Selective Management System, the cutting limits prescribed for the group of dipterocarp species range from 50-65 cm dbh

while those prescribed for the group of non-dipterocarp species range from 45-55 cm dbh, with the maximum volume allowed to be harvested being 85 m^3/ha.

In Sabah, the dipterocarp forest is selectively harvested based on a 50-year cutting cycle and only trees having size of 60 cm dbh and above are removed, while in Sarawak, the cutting cycle prescribed for the dipterocarp forest is 25 years with the prescribed cutting limits for the dipterocarp and non-dipterocarp species being 60 cm dbh and 45 cm dbh and above respectively.

For the peat swamp forest, the cutting cycle adopted in Sarawak is 45 years with the prescribed cutting limits for *Gonystylus bancanus* (Ramin) and that of the other species being 40 cm dbh and 50 cm dbh and above respectively.

Currently, there is no commercial harvesting of mangrove forests in Sabah, while in Peninsular Malaysia and Sarawak they are managed under felling cycles varying between 20 to 30 years.

Forest harvesting practices

Forest harvesting in the inland forest in Malaysia is generally carried out by a combination of crawler tractor-winch lorry. Currently, reduced impact logging (ground skidding) is also being carried out in Malaysia, while low impact logging (helicopter logging) is being carried out in Sarawak, and to a lesser extent in Sabah.

Conservation practices

Currently, Malaysia has 2.44 million ha of conservation areas which are totally protected by legislation. Of these, 2.05 million ha are located outside the PRFs, whilst another 0.39 million ha are located within the PRFs. Hence, with the protection forests of the PRFs of 3.11 million ha, the totally protected areas in Malaysia are now estimated to be 5.16 million ha, representing 28.2 percent of its total forested land or 15.7 percent of its land area.

Malaysia has also declared a total of five areas as RAMSAR sites covering 48,029 ha, while the United Nations Educational, Scientific and Cultural Organization (UNESCO) has recognized and declared the Kinabalu Park, covering an area of 75,370 ha in Sabah, and the Gunung Mulu National Park, covering an area of 52,865 ha in Sarawak as World Heritage Sites. In addition, UNESCO has also listed the Langkawi Geopark, covering 47,800 ha in the island of Langkawi, in its global network of Geoparks in June 2007. In February 2007, Malaysia together with Brunei Darussalam and Indonesia had embarked on the Heart of Borneo initiative which has designated 24 million ha as protected areas, production forests and sustainable land-use areas.

To ensure adequate supply of water to meet the varying demands of the population, agriculture and industry, Malaysia has gazetted watershed areas covering 5.16 million ha with 4.08 million ha or 79.1 percent in Sarawak and the balance of 0.85 million ha and 0.23 million ha in Peninsular Malaysia and Sabah respectively.

Under the National Physical Plan (NPP), “a Central Forest Spine (CFS)” stretching from north to south in Peninsular Malaysia, currently estimated to cover an area of 4.3 million ha, which include forests, lakes, highlands and wetlands will be established to serve as a reservoir for biological diversity, provide protection areas for catchments, and create environments for nature and ecotourism.

Environmental protection practices

To mitigate the adverse impacts of forestry activities on the environment, the Environmental Quality Act 1974 was amended to include Environmental Impact Assessment (EIA) in 1985 which, inter alia, requires any land development schemes converting an area of 500 ha or more of forest land into a different land use, logging covering an area of 500 ha or more, and conversion of mangrove forests for industrial, housing or agricultural use covering an area of 50 ha or more, to conduct EIA reports before such activities can commence.

Rapid urbanization in Malaysia and the growing appreciation of the aesthetic value of trees and the pleasure of outdoor recreation have obliged the various local authorities and relevant agencies to plant trees along highways and sidewalks, and to date 4.68 million trees have been planted.

Sustainability of natural forest

It has been shown that with average growth rates of trees over 30 cm dbh of 0.8-1.0 cm/year in diameter and 2.0-2.5 m^3/ha/year in commercial gross volume, the hill forests in Malaysia are capable of producing every 25-55 years of at least 45-85 net m^3/ha, taking into account that the harvesting damage of the residual stand should not be more than 30 percent of the intermediate sized trees.

In this regard, under the Ninth Malaysia Plan, 2006-2010, the natural production forests of the PRFs in Malaysia is expected to yield annually 15.18 million m^3 of roundlogs, with 3.13 million m^3, 3.55 million m^3 and 8.50 million m^3 emanating from Peninsular Malaysia, Sabah and Sarawak respectively.

Forest plantation establishment

The Government of Malaysia has granted full tax exemption under the Pioneer Status for ten years or 100 percent tax exemption under the Investment Tax Allowance for five years, effective from 29 October 1993 for forest plantation establishment undertaken by the private sector. To further encourage the private sector to establish and develop forest plantations, additional incentives were granted in 1999 under Schedule 4A of the Approved Agricultural Projects, while in May 2003 further incentives were also granted under the "Group Relief" where a company is allowed to reduce its tax burden by offsetting its losses from profit of another company within the same group.

In the past few years, the Federal Government has developed plans to establish 375,000 ha of forest plantation in the next 15 years at an annual planting target of 25,000 ha, and currently has provided soft loans to six selected private sector companies to plant a total of 16,100 ha.

In addition, Sabah also has set a target to establish 500,000 ha of forest plantation by the year 2020, while Sarawak is expected to have a total of 1.2 million ha of established forest plantation as it has already awarded 39 Licenses for Planted Forest, covering 2.4 million ha, to the private sector to establish forest plantation, besides the Government's forest plantation project covering another 500,000 ha.

Wood-based industries

In 2005, the primary wood-based industry in Malaysia comprised 1,138 sawmills and 176 plywood and veneer mills. Among the other wood-based industries found in Malaysia are 345 moulding plants, 13 chipboard plants, 14 medium density fibreboard plants, 15 woodchip plants, 27 parquet flooring plants, 46 laminated board plants, 3 pencil factories, one integrated

pulp and paper mill, 237 kiln drying plants, 158 wood preservation plants, and 2,363 furniture/woodworking/joinery factories.

The total roundlog consumption in 2005 by the sawmills in Malaysia was estimated to be 9.37 million m^3 or 47.4 percent of their installed capacity while consumption by the plywood/veneer mills was estimated to be 10.34 million m^3 or 92.6 percent of their installed capacity. In this context, most of the excess capacity of the sawmills and plywood/veneer mills was in Peninsular Malaysia where the 664 sawmills and 52 plywood/veneer mills only utilized 46.7 percent and 35.4 percent of their installed capacity respectively.

In 2005, the total export of timber and timber products was valued at RM 21.51 billion or 4.0 percent of the country's total export earnings of RM 533.79 billion. In the same year, the forestry sector in Malaysia accounted for about 8.2 percent of the country's Gross Domestic Product of RM 262.17 billion and provided direct employment to 270,670 persons which represents 2.6 percent of the country's workforce.

Institutional frameworks

The Ministry that is directly involved in administering the forest sector in Malaysia is the Ministry of Natural Resources and Environment (NRE), while the Ministry of Plantation Industries and Commodities is responsible for developing the wood-based industries, the trade in timber and timber products, and the establishment of industrial wood plantations.

More specifically, the management of the forest resources in Peninsular Malaysia, including administration, is vested in the Forestry Department Headquarters in Kuala Lumpur and its ten State Forestry Departments located throughout the Peninsula. However, the Department is not directly involved in the management of wildlife reserves, bird sanctuaries and national parks as these are under the control of the Federal Government through the Department of Wildlife and National Parks Peninsular Malaysia, although the States are encouraged to manage parks that are located in the PRFs.

In Sabah, the Forestry Department is responsible for all aspects of forest administration, management, planning and development of the forest resources in the State. However, the wildlife reserves and sanctuaries, and national parks in Sabah are managed by the Wildlife Department and the Parks Department of Sabah respectively.

In the case of Sarawak, the responsibilities of the Forest Department of Sarawak are similar to those of Sabah except that the Department is also responsible for the administration, management, planning and development of all the national parks and wildlife reserves and sanctuaries in the State. However, since the launching of the Sarawak Forestry Corporation Sdn. Bhd. in June 2003, the responsibility of managing the forest resources in Sarawak has now been placed under this new authority, leaving the Forest Department of Sarawak to concentrate on forest policy planning and to attend to statutory and regulatory matters.

Research and development (R&D) activities in Malaysia are mainly carried out by FRIM which focuses on all aspects of forestry and forest products, such as developing suitable management and silvicultural systems for the forests in Malaysia, including forest plantation establishment and development; and the more efficient and diversified utilization of the nation's forest resources, especially in reducing wood-waste and extending the utilization of the under-utilized timber species. Similar R&D activities are also being carried out by the Forestry Department of Sabah and the Sarawak Forestry Corporation Sdn. Bhd., as well as local public universities.

In developing the timber industries and the trade of timber and timber products in both the domestic and overseas markets, a number of agencies in Malaysia, namely the MTIB, the

Sarawak Timber Industry Development Corporation (STIDC), the MTC and the MTCC, are involved.

The MTIB is responsible for initiating appropriate development in the various sectors of the timber industry and in providing the necessary assistance to ensure its continued growth as a modern and thriving sector of the economy. In August 2001, the MTIB was also appointed as an additional management authority to implement the provisions of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in Peninsular Malaysia.

The role of the STIDC is to stimulate the planned development of the timber industries in Sarawak towards the optimum and efficient utilization of timber resources by encouraging downstream processing and product diversification. It also provides training in various aspects of logging operations and activities connected with timber processing, such as sawmilling, and sales and marketing of timber and timber products.

The major role of the MTC is to ensure the sustainability of the Malaysian timber industry by improving its competitiveness, enhancing market access and creating trade opportunities, while its objectives are to promote timber trade and develop the market for timber products; provide technical services and other activities to the timber industry; augment the supply of raw materials for the timber processing industries; and provide information services to the timber trade and industry.

The responsibility of the MTCC is to develop and implement a timber certification scheme in Malaysia and to facilitate the trade in timber from Malaysia. Hence, it receives and processes applications for forest management certification, as well as arranging for assessments to be carried out by its registered independent third party assessors. It has also been a member of the Programme for the Endorsement of Forest Certification schemes (PEFC) since November 2002, and is currently taking steps to submit its scheme for endorsement within the PEFC's framework for mutual recognition.

International commitments

Malaysia has been a party to the RAMSAR Convention on Wetlands since March 1995; the Convention on Biological Diversity (CBD) since September 1994; and the United Nations Framework Convention on Climate Change (UNFCCC) since October 1994, as well as the Kyoto Protocol to the UNFCCC as of February 2005. Malaysia has also been a party to the Cartagena Protocol on Biosafety to the CBD since December 2003, as well as having signed and ratified the International Tropical Timber Agreement (ITTA), 1983 and the ITTA, 1994 in February 1985 and March 1995 respectively; Malaysia acceded to CITES in October 1977 and ratified the Convention in 1978.

Trends and challenges in the forestry sector

Extent of forest resources

Between 1985 and 2005, the total forest areas in Malaysia had declined from 20.42 million ha in 1985 to 18.31 million ha in 2005, a decrease of an estimated 2.11 million ha or at an average annual rate of slightly more than 100 000 ha a year.

This loss of forest areas is mainly due to the conversion of forest lands to permanent non-forest uses and to meet the demand of the growing population as over the same period, the total area under perennial agricultural tree crops had increased from 3.75 million ha in 1985 to 5.55 million ha in 2005, an increase of 1.80 million ha, with areas under oil palm plantations more than doubling from 1.47 million ha in 1985 to 4.05 million ha in 2005, while the

population in Malaysia had also grown from 15.68 million in 1985 to 26.75 million in 2005 or an increase of 70.6 percent over the 20-year period.

However, the forested lands gazetted as PRFs that are managed for permanent forest uses in Malaysia have increased from a total of 14.19 million ha in 1995 to 15.30 million ha in 2005, an increase of more than 1 million ha, with most of the increase recorded in Sarawak.

Forest plantations in Malaysia had also increased from 62.65 000 ha in 1985 to 403.89 000 ha in 2005 with most of the increase in Sabah. However, forest plantations in Malaysia only represent a mere 2.2 percent of the total forested lands or 1.2 percent of its land areas.

Forest management

Malaysia is fully committed to manage its forest resources sustainably in the overall context of sustainable development and this has led to the development of a set of Malaysian criteria and indicators (MC&I) for sustainable forest management at the national and forest management unit levels. In this context, it was estimated in 1997 that Malaysia would require a sum of RM 2,884.71 million to enable its forest resources to be sustainably managed, including the need for research, infrastructure and human resources development.
As land is a finite resource, one would have to integrate forestry with agriculture, especially in rural development, so as to enhance employment opportunities and supplement income earning and raise the livelihoods of the rural communities, as well as to contain and further reduce the practice of shifting cultivation which is currently estimated to exceed four million ha, mainly in Sabah and Sarawak.

Actions will have to be taken to further develop environmentally sound and economically viable forest harvesting systems that reduce the extent of inevitable damage to the residual stand and the soil surface during forest harvesting, and promote the optimal use of a wider range of timber species.

In the coming years, more attention will have to be directed to the importance of non-wood forest products, especially the herbs and medicinal plants, as it has been estimated that the current market value of RM 4.56 billion of herbal and medicinal products in Malaysia will grow at an annual rate of 10-15 percent, as well as in revitalizing the rattan and bamboo industry.

Forest conservation and protection

In terms of forest conservation, actions should be taken to secure a minimum set of strategically located primary forests in representative areas having high diversity and endemism, taking into account the need for biological corridors linking them or ‘stepping stones’ between them, as well as in enhancing *in situ* conservation of biological diversity during forest harvesting.

The cost in protecting and managing the existing biological reserves and the opportunity cost foregone in implementing *in situ* conservation of biological diversity and its potential use in the light of advances in biotechnologies in using the resources should be quantified. In this regard, the issue of patents and intellectual property rights (IPRs) and patents of products, including biotechnological products derived from the use of forest genetic resources should be addressed, taking into account the National Biotechnology Policy 2005.

The strategies in the National Environment Policy 2002 will provide a comprehensive approach in managing the environment and natural resources where natural resource areas, particularly those containing biologically rich habitats and ecosystems will be established and

maintained as zones for the conservation and protection of indigenous flora and fauna and genetic resources so as to ensure the integrity of biological diversity and life support systems.

It is pertinent to demonstrate the economic and financial feasibility and benefits of integrating watershed management measures into multiple-use forest management practices. More specifically, the relationship between upstream and downstream activities such as on-site and off-site productivity and impact (biophysical aspects), water yield and quality, erosion and sedimentation, as well as stream flow patterns (water aspects).

Emphasis should be accorded to watershed management in order to enhance food production in high-yield areas. Links between forestry and food production should be strengthened through an integrated approach with watershed management, and incentives be provided to rehabilitate degraded watershed areas.

The protection of production forest against encroachment and illegal forest harvesting is also of paramount importance as uncontrolled encroachment and illegal logging will impede efforts taken to achieve sustainable forest management, even though illegal logging is no longer a serious problem in Malaysia. A study conducted by WWF-Malaysia and presented at the Workshop on Illegal Logging in East Asia in Jakarta, Indonesia from 27-28 August 2000, found the level of illegal logging in Sabah and Sarawak to be small, in the order of one percent or less, as compared to the legal wood products trade, while illegal logging in Peninsular Malaysia is well under control.

Production and trade in major wood products

Over the period 1985 to 2005, the production of industrial roundwood recorded a peak in production of 49.98 million m^3 in 1990 and then decreased to 28.23 million m^3 in 2005, with the production of sawnwood showing similar trends. However, the production of wood-based panels and paper and paperboard recorded increasing trends from 1985 to 2005.

Although from 1985 to 2005 the import of industrial roundwood into Malaysia had declined from a high of 0.39 million m^3 in 1985 to 0.08 million m^3 in 2005, the import of sawnwood had increased from a mere 0.08 million m^3 in 1985 to 1.10 million m^3 in 2005. This trend was also observed for the imports of wood-based panels and paper and paperboard when in 2005 the recorded imports of wood-based panels and paper and paperboard were 0.40 million m^3 and 2.21 million tonnes respectively.

The export of industrial roundwood from Malaysia had declined significantly from 20.25 million m^3 in 1985 to 5.84 million m^3 in 2005, a decrease of 71.2 percent, while the export of wood-based panels had increased substantially from 0.78 million m^3 in 1985 to 6.62 million m^3 in 2005, an increase of 5.84 million m^3 over the two years. In fact, Malaysia was among the top five leading exporters of wood-based panels in the world in 2005.

The increasing demand for timber and timber products that are produced legally and from sustainably managed sources by the international market, and the need for them to be certified by independent third party assessors through recognized timber certification schemes have pushed Malaysia to initiate independent third party forest management certification in 1998. To date, nine Forest Management Units (FMUs) covering 4.73 million ha of the PRFs have been certified using the *Malaysian Criteria, Indicators, Activities and Standards of Performance for Forest Management Certification* [*MC&I*(2001)] by the MTCC, while as of June 2007, a total of 102 timber companies had also been awarded the *Certificate for Chain-of-Custody* by the MTCC.

Furthermore, the Deramakot Forest Reserve covering 55,084 ha in Sabah and a forest concessionaire, the Perak Integrated Timber Complex (ITC) Sdn. Bhd. in Perak, with an area

of 9,000 ha were also certified in 1997 and 2002 respectively as being 'well-managed forests' under the Forest Stewardship Council's Principles and Criteria for Forest Stewardship (FSC P&C). Two other companies, namely, Asiaprima RCF Sdn. Bhd. and Golden Hope Plantations Bhd. have also been awarded FSC forest management certificates, while presently a total of 66 companies in Malaysia have been awarded the FSC Chain-of-Custody certificates.

Currently, Malaysia is negotiating with the European Union on its Forest Law Enforcement, Governance and Trade (FLEGT) Voluntary Partnership Agreements, as well as taking steps to submit the MTCC timber certification scheme for endorsement within the PEFC's framework for mutual recognition.

Estimated future log production

The average annual production of industrial logs in Malaysia is estimated at 24.63 million m^3 for the period under the Ninth Malaysia Plan, 2006-2010; 29.23 million m^3 for the next five years from 2011-2015, and 32.47 million m^3 for the period 2016-2020.

In this regard, Sarawak is projected to increase its average annual log production from 13.45 million m^3 during the period 2006-2010 to 25.00 million m^3 for the period 2016-2020, mainly from its aggressive forest plantation programs, while in Peninsular Malaysia and Sabah the estimated average annual log productions are expected to decline due to more stringent enforcement of the annual allowable coupe and the level of permissible cut under sustainable forest management.

Nevertheless, the average annual log productions from the production forests of the PRFs which are under sustainable forest management in Malaysia for the five-year periods 2006-2010, 2011-2015 and 2016-2020 are estimated to be 18.10 million m^3, 24.12 million m^3 and 27.62 million m^3 respectively, with most of the production emanating from Sarawak.

Wood-based industries

Under the Third Industrial Master Plan (IMP3), 2006-2020, total investments in the wood-based industry during the period have been targeted to be RM 25.4 billion or RM 1.7 billion per annum, while exports are targeted to grow at an annual rate of 6.4 percent to reach RM 53 billion by 2020, mainly from downstream products, such as furniture, medium density fibreboard, plywood and panel products.

It is imperative to address the over-capacity of the primary wood-based industries in Peninsular Malaysia and Sabah *vis-à-vis* their respective log availability as the combined annual installed capacity of the sawmills and plywood/veneer mills in Peninsular Malaysia and Sabah in 2005, which were estimated to be 12.73 million m^3 and 8.35 million m^3 had far exceeded their log production of 5.74 million m^3 or 54.9 percent and 6.56 million m^3 or 21.4 percent in 2005 respectively. This could involve the withdrawal or cancellation of the mill licenses, especially those that are not in operation for prolonged periods.

Employment in the forestry sector in Malaysia, especially in the wood-based industries, had registered a steady increase between 1985 and 2000, from 147.24 000 workers in 1985 to 274.38 000 workers in 2000, but with a slight decline to 270.67 000 workers in 2005, while the population in Malaysia is expected to grow at an average annual rate of 1.6 percent for the period 2006-2010 to 28.96 million people by 2010, and to 32 million in 2020.

Forest ecosystem services

Under the Ninth Malaysia Plan, 2006-2010, emphasis has been given, among others, to further promote ecotourism in Malaysia through the preservation of natural attractions, such as wilderness and wildlife areas, nature and forest recreational parks, highlands and islands, which will be guided by the National Ecotourism Plan. During the Plan period, tourist arrivals are expected to grow at an average annual rate of 8.4 percent and to reach 24.6 million in 2010 while tourist receipts are set to rise at an average annual rate of 13.9 percent to RM 59.4 billion in 2010.

In this context, the various Forestry Departments in Peninsular Malaysia have developed a total of 116 forest recreational parks and 2 nature parks located through the Peninsula to cater for the projected increase of tourist arrivals, both domestic and foreign. This would provide the added impetus for Malaysia to conserve and protect its rich natural forests.

Management of water resources in Malaysia under the Ninth Malaysia Plan, 2006-2010, would focus on maintaining and enhancing the ecosystem functions of river systems through the restoration and maintenance of highland catchments, wetlands, river buffers and riparian zones. The suitability of market-based instruments would also be explored to internalize environmental costs, including scarcity, into water pricing systems.

Institutional arrangements

On 27 March 2004, the Government of Malaysia placed the Forestry Department Peninsular Malaysia (FDPM), FRIM, and the Department of Minerals and Geoscience Malaysia under the newly created Ministry of Natural Resources and Environment (NRE), together with the Department of Environment and the Department of Wildlife and National Parks Peninsular Malaysia. This provided a more holistic, multi-disciplinary and cross-sectoral approach in addressing forest and forest-related matters, as well as the further integration of forestry with the need to protect and safeguard the environment for the benefit of future generations. However, there is a need to ensure adequate trained and motivated manpower to manage, conserve and develop the forest resources sustainably in Malaysia.

Nevertheless, the total expenditures for administering the forests in Malaysia by the public sector had increased from RM 162.58 million in 1985 to RM 257.33 million in 2005, an increase of 58.3 percent or at an average annual rate of 2.9 percent, while the total expenditures incurred in undertaking management, conservation and development activities had recorded more than a fourfold increase from RM 45.40 million in 1985 to RM 182.06 million in 2005. In addition, the total forest revenue collected by the public sector in 2005 alone was RM 1,567.22 million.

Probable scenario of the forestry sector in 2020

It is expected that the total area under PRFs designated for permanent forestry uses in 2020 will increase by at least 1 million ha, thus, bringing the total area of the PRFs in Malaysia to 16.30 million ha or representing 49.6 percent of its total land area. However, the current level of forested land of 18.31 million ha is expected to decline by 1.58 million ha to 16.73 million ha by 2020, based on the average annual loss of 105,500 ha over the period 1985 to 2005.

The area under forest plantations is expected to increase by 1.75 million ha by 2020, thus, bringing the total planted areas in Malaysia to 2.15 million ha with 55.8 percent of these areas located in Sarawak.

Forest harvesting techniques, especially in the production forests of the PRFs, will be more conservative and benign to the environment, as well as in conserving forest biological

diversity more effectively during harvesting operations, including mitigating human-wildlife conflict in forest management practices.

By 2020, all the areas in the PRFs in Malaysia will be sustainably managed in accordance with agreed international criteria and indicators for sustainable forest management which could be certified by independent third party assessors, if required.

By 2020, all timber and timber products produced in Malaysia will also be certifiable as legal and from sustainable managed forests by independent third party assessors consistent with internationally recognized timber certification schemes, including the Malaysian Criteria and Indicators for Forest Management [MC&I (2002)] used by the MTCC.

More representative virgin forest areas are expected to be constituted by 2020, especially those representing the more fragile forest ecosystems, such as the lower and upper montane forests, and wetlands, consistent with the National Policy on Biological Diversity 1998 and the National Wetlands Policy 2004.

The number of national and state parks, nature reserves, wilderness and wildlife areas, and bird sanctuaries, including wildlife rehabilitation centers, are expected to increase to cater for the projected increase of domestic tourists due to higher disposable income and improved quality of life, as well as the influx of tourist arrivals, consistent with the Government's efforts to further promote ecotourism in Malaysia under the National Ecotourism Plan.

It is expected that by 2020, watershed management, especially in upland forested areas, will be better integrated into multiple-use forest management practices, and links between watershed management and food production areas will be strengthened through an integrated approach, while greater emphasis will also be placed on hydropower generation in the overall context of clean and efficient energy production.

By 2020, the total production of logs is expected to increase to 32.47 million m^3 from the 2005 level of 28.24 million m^3 in tandem with the projected increase of forest plantation, especially in Sarawak. In this regard, logs from the PRFs are expected to contribute an estimated 27.62 million m^3 with the proportion of plantation wood accounting for 58.3 percent of the production.

It is envisaged that the export of logs will be further reduced and will most probably be phased out by 2020 as currently there has been a total ban on log exports from Peninsular Malaysia since 1985, while the primary processing mills in Sabah are facing shortages in log supply.

Most of the exports from the wood-based industry in Malaysia in future will be wood-based panel products, especially furniture, and laminated scantlings. The wood-based industry is also expected to convert wood waste materials into solid and engineered products for construction and household applications, as well as in using natural fibres, such as oil palm biomass which could be processed into blockboards, moulded particle boards, medium density fibreboards and even plywood.

The rich forest biological diversity will be further optimized for the development of herbal, cosmetic and pharmaceutical products through the application of appropriate biotechnology, as well as the increasing use of rattan and bamboo for the production of value-added products for niche markets.

The number of primary processing mills, especially the sawmills in Peninsular Malaysia, will be reduced due to the unavailability of local log supply and this consolidation of the primary processing mills will ensure that the reduced installed capacities of these mills will be

commensurate with the level of log production, in particular the sustainable level of harvests from the PRFs.

It is envisaged that Malaysia will increase its import of sawnwood, wood-based panels and paper and paperboard to meet the rising demand of the growing population, especially printing and writing paper as the population becomes more educated in a knowledge-based society.

Future forestry R&D in Malaysia will focus on the improvement of sustainable management practices of natural forest, silviculture of forest plantations, planting-stock production, biotechnology, landscape and recreation, conservation of forest biological diversity, natural-products discovery, wood processing technology, wood protection and construction application, and downstream utilization of wood residues for development of composite products, pulp and paper, and energy from biomass.

With the expanded roles of forest in meeting changing societal demands, future human resource development (HRD) in Malaysia will place greater emphasis in enhancing knowledge and in the development and expansion of skills, such as in managing forests for bio-energy and in mitigating climate change; in the conservation of areas having high diversity and endemism and the effective management of watershed areas; as well as in advanced wood processing technology, and in the manufacture of bio-composites and furniture designs. In addition, the number of personnel in the forestry sector in Malaysia will also increase so as to fully achieve multiple-resource forest management, which is compatible with the need to conserve the forest ecosystem and protect the environment.

4. Depending on the outcomes of post-Kyoto, Malaysia may consider forestry projects under the Clean Development Mechanism (CDM), if carbon sequestered from reduced impact logging and enrichment planting can be traded in the international markets; and with regard to the protection of carbon stocks in natural forests that is currently being deliberated under the Reducing Emissions from Deforestation and Degradation (REDD) initiative that is part of the Kyoto framework.

Conclusions

Although the current level of forested land of 18.31 million ha is expected to decline to 16.73 million ha by 2020, the total forest areas under the PRFs in Malaysia at the end of 2020 are expected to increase by 1 million ha to 16.30 million ha, representing 49.6 percent of its total land area. This will contribute to meeting the first global objective on forests of the Non-legally Binding Instrument on All Types of Forests, among others, in reversing the loss of forest cover worldwide through sustainable forest management.

By 2020, all the areas in the PRFs in Malaysia will be sustainably managed, while all timber and timber products produced in Malaysia will also be certifiable as legal and from sustainably managed forests by independent third party assessors. This will also contribute to meeting the third global objective on forests of the Non-legally Binding Instrument on All Types of Forests in increasing significantly the area of protected forests worldwide and other areas of sustainably managed forests, as well as increase the proportion of forest products from sustainably managed forests.

The total log production in Malaysia is expected to increase to 32.47 million m^3 by 2020 as a result of an additional 1.74 million ha of established forest plantations, especially in Sarawak, while watershed management, especially in upland forested areas, will be better integrated into multiple-use forest management practices.

The rich forest biological diversity will be further optimized for the development of herbal, cosmetic and pharmaceutical products through the application of appropriate biotechnology, while most of the exports from the wood-based industry in Malaysia in future will be wood-based panel products, and other higher-valued products to cater for niche markets. Furthermore, the number of primary processing mills, especially the sawmills in Peninsular Malaysia, will be reduced due to the unavailability of local log supply.

Future forestry research in Malaysia will focus on the improvement of sustainable management practices of natural forest, including mitigating human-wildlife conflict in forest management practices; forest plantation establishment and development; conservation of forest biological diversity and the application of biotechnology; natural-products discovery; wood processing technology and the further utilization of wood residues; and energy from biomass.

Next steps

Actions should be taken to examine in-depth the National Forestry Act 1984 and the other forest-related laws so as to simplify them and remove contradictions, inconsistencies and overlapping jurisdictions between the laws, especially those provisions supporting sustainable forest management and in curbing illegal forest harvesting activities and trade in illegal timber products. This revision or amendments to the laws should be undertaken through an inclusive, participatory and cross-sectoral process and be based on an examination of the financial, technical and human resources needed to effectively implement them. A prerequisite for such a revision is the need to update the National Forestry Policy 1978 as this will form the framework under which the revision of the National Forestry Act 1984 should be undertaken.

It is imperative that interagency coordination be further strengthened at the Federal, States and forest management unit levels in order to ensure sustainable forest management, conservation and development of forest resources in Malaysia. This should involve horizontal and vertical coordination, as well as enhance information flow and accountability between the different tiers of government.

Forest management which is currently based on an ecosystem approach to produce a few forest goods and services simultaneously should be evolved to reflect and move towards the ‘true’ ecosystem approach of the CBD and in better addressing intergenerational equity.

Actions should be initiated to ensure that future forest management practices place more emphasis on the linkages between the highland and lowland users of forest goods and services. Such practices should also be more people-centered which should involve more transparent participatory management, including decision-making and accountability, as well as improved governance and with the involvement of indigenous people, forest dwellers and local communities.

Benchmarks for the quantification of watershed parameters, and in particular, the cumulative watershed effects from forest management activities, such as those involved in forest harvesting, which may impact on the long-term sustainability of the forest ecosystem need to be developed. This is especially critical for the mangrove and peat swamp forests in Malaysia as quantitative information of the hydrological impacts of harvesting these forests is still lacking as much of the research programs thus far have been concentrated in the inland forests.

Further work is also needed, first, to develop more effective procedures for assessing changes in forest biological diversity and water quality of streams emerging from logged-over forests as compared with similar areas that are kept free from human intervention; second,

appropriate mechanisms to resolve disputes, conflicts and grievances, particularly those over tenure claims and use rights; third, procedures for evaluating social impact of forest operations directly affecting communities; and fourth, to document traditional forest-related knowledge and practices of indigenous people in the use of forest species or management systems in forest operations, including the development of mechanisms or instruments for the equitable sharing of benefits arising from the commercial application of such knowledge and practices.

Steps should be taken to ensure the adequacy of the current network of representative areas for the conservation of forest biological diversity, including establishing forest diversity indicators for threatened ecosystems in Malaysia, while taking into account the need for biological corridors linking them or 'stepping stones' between them.

Studies should be initiated to quantify the cost in protecting and managing the existing biological reserves in Malaysia and the opportunity cost foregone in implementing *in situ* conservation of biological diversity and its potential use in the light of advances in biotechnologies in using the resources as this will optimize allocation of resources for the conservation of biological diversity.

With regard to the installed capacities of the primary processing industries in Peninsular Malaysia and Sabah that have far exceeded the local wood supply, actions should be initiated to restructure the industries so that their installed capacities are commensurate with the availability of log supply, while new primary processing mills or mills planning to expand their processing capacity should be made to show proof of their sources of raw materials which should be of legal origin.

In view of the current high profile of forest issues in the climate change agenda, it is pertinent for Malaysia to develop and strengthen the institutional capacity, expertise and make available equipment to measure, monitor and report on carbon sequestration arising from afforestation and reforestation activities, as well as from protecting the carbon stocks in natural forests.

1. INTRODUCTION

This paper on the outlook of the Malaysian forestry sector in the year 2020 is prepared under the auspices of the Asia-Pacific Forestry Commission (APFC) Asia-Pacific Forestry Sector Outlook Study II (APFSOS II) and in accordance with the Terms of Reference for the Consultancy. This is a follow up to the first APFSOS that was undertaken in 1996, culminating in the publication of the Report of the Asia-Pacific Forestry Sector Outlook Study — Asia-Pacific Forestry Towards 2010 by the Food and Agriculture Organization of the United Nations (FAO) in 1998.

The paper will assess and analyze the status, trends and the most probable outlook of the Malaysian forestry sector in year 2020. Focus will be given to the economic, social and environmental contributions of forests and their utilization in the pursuit of achieving sustainable development in Malaysia.

More specifically, the paper will examine the key factors impacting the forestry sector in Malaysia, both inside and outside the sector; the past trends and current state of the forests and the sector; the development of the forest industries, including the utilization of non-wood forest products; forest ecosystem services; the increasing roles of forest in the conservation of biological diversity, and in mitigating climate change; as well as in meeting the changing societal demands placed on forest, for example in the protection of watersheds and environmentally sensitive areas.

It is envisaged that the paper will contribute to better informed national policy development and planning, including investment planning in the use of private capital; and in international forestry dialogue, especially in the attainment of the four global objectives on forests of the Non-legally Binding Instrument on All Types of Forests which was adopted at the Seventh Session of the United Nations Forum on Forests (UNFF) held in April 2007, namely:

(i) 'Global Objective 1: Reverse the loss of forest cover worldwide through sustainable forest management, including protection, restoration, afforestation and reforestation, and increase efforts to prevent forest degradation';

(ii) 'Global Objective 2: Enhance forest-based economic, social and environmental benefits, including by improving the livelihoods of forest dependent people';

(iii) 'Global Objective 3: Increase significantly the area of protected forests worldwide and other areas of sustainably managed forests, as well as increase the proportion of forest products from sustainably managed forests'; and

(iv) 'Global Objective 4: Reverse the decline in official development assistance for sustainable forest management and mobilize significantly increased, new and additional financial resources from all sources for the implementation of sustainable forest management'.

In preparing the paper, data were collected and information assembled from a number of departments and agencies, such as the Forestry Departments of Peninsular Malaysia, Sabah and Sarawak, the Malaysian Timber Industry Board (MTIB), and the Malaysian Timber Council (MTC), as well as information received through the Asia-Pacific Forestry Sector Outlook Study: The Future of Asia-Pacific Forests' Questionnaires (Country Worksheets) from, among others, the Forestry Departments of Peninsular Malaysia, Sabah and Sarawak; MTIB; World Wide Fund for Nature (WWF)-Malaysia; the Malaysian Timber Certification Council (MTCC); and the Forest Research Institute, Malaysia (FRIM). Coordinating meetings were also held by the Forestry Department Headquarters, Peninsular Malaysia with the participation of not only officials from government departments and agencies involved in

forest matters but also representatives from non-governmental organizations (NGOs), such as the WWF-Malaysia; as well as a two-day Multi-stakeholder Dialogue on the Outlook of the Malaysian Forestry Sector in the Year 2020, jointly organized by the Forestry Department, Peninsular Malaysia (FDPM) and MTC. This Multi-stakeholder Dialogue was attended by 44 participants representing 16 governmental departments and agencies, including the Ministry of Natural Resources and Environment, Malaysia; seven organizations from the timber trade and industry, three social and environmental NGOs, and two academic/research institutions.

2. STATE OF THE FORESTRY SECTOR

Background

Malaysia is a federation of thirteen States and three Federal Territories with eleven of the States and the Federal Territories of Kuala Lumpur and Putrajaya located in Peninsular Malaysia, while the State of Sabah together with the Federal Territory of Labuan and the State of Sarawak are located in the northern and the northwestern parts of the island of Borneo respectively. Peninsular Malaysia is separated from Sabah and Sarawak by 720 km of the South China Sea, giving the country a coastline of almost 4,830 km.

The total land area of Malaysia is estimated to be 32.83 million ha. Peninsular Malaysia with a total area of 13.16 million ha is located between latitudes 1º20´and 6º45´ North and between longitudes 99º40´ and 104º20´ East. Its maximum width is 322 km with a length from the northernmost to the southernmost tip of approximately 740 km. Parallel mountain ranges in northeast-southeast direction characterize the northern and central-western parts, with peaks about 2,000 m high with the highest point being 2,190 m.

Sabah which is located between latitudes 4º and 7º North and longitudes 115º20´ and 119º20´ East is situated at the northern tip of the island of Borneo and has a land area of 7.37 million ha. The main offshore islands are Labuan in the west, Banggi in the north, and, in the east, Jambongan, Timbun Mata and Sebatik. The latter is bisected by the boundary with Kalimantan. To the west is the South China Sea, to the east the Sulu Sea, and the Sulawesi Sea is off the southeast coast of the State.

Sarawak with a land area of 12.30 million ha is situated on the northwest coast of the island of Borneo, between latitudes 0º50´and 5º North and longitudes 109º35´ and 115º40´ East. It is bordered to the north and west by the South China Sea, to the south by the Indonesian province of Kalimantan, and to the east by the Malaysian State of Sabah. It also surrounds, on the landward side, the country of Brunei Darussalam. Its maximum width is approximately 257 km with a length of about 740 km.

The climate of Peninsular Malaysia is typically humid tropical or wet equatorial and is characterized by year round high temperatures and seasonal heavy rain. The mean temperatures during the day and night are 32ºC and 22ºC respectively. The average monthly temperature variation is about 2ºC while diurnal temperature variations for inland and coastal areas are 8.5º to 11ºC and 5.5º to 8.5ºC respectively. Although Peninsular Malaysia is outside the belt of tropical cyclones, it is influenced by monsoon winds from the southwest during May to September and from the northeast from October to March. The average rainfall is about 2,540 mm per year with a maximum of 5,080 mm and a minimum of 1,650 mm. Humidity is always high and ranges from 70 to 98 percent and the sky is cloudy most of the day, especially during the monsoon months. Thunderstorms occur year-round, on average 200 days a year with a peak in the afternoons, except for night-thunder in the coastal plains.

In Sabah, temperatures in the lowlands average 26.3ºC and decrease by 0.6ºC for every 100 m rise in elevation to 2,000 m and then by 0.5ºC thereafter. At the summit of Mt. Kinabalu which is at 4,101 m, the average temperature is in the range of 10º-18ºC. The average annual rainfall in Sabah varies from 1,730 mm to 5,080 mm and is subjected to seasonal variation due to the northeast monsoon from October or November to February and the southeast monsoon from May to August or September. Between the monsoons, winds are indeterminate. Although Sabah lies south of the typhoon belt, it experiences severe rain and wind storms which usually occur in association with typhoons over the Philippine islands to the north. Humidity is generally high at 70-90 percent and rising to 100 percent at night (Fox 1978).

The climate of Sarawak is dominated by the northeast monsoon which starts in November and lasts until March. This is a period of heavy and persistent rain accompanied, in the coastal areas, by strong winds. In the inland areas, the rainfall between March and October is relatively light at 120 mm to 150 mm per month although the actual rainfall varies considerably from area to area. The mean air temperatures range from 26º to 29ºC while diurnal temperature changes are normally 5º to 8ºC over grassland and several degrees lower under forest cover. The mean annual rainfall is 3,000 mm to 4,000 mm over the greater part of the State while the humidity is constantly high. The area of lowest mean annual rainfall of 2,000 mm is approximately mid-way between Bintulu and Miri Guite, near the coast.

Peninsular Malaysia consists of east and west coastal plains and central mountain ranges running roughly north to south and reaching up to 2,130 m in some places. The two largest rivers, the Perak River and the Pahang River, flow towards the Straits of Malacca and the South China Sea respectively. At their sources and upper reaches, the rivers are fast-flowing but at the lower reaches the rivers on the west coast sometimes flow through swampy land, while those on the east coast are sometimes impeded by sand bars.

Sabah and Sarawak consist of alluvial and often swampy coastal plains with hilly rolling country inland and mountain ranges in the interior. In Sabah, the central mountain ranges rise abruptly from the west coast to Mt. Kinabalu at 4,101 m, the highest in South East Asia, with many rivers flowing northwest and east to the South China Sea and Sulu Sea. The largest, the Kinabatangan, is navigable for considerable distances and waters an extensive plain. In Sarawak, the eastern mountain ranges rise to more than 1,520 m and contain the largest cave in the world. The largest river, the Rejang, is 564 km long and is navigable for about 160 km.

Policy and legislation

Under Article 74 (2) of the Malaysian Constitution, forestry comes under the jurisdiction of the respective State Governments. As such, each State is empowered to enact laws on forestry and to formulate forestry policy independently. The executive authority of the Federal Government only extends to the provision of advice and technical assistance to the States, training, the conduct of research, and in the maintenance of experimental and demonstration stations.

In order to facilitate the adoption of a coordinated and common approach to forestry, as well as to reconcile cross-sectoral policies that interface with the forestry sector, the National Forestry Council (NFC) was established on 20 December 1971 by the National Land Council (NLC). The NLC is empowered under the Malaysian Constitution to formulate a national policy for the promotion and control of utilization of land for mining, agriculture and forestry. The NFC is chaired by the Deputy Prime Minister and comprises the Chief Ministers of the thirteen Malaysian States, the Minister of Natural Resources and Environment, and other Federal Ministers whose portfolios have an impact on the forestry sector, such as finance; trade; agriculture and agro-based industry; plantation industries and commodities; and science, technology and innovations; and heads of the forestry services of Peninsular Malaysia, Sabah and Sarawak. It serves as a forum for the Federal and the State Governments to discuss and resolve common problems and issues relating to forestry policy, administration and management, as well as to enhance cooperation between the Federal and State Governments, so as to ensure a coordinated approach in the implementation of policies and programs related to forestry. All the decisions of the NFC have to be endorsed by the NLC. The responsibility for implementing the decisions of the NFC lies with the State Governments unless it is within the authority of the Federal Government.

At the State level, coordination of cross-sectoral policies that interface with the forestry sector is undertaken through the State Development Council/Committee and the State Executive Council/State Cabinet.

In 1977, a National Forestry Policy was formulated and approved by the NFC which was later endorsed by the NLC on 19 April 1978. This Policy is currently being implemented by all the States in Peninsular Malaysia, while the objectives of this Policy are also being implemented in Sabah. In Sarawak, the Forest Policy which was approved by the Governor-in-Council in 1954 and has very similar provisions to the National Forestry Policy, has remained the basis for forestry practices. However, with the concern expressed by the world community on the importance of biological diversity conservation and the sustainable utilization of forest genetic resources, as well as the role of local communities in forest development, the National Forestry Policy was revised in 1992 to include these important aspects of forestry. The salient features of the National Forestry Policy 1978 (Revised 1992) are as follows:

(i) to dedicate as **PERMANENT FOREST ESTATE** sufficient areas **(Permanent Reserved Forests)** strategically located throughout the country in accordance with the concept of rational land use, which will be managed and classified under four major functions, namely:

* **PROTECTION FOREST** for ensuring favorable climatic and physical conditions of the country, the safeguarding of water resources, soil fertility and environmental quality, the conservation of biological diversity and the minimization of damage by floods and erosion to rivers and agricultural lands;

* **PRODUCTION FOREST** for the supply in perpetuity, at reasonable costs of all forms of forest produce which can be economically produced within the country and are required for agricultural, domestic and industrial purposes, and for export;

* **AMENITY FOREST** for the conservation of adequate forest areas for recreation, ecotourism and in enhancing public awareness in forestry; and

* **RESEARCH AND EDUCATION FOREST** for the conduct of research and education.

(ii) to implement a planned program of forest development through forest regeneration and rehabilitation operations in accordance with prescribed silvicultural practices;

(iii) to promote efficient harvesting and utilization within the production forest for maximum economic benefits from all forms of forest produce and to stimulate the development of appropriate forest industries commensurate with the resource flow, as well as to create employment opportunities;

(iv) to increase the production of non-wood forest produces through scientific and sustainable management practices to meet local demands and related industries;

(v) to provide for the conservation of biological diversity and areas with unique species of flora and fauna;

(vi) to encourage private sector investment in forest development through the establishment of forest plantation;

(vii) to undertake and support intensive research programs in forestry and forest products aimed at enhancing maximum benefits from the forest;

(viii) to undertake and support a comprehensive program of forestry training at all levels for the public and private sectors in order to ensure adequate supply of trained

manpower to meet the requirements of the forest sector and the forest-based industries;

(ix) to promote education in forestry and undertake publicity and extension services in order to generate better understanding among the community of the multiple values of forest;

(x) to set aside specific areas for the purpose of forestry education and other scientific studies;

(xi) to promote active local community participation in various forestry development projects and to enhance their involvement in agro-forestry programs; and

(xii) to develop a comprehensive program in community forestry to cater for the needs of the rural and urban communities.

To ensure effective forest management and the implementation of the National Forestry Policy in Malaysia, various forestry enactments and ordinances have been formulated and enforced by the respective State authorities since the early 1900s. These enactments and ordinances were further uniformized and strengthened in areas of forest management planning and operations through the adoption of the National Forestry Act and the Wood-based Industries Act in October 1984. These two Acts are currently being enforced by all the States in Peninsular Malaysia as Sabah and Sarawak have their own forest and forest-related enactments and ordinances, such as the Sabah Forest Enactment 1968 amended 1992, Sabah Parks Enactment 1984, Sabah Cultural Heritage (Conservation) Enactment 1997, Sabah Wildlife Conservation Enactment 1997, Sabah Water Resources Enactment 1998, Sabah Biodiversity Enactment 2000, Sabah Environment Protection Enactment 2002, Sarawak Forests Ordinance 1954 amended 1999, Sarawak National Parks and Nature Reserves Ordinance 1998, Sarawak Wildlife Protection Ordinance 1998, Sarawak Biodiversity Centre Ordinance 1997, and the Sarawak Natural Resource and Environment Ordinance 1994. These enactments and ordinances are also augmented by other legislation on land use, such as the Water Enactment 1935, Land Conservation Act 1960, Environmental Quality Act 1974, Protection of Wildlife Act 1972, and the National Parks Act 1980.

In addition, to further strengthen the provisions for safeguarding and protecting forest resources from encroachment and illegal logging, the National Forestry Act was amended in 1993. In this context, the penalty for the commission of any forest offence has been increased from the maximum penalty of RM10,000[1] or imprisonment for a term not exceeding three years or both to a maximum penalty of RM500,000 and imprisonment of not less than one year, but not exceeding 20 years. The amended National Forestry Act has also allowed the Forestry Departments in Peninsular Malaysia to request assistance from the Armed Forces to undertake surveillance of forestry activities, especially in curbing illegal logging, encroachment of forested areas and timber theft.

Under Part III, Chapter 2, section 10 (1) of the National Forestry Act 1984, all the State Forestry Departments in Peninsular Malaysia have also further classified the Permanent Reserved Forests (PRFs) into one or more of the following functional use categories through a combination of slope and elevation classes:

(i) timber production forest under sustained yield;

(ii) soil protection forest;

(iii) soil reclamation forest;

[1] US$1.00 is equivalent to Ringgit Malaysia (RM) 3.2230.

(iv) flood control forest;

(v) water catchment forest;

(vi) forest sanctuary for wildlife;

(vii) virgin jungle reserved forest;

(viii) amenity forest;

(ix) education forest;

(x) research forest; and

(xi) forest for federal purposes.

Furthermore, under Part II, section 4 of the same Act, the Director of each of the State Forestry Departments in Peninsular Malaysia has also to:

(i) prepare and implement State forest management plans which shall prescribe the allowable cut either in terms of volume or area, in accordance with the principle of sustained yield;

(ii) prepare and implement reforestation plans;

(iii) review from time to time the State forest management plans and reforestation plans; and

(iv) prepare and implement programs relating to amenity forests.

To assist the Forestry Departments in undertaking forest development works, under Part IV, Chapter 8, section 56 of the National Forestry Act 1984, each State Authority, especially in Peninsular Malaysia, has established a Forest Development Fund which is funded through the following means:

(i) any sums that are annually appropriated by the State Legislative Assembly for the purposes of the Fund;

(ii) any forest development cess collected in respect of any forest produce removed from any forested area;

(iii) any loans or grants given to the State Authority by the Federal Government for the purposes of the Fund;

(iv) any money paid to the State Authority for carrying out into effect a reforestation plan when the forest licensee fails to implement it successfully; and

(v) all moneys collected under any previous forest law by the State Authority for the purpose of financing research on forestry, silviculture works, forest surveys, inventory and other related operations connected with forest development in the State, which remains unexpended.

In this context, the Fund would be used for the following purposes in accordance with Part IV, Chapter 8, section 58 of the same Act:

(i) the preparation of the State forest management plans;

(ii) the preparation and implementation of reforestation plans;

(iii) the reviewing of the State forest management plans and reforestation plans;

(iv) the preparation and implementation of programs relating to amenity forests; and

(v) any expenses incurred by the State Authority in carrying into effect a reforestation plan when a licensee fails to implement it.

Forest resources

The tropical rain forests of Malaysia are extremely complex ecosystems and are richer in tree species than in similar areas of Africa and South America. They are, in fact, the most species-rich plant communities known anywhere in the world (Whitmore 1975) and have evolved over million of years. There are at least 15,000 species of flowering plants, of which 2,500 are tree species; 286 species of mammals; 600 species of birds; 140 species of snakes; 150 species of frogs and thousands of species of insects, many of which are still being documented. In addition, over 1,300 plant species have been identified as having potential pharmaceutical properties with some of them currently being used as traditional herbal medicine.

At the end of 2005, total land under forests in Malaysia was estimated to be 18.31 million ha or 55.8 percent of its total land area; lands under perennial agricultural tree crops such as rubber, oil palm, cocoa and coconut, and those under other land usage such as for settlements and infrastructural development totaled 5.55 million ha or 16.9 percent and 8.97 million ha or 27.3 percent of its total land area respectively, as shown in Table 1.

Table 1. Land-use patterns by regions in Malaysia, 2005 (million ha)

Region	Land area	Natural forest	Forest plantation	Agricultural tree crops	Other land uses	Total forest area	% total of forest area
Peninsular Malaysia	13.16	5.81	0.07	3.32	3.96	5.88	44.7
Sabah	7.37	4.16	0.20	1.50	1.51	4.36	59.2
Sarawak	12.30	7.94	0.13	0.73	3.50	8.07	65.6
Malaysia	32.83	17.91	0.40	5.55	8.97	18.31	55.8

Source: FD Peninsular Malaysia, FD Sabah, FD Sarawak.

In fact, together with the 5.55 million ha of perennial agricultural tree crops which are similar to reforested land and increasingly looked upon as alternative sources of wood supply, especially that of rubberwood, the total area under tree cover in Malaysia at the end of 2005 had increased to 23.86 million ha or 72.7 percent of its total land area.

In terms of major forest types, it was estimated that in 2005 Malaysia had 15.97 million ha of dry inland forest, 1.36 million of swamp forest and 0.58 million ha of mangrove forest, with the balance of 0.40 million ha being forest plantation. The distribution of these major forest types by regions is shown in Table 2. It is evident from the table that the proportion of forest is much higher in Sabah and Sarawak than in Peninsular Malaysia which is more developed.

Table 2. Distribution and extent of major forest types by regions in Malaysia, 2005 (million ha)

Region	Land area	Natural forest			Forest plantation	Total forested land	% total of forested land
		Dry inland forest	Swamp forest	Mangrove forest			
Peninsular Malaysia	13.16	5.41	0.30	0.10	0.07	5.88	44.7
Sabah	7.37	3.70	0.12	0.34	0.20	4.36	59.2
Sarawak	12.30	6.86	0.94	0.14	0.13	8.07	65.6
Malaysia	32.83	15.97	1.36	0.58	0.40	18.31	55.8

Source: FD Peninsular Malaysia, FD Sabah, FD Sarawak.

On the plains and low hills, the dry inland forests, which are mainly the dipterocarp forests, predominate and form an almost unbroken canopy, but in the higher mountains the forests tend to thin out and exhibit considerable variation in flora. The high forests are replaced by swamp flora in the swampy areas and by mangroves along some coastal areas. The dry inland forests, which represent 89.2 percent of the total natural forests, are characterized by the predominance of the family Dipterocarpaceae with many of the species of the genera *Anisoptera, Dipterocarpus, Dryobalanops, Hopea, Shorea* and *Parashorea.*

Furthermore, recognizing the crucial role of forests is not only about the production of timber, but more importantly in the conservation of soil, water and wildlife, as well as in the protection of the environment, Malaysia has a total of 15.30 million ha of forested land designated as PRFs which are under sustainable management. Approximately 12.19 million ha of the PRFs are production forests with the remaining 3.11 million ha being protection forests. The status of the PRFs in Malaysia by regions is summarized in Table 3.

Table 3. Permanent Reserved Forests (PRFs) by regions in Malaysia, 2005 (million ha)

Region	Protection forest	Production forest	Total land area under PRFs	% of total land area
Peninsular Malaysia	1.52	3.18	4.70	35.7
Sabah	0.59	3.01	3.60	48.8
Sarawak	1	6.00	7	56.9
Malaysia	3.11	12.19	15.30	46.6

Source: FD Peninsular Malaysia, FD Sabah, FD Sarawak.

At the end of 2005, the total growing stock in the natural forests for all trees of 10 cm dbh and above in Malaysia was estimated to be 4,426.77 million m^3 while the total merchantable volume of all trees having 45 cm dbh and above, excluding mangrove forests, was estimated to be 2,332.60 million m^3. The details of the total growing stock and merchantable volume by regions and major forest types are shown in Table 4, where it is observed that 92.3 percent of the total growing stock of 10 cm dbh and above are from the dry inland forests.

Table 4. Total growing stock and merchantable volume by regions and major forest types in Malaysia, 2005 (million m^3)

Region	Dry inland forest		Swamp forest		Mangrove forest		Total	
	≥10 cm dbh	≥45 cm dbh	≥10 cm dbh	≥45 cm dbh	≥10 cm dbh	≥45 cm dbh	≥10 cm dbh	≥45 cm dbh
Peninsular Malaysia	1,357.91	898.06	81.60	18.30	24.50	-	1,464.01	916.36
Sabah	869.50	432.90	13.20	6.48	83.30	-	966.00	439.38
Sarawak	1,859.06	926.10	103.40	50.76	34.30	-	1,996.76	976.86
Malaysia	4,086.47	2,257.06	198.20	75.54	142.10	-	4,426.77	2,332.60

For the PRFs in Malaysia, the total growing stock, at the end of 2005, for all trees having 10 cm dbh and above was estimated to be 3,833.09 million m^3 with 780.42 million m^3 and 3,052.67 million m^3 in the protection and production forests respectively. It was further estimated that the total merchantable volume for all trees having 45 cm dbh and above and excluding mangrove forests was 2,041.57 million m^3 with the protection and production forests having 434.93 million m^3 and 1,606.64 million m^3 respectively. The details of the total growing stock and merchantable volume in the PRFs in Malaysia by regions and functions are as shown in Table 5.

Table 5. Total growing stock and merchantable volume of the permanent reserved forests (PRFs) by regions and functions in Malaysia, 2005 (million m^3)

Region	Protection forest		Production forest		Total	
	≥10 cm dbh	≥45 cm dbh	≥10 cm dbh	≥45 cm dbh	≥10 cm dbh	≥45 cm dbh
Peninsular Malaysia	383.68	240.16	802.70	502.44	1,186.38	742.60
Sabah	145.26	71.74	741.09	366.02	886.35	437.76
Sarawak	251.48	123.03	1,508.88	738.18	1,760.36	861.21
Malaysia	780.42	434.93	3,052.67	1,606.64	3,833.09	2,041.57

In addition, the total growing stock of the current 0.40 million ha of forest plantations in Malaysia, which are planted mainly with *Acacia mangium*, *Gmelina arborea* and *Paraserianthes falcataria*, is estimated to be 58 million m^3, based on an weighted average of 145 m^3 per ha, with 50 percent of the growing stock in Sabah.

Based on the estimated growing stock in the natural forests for all trees of 10 cm dbh and above for Peninsular Malaysia, Sabah and Sarawak, and using the Tier 1 estimated values for Basic Wood Density of 0.5 tonnes of dry matter per m^3 and the Biomass Expansion Factor of 2.16 from the Intergovernmental Panel on Climate Change-Good Practice Guidance for Land Use, Land-use Change and Forestry, 2003 (IPCC-GPG 2003) (Anon 2003), the above-ground biomass for the Peninsula, Sabah and Sarawak, at the end of 2005, was estimated to be 1,581.13 million tonnes, 1,043.28 million tonnes and 2,156.50 million tonnes respectively, giving Malaysia a total of 4,780.91 million tonnes of live biomass.

Furthermore, using the default value of root to shoot ratio of 0.24 from the IPCC-GPG, 2003, the below-ground biomass in Malaysia was estimated to be 1,147.42 million tonnes, with 379.47 million tonnes in Peninsular Malaysia, 250.39 million tonnes in Sabah and 517.56 million tonnes in Sarawak.

In summary, the total live biomass in the natural forests in Malaysia at the end of 2005 was estimated to be 5,928.33 million tonnes with Peninsular Malaysia, Sabah and Sarawak having 1,960.60 million tonnes, 1,293.67 million tonnes and 2,674.06 million tonnes respectively, as shown in Table 6.

Table 6. Biomass of the natural forests by regions in Malaysia, 2005 (million tonnes)

Region	Above-ground biomass	Below-ground biomass	Total live biomass
Peninsular Malaysia	1,581.13	379.47	1,960.60
Sabah	1,043.28	250.39	1,293.67
Sarawak	2,156.50	517.56	2,674.06
Malaysia	4,780.91	1,147.42	5,928.33

Adopting the default value of dead to live ratio of 0.15 from the IPCC-GPG, 2003, the estimated dead wood biomass in Peninsular Malaysia, Sabah and Sarawak at the end of 2005 were estimated to be 294.09 million tonnes, 194.05 million tonnes and 401.11 million tonnes respectively, giving Malaysia a total dead wood biomass of 889.25 million tonnes.

In estimating the forest carbon stock in Malaysia, the default value of carbon fraction factor of 0.5 tonnes of carbon per tonne of dry matter from the IPCC-GPG, 2003 was used to estimate the amount of carbon stored in above-ground and below-ground biomass, as well as carbon in dead wood, while a default value of 2.1 tonnes per ha of litter carbon stock of matured forests, also from the IPCC-GPG, 2003, was used to estimate the amount of carbon stored in the litter of the dry inland forests in Malaysia (excluding inundated forests). It is evident from Table 7 that the total carbon stock in the natural forests in Malaysia at the end of 2005 was estimated to be 3,442.33 million tonnes, with the Peninsula, Sabah and Sarawak having 1,138.71 million tonnes, 751.63 million tonnes and 1,551.99 million tonnes respectively.

Table 7. Carbon stock of the natural forests by regions in Malaysia, 2005 (million tonnes)

Region	Carbon in above-ground biomass	Carbon in below-ground biomass	Carbon in dead wood	Carbon in litter*	Total carbon
Peninsular Malaysia	790.56	189.74	147.05	11.36	1,138.71
Sabah	521.64	125.19	97.03	7.77	751.63
Sarawak	1,078.25	258.78	200.55	14.41	1,551.99
Malaysia	2,390.45	573.71	444.63	33.54	3,442.33

*For dry inland forest only.

Forest management practices

In managing the natural tropical forests of Malaysia, the forests are classified into three broad forest types, namely the dry inland forest or dipterocarp forest, peat swamp forest and mangrove forest. Under sustainable forest management, the harvesting prescriptions and cutting cycle prescribed for each forest type in each State would depend on its stand structure, species composition and stocking, as well as the soil and climatic conditions.

In Peninsular Malaysia, the dipterocarp forest of the production forest of the PRFs is managed under two management systems, namely the Modified Malayan Uniform System (55-year cutting cycle) and the Selective Management System (30-year cutting cycle). In brief, the Modified Malayan Uniform System consists of removing the mature crop in one single felling of all trees down to 45 cm dbh for all species, while the Selective Management System (SMS) entails the selection of optimum management (felling) regimes based on pre-felling forest inventory data.

Under the SMS, the cutting limits prescribed for the group of dipterocarp species would range from 50-65 cm dbh while those prescribed for the group of non-dipterocarp species would range from 45-55 cm dbh, with the maximum volume allowed to be harvested being 85 m^3/ha. The difference in the cutting limits prescribed between the dipterocarp species and that of the non-dipterocarp species would be at least 5 cm in order to conserve a higher percentage of dipterocarp species for the next cut.

In pursuance of sound management objectives, forest harvesting in Sabah is undertaken in accordance with the prescribed silvicultural practices of promoting the development of natural regeneration. In this context, the dipterocarp forest in Sabah is selectively harvested based on a 50-year cutting cycle and only trees having size of 60 cm dbh and above are removed.

In Sarawak, the cutting cycle prescribed for the dipterocarp forest is 25 years with the prescribed cutting limits for the dipterocarp and non-dipterocarp species being 60 cm dbh and 45 cm dbh and above respectively, where on average the number of trees harvested ranges from 7 to 9 trees/ha with an output of 54 m^3/ha.

Currently, the peat swamp forest in Peninsular Malaysia is managed under the 'modified' SMS where higher cutting limits are prescribed due to a lower stocking of natural regeneration in the stand. Research and development efforts are currently being taken to formulate more effective management system for this forest type. In this regard, the cutting cycle adopted for the peat swamp forest in Sarawak is 45 years with the prescribed cutting limits for *Gonystylus bancanus* (Ramin) and that of the other species being 40 cm dbh and 50 cm dbh and above respectively.

The mangrove forest, in general, is managed under cutting cycles varying between 20 to 30 years. However, currently there is no commercial harvesting of mangrove forests in Sabah, while in Peninsular Malaysia mature trees are clear-felled with the retention of seven mother trees per ha, and a three metre wide river bank and coastal strip for ensuring adequate natural regeneration and protection of the environment. In Sarawak, under sustainable forest management, the mangrove forests are managed under a 20-year cutting cycle with a prescribed minimum cutting limit of 7 cm dbh, while for those forests located in stateland and with no formal management plan the minimum cutting limit is prescribed at 12.7 cm dbh.

Forest harvesting practices

Forest harvesting in the inland forest in Malaysia is generally carried out by a combination of crawler tractor-winch lorry. Under this harvesting system the crawler tractor skids the logs from the felling sites to the skid trails where the winch lorry continues the transportation to

the roadside landings. In Malaysia, the skidder generally does not pick up its load from the felling site because of adverse soil and terrain conditions. Currently, reduced impact logging (ground skidding) is also being carried out in Malaysia, while low impact logging (helicopter logging) is being carried out in Sarawak, and to a lesser extent in Sabah.

To further mitigate the adverse effects of forest harvesting, the Forestry Departments have also adopted standard road specifications and forest harvesting rules and guidelines for strict adherence by all logging contractors both at the planning and implementation levels. In this regard, all harvesting operations have to be carried out in accordance with these specifications, rules and guidelines, particularly those pertaining to road construction, alignment, gradient, drainage, tree marking, direction of felling and the setting up of log-yards. The Departments' role is to supervise closely the implementation of the environmental conservation measures such as in the choice of machinery, construction of water bars, silt traps and the control of pollution of rivers and waterbodies resulting from logging. The forest engineers of the Forestry Departments play an active role in providing technical advice and services on all matters pertaining to infrastructural development of the logging sector, such as in the design and construction of forest roads so as to enhance environmental stability and quality.

Conservation practices

Over the years, Malaysia has been establishing a network of protected areas for the conservation of biological diversity. Some of these national parks, wildlife reserves, nature parks, bird sanctuaries and marine and state parks have been established since the 1930s. Malaysia's largest national park, covering 434,351 ha, was gazetted as early as 1939; it comprises mainly virgin forests of various forest types according to altitudes and soil conditions. Currently, Malaysia has 2.44 million ha of conservation areas which are totally protected by legislation as shown in Table 8. Of these, 2.05 million ha are located outside the PRFs, whilst another 0.39 million ha are located within the PRFs.

Table 8. Area under national and state parks, and wildlife and bird sanctuaries by regions in Malaysia, 2005 (million ha)

Region	National park/state park	Wildlife and bird sanctuary	Total
Peninsular Malaysia	0.62+	0.31++	0.93
Sabah	0.25	0.16#	0.41
Sarawak	0.80*	0.30**	1.10
Malaysia	1.67	0.77	2.44

Source: FD Peninsular Malaysia, FD Sabah, FD Sarawak.

\+ A total of 0.18 million ha is located within the PRFs of Peninsular Malaysia.
++ A total of 0.08 million ha is located within the PRFs of Peninsular Malaysia.
\# A total of 0.13 million ha is located within the PRFs of Sabah.
* Includes 0.40 million ha of proposed national parks.
** Includes 0.03 million ha of proposed wildlife sanctuaries and nature reserves.

Hence, with the protection forests of the PRFs of 3.11 million ha, the totally protected areas designated for the conservation of biological diversity in Malaysia are now estimated to be 5.16 million ha, representing 28.2 percent of its total forested land or 15.7 percent of its land area.

In its efforts to further conserve various forest and ecological types in their original conditions, the Forestry Departments have also set aside pockets of virgin forest. These pockets, known as Virgin Jungle Reserves (VJRs), were established to serve as permanent nature reserves and natural arboreta, as controls for comparing harvested and silviculturally treated forests and as undisturbed natural forests for general ecological and botanical studies. Since its inception in the 1950s, a total of 87 VJRs covering 23,002 ha have been established throughout Peninsular Malaysia while in Sabah, a total of 50 VJRs have also been established covering an area of 91,914 ha. These VJRs represent samples of the many types of virgin forest found in the country which are located in the PRFs. Represented forest types include Mangrove Forest, Heath Forest, Peat Swamp Forest, Lowland Dipterocarp Forest, Hill Dipterocarp Forest, Upper Dipterocarp Forest and Montane Forest.

As Malaysia is one of the 12 mega diversity areas in the world, the importance of biological diversity conservation was accorded high priority with the adoption of the National Policy on Biological Diversity in April 1998. The main thrust of the Policy is to identify and protect 'hotspots' that have high value for biological diversity conservation. It also includes the strengthening and integration of conservation programs, promotion of private sector participation in biological diversity conservation, and exploration and sustainable utilization of the genetic resources, as well as mitigation measures to reduce the adverse effects of anthropogenic activities on biological diversity. Malaysia is also formulating a national policy and reviewing the adequacy and appropriateness of current legislation to govern the collection of genetic resources and protect farmers' rights, as well as to safeguard breeder's intellectual property rights. In this regard, Malaysia is currently preparing an access and benefit sharing bill and under the Ninth Malaysia Plan, 2006-2010, efforts will be intensified to protect critical habitats and optimize the use of forest biological diversity; appropriate actions have been included for the conservation of biological diversity through rigorous *in situ* and *ex situ* conservation programs.

As a party to the RAMSAR Convention on Wetlands, Malaysia has declared a total of five areas as RAMSAR sites covering 48,029 ha with the first site, Tasek Bera in Pahang, declared on 10 November 1994. The details of the five RAMSAR sites in Malaysia are shown in Table 9.

Table 9. RAMSAR sites in Malaysia (ha)

Name	Location	Date of declaration	Extent (ha)
Tasek Bera	Pahang	10 November 1994	31,120
Tanjung Piai	Johor	31 January 2003	526
Sungai Pulai	Johor	31 January 2003	9,126
Pulau Kukup	Johor	31 January 2003	647
Kuching Wetlands National Park	Sarawak	8 November 2005	6,610
Total area			**48,029**

Source: NRE.

Furthermore, as a party to the Convention Concerning the Protection of the World's Cultural and Natural Heritage, UNESCO has recognized and declared the Kinabalu Park, covering an area of 75,370 ha in Sabah, and the Gunung Mulu National Park, covering an area of 52,865 ha in Sarawak, both in 2000 as World Heritage Sites. In addition, UNESCO has also listed the Langkawi Geopark, comprising mainly the Machinchang, the Kilim and the Dayang Bunting Geoforest Parks and covering 47,800 ha in the island of Langkawi, in its global network of Geoparks in June 2007.

The Malaysian Government has also drawn up a comprehensive list of plants and animals to be protected. Currently many of these, such as the tiger, rhinoceros, slow loris and even the birdwing butterfly are fully protected by law. The Wildlife and National Parks Department of Peninsular Malaysia runs active programs to conserve the larger mammals, while the State Forest Department of Sarawak and the Wildlife Department of Sabah manage wildlife rehabilitation centers for wild animals with special emphasis on the *orang utan.* Complementing these efforts, there are many other programs coordinated by the National Steering Group to conserve the plant genetic resources of the country. One such program is the conservation of wild fruit trees.

Recognizing the important of transboundary collaboration in the protection and conservation of biological diversity, Malaysia together with Brunei Darussalam and Indonesia has embarked on the Heart of Borneo initiative. With the signing of the Heart of Borneo Declaration on 12 February 2007 in Bali, Indonesia, an area totaling up to 24 million ha will be designated as protected areas, production forests and sustainable land-use areas. For Malaysia, this initiative would support its efforts in eradicating poverty that is concentrated in the interior of Sabah and Sarawak (WWF-Malaysia, 2007). In fact, Malaysia has had good working experiences with Indonesia on transboundary conservation of biological diversity, namely the Lanjak-Entimau Wildlife Sanctuary, covering an area of 170,000 ha in Sarawak and the Betung Kerihun National Park, covering an area of 800,000 ha in Indonesia. Together, totaling almost 1 million ha, they represent one of the largest, most extensive, totally protected areas in the world.

A number of watershed areas have also been gazetted to ensure adequate supply of water to meet the varying demands of the population, agriculture and industry. Presently, these areas cover 5.16 million ha with 4.08 million ha or 79.1 percent in Sarawak and the balance of 0.85 million ha and 0.23 million ha in Peninsular Malaysia and Sabah respectively. The distribution of the watershed areas by States in Malaysia at the end of 2005 is shown in Table 10.

Furthermore, under the National Physical Plan (NPP), currently confined to Peninsular Malaysia as Sabah and Sarawak are governed by different planning legislation, the four major forest complexes in the Peninsula, which are presently fragmented and divided will be reconnected to form “a Central Forest Spine (CFS)” from north to south, currently estimated to cover an area of 4.3 million ha. This unique continuous corridor, which forms the backbone for a network of environmentally sensitive areas that include forests, lakes, highlands and wetlands will serve as a reservoir for biological diversity, provide protection areas for catchments, and create environments for nature and ecotourism. Once established, the CFS will be gazetted as a protection forest under the National Forestry Act, 1984 and management plans, guidelines and operational procedures will be developed to regulate the uses of the forest spine and tourism bases within the spine will be enhanced (Anon 2005).

Table 10. Distribution of watershed areas by states, 2005 (ha)

State	Extent (ha)
Johor	67,746
Kedah	113,501
Kelantan	82,684
Melaka	4,734
Negeri Sembilan	47,150
Pahang	271,823
Perak	162,459
Perlis	7,398
Pulau Pinang	3,016
Selangor	43,678
Terengganu	49,107
Sabah	231,150
Sarawak	4,079,535
Total	**5,163,981**

Source: FD Peninsular Malaysia, FD Sabah, FD Sarawak.

Environmental protection practices

To mitigate the adverse impacts of forestry activities on the environment, the Environmental Quality Act 1974 was amended to include Environmental Impact Assessment (EIA) in 1985 and the order come into force in 1987. It requires any project proponent to prepare a preliminary EIA report on the 'prescribed' activities to be carried out and if the EIA report demonstrates potentially significant impacts on the environment arising from such activities, a full EIA report will have to be prepared by the project proponent. The 'prescribed' activities that involve forest lands are as follows:

(i) land development schemes converting an area of 500 ha or more of forest land into a different land use;

(ii) drainage of wetland, wildlife habitat or virgin forest covering an area of 100 ha or more;

(iii) land-based aquaculture projects accompanied by clearing of mangrove forests covering an area of 50 ha or more;

(iv) conversion of hill forest land to other land use covering an area of 50 ha or more;

(v) logging or conversion of forested land to other land use within the catchment area or reservoirs used for municipal water supply, irrigation or hydropower generation or areas adjacent to state and national parks and national marine parks;

(vi) logging covering an area of 500 ha or more;

(vii) conversion of mangrove forests for industrial, housing or agricultural use covering an area of 50 ha or more;

(viii) clearing of mangrove forests on islands adjacent to national marine parks; and

(ix) other activities, which may affect forest, such as coastal reclamation and hydropower projects.

In addition, the NPP requires State and local authorities to cooperate with the Federal Government to identify and rank environmentally sensitive areas (ESA) in the country, such as forest lands, marine parks, catchment areas, drainage areas, recharge areas, erosion-risk and elevated areas into broad three categories. In the first category or ESA Rank 1, no development, agriculture or logging is allowed except for low-impact natural tourism, research and education. These include all protected areas, potential protected areas, wetlands, turtle landing sites, catchment areas of existing and proposed dams and areas with elevation above 1,000 m above mean sea level (a.m.s.l). In the second category or ESA Rank 2, no development or agriculture is allowed, but sustainable logging and low impact nature tourism may be permitted subject to local constraints. This category includes all forests, wildlife corridors, buffer zones around ESA Rank 1 areas and areas with elevation between 300 and 1,000 m a.m.s.l. In the third category or EAS Rank 3, only controlled development will be permitted where the type and intensity of the development will be strictly controlled depending on the nature of the constraints. These include all marine park islands, buffer zones around ESA Rank 2 areas, catchment areas for water intakes, areas for ground water extraction (well fields), areas with erosion risk greater than 150 tonnes/ha/year, areas experiencing critical or significant coastal erosion and areas between 150 and 300 m a.m.s.l (Anon 2005). Work is now being undertaken to delineate ESA areas into the three categories according to the agreed elevation classes.

Rapid urbanization in Malaysia has had increasing adverse impact, both physically and mentally, on the population which is becoming increasingly aware of the degradation and pollution of the environment. As a consequence, there has been growing appreciation of the aesthetic value of trees and the pleasure of outdoor recreation. Urban forestry in terms of tree planting along highways and sidewalks has been carried out by various local authorities and relevant agencies. To date 4.68 million trees have been planted. Species planted include *Samanea saman* (Rain Tree), *Cinnamomum iners* (Teja), *Tectona grandis* (Teak), *Peltophorum pterocarpum* (Yellow Flame), *Fagraea fragrans* (Tembesu), *Pterocarpus indicus* (Sena), *Delonix regia* (Red Flame), and *Eugenia grandis* (Jambu Laut).

Sustainability of natural forest

To ensure the continuity of flow of wood production in Malaysia, the control and regulation of forest resources is carried out using the Area Control and/or Volume Control methods as prescribed in the forest management plan. In this regard, the allocation of the annual felling coupe is based on forest inventory data, the net area of production forest and the current silvicultural management practices that are being prescribed.

In fact, the forest planning and integrated operational studies carried out in Malaysia have clearly indicated the feasibility of continuous viable hill forest production in terms of economic log-outturn volume with periodic cuts every 25 to 55 years using locally appropriate cutting limits and leaving an adequate number of medium-sized trees of marketable species for natural growth into commercial sizes. It has been shown that, with average growth rates of trees over 30 cm dbh of 0.8-1.0 cm/year in diameter and 2.0-2.5 m^3/ha/year in commercial gross volume, the hill forests in Malaysia are capable of producing every 25 to 55 years of at least 45-85 net m^3/ha, taking into account that the harvesting

damage of the residual stand should not be more than 30 percent of the intermediate sized trees.

Selective harvesting of the natural inland forests in Malaysia will ensure that the larger trees that remain will reach commercial sizes in 25 to 55 years to allow for a second round of harvesting. And the process goes on. This in itself is a form of silvicultural treatment because natural regeneration is increased by the gaps created during forest harvesting. Several studies have also indicated that regeneration of desirable species occurs naturally in and around the gaps left by logging, and only when necessary, the logged-over forests are silviculturally treated to aid in their rehabilitation.

In this regard, under the Ninth Malaysia Plan, 2006-2010, the annual allowable coupe for the natural production forests of the PRFs in Malaysia is estimated to be 266,940 ha with 36,940 ha, 60,000 ha and 170,000 ha in Peninsular Malaysia, Sabah and Sarawak respectively. This is expected to yield annually 15.18 million m^3 of roundlogs with 3.13 million m^3, 3.55 million m^3 and 8.50 million m^3 emanating from Peninsular Malaysia, Sabah and Sarawak respectively.

Forest plantation establishment

Due to declining wood supply and recognizing that forest plantations can yield a higher volume of timber per unit area and in a shorter time to relieve pressure from over-harvesting of natural forests, as well as to encourage private sector investment in forest plantation development to supplement future wood supply of the country, a *National Committee on Forest Plantation Development* with full participation by the private sector was formed in April 1992 to formulate a national strategy and action plan for the promotion and effective implementation of the forest plantation programs. In this context, the Government of Malaysia reviewed the existing fiscal incentives and granted full tax exemption under the Pioneer Status for ten years or 100 percent tax exemption under the Investment Tax Allowance for five years, effective from 29 October 1993 for forest plantation establishment undertaken by the private sector.

To further encourage the private sector to establish and develop forest plantations, effective from the year of assessment of income 1999, additional incentives were granted by the Government to enable private companies undertaking forest plantation projects to offset qualifying capital expenditures, such as the clearing and preparation of land, planting of timber seedlings, provision of plant and machinery, building of access roads and bridges, and construction or purchase of buildings, against income from other business sources of the company under Schedule 4A of the Approved Agricultural Projects. The rotation cycle for the 75 approved species as in **Annex 1** varies from a minimum of six years to a maximum of 50 years depending on the type of species planted, while the minimum area planted should be at least 50 ha.

On 21 May 2003, the Government of Malaysia also provided further incentives to encourage the establishment and development of forest plantations by the private sector through the "New Strategies Towards Stimulating the Nation's Economic Growth", where under the "Group Relief" a company is allowed to reduce its tax burden by offsetting its losses from the profit of another company within the same group. In addition to the qualifying capital expenditures as allowed under Schedule 4A of the Approved Agricultural Projects, companies are also allowed to include expenses incurred in pre-operating activities, such as:

(i) Preparation of the Forest Management Plan, Environmental Impact Assessment (EIA) Report etc.;

(ii) Fees related to the procurement of timber certification;

(iii) Surveying work; and

(iv) Enrichment planting, silviculture, pest and disease control and fire management.

In the past few years, the Government in aggressively pursuing the establishment of more forest plantations by the private sector has formed, through the MTIB, a special purpose vehicle, the Forest Plantation Development Sdn. Bhd., to disburse soft loans for private companies willing to establish forest plantations. Through this initiative, the Government plans to develop 375,000 ha of forest plantation in the next 15 years, at an annual planting target of 25,000 ha, which are expected to yield 5 million m^3, and at an estimated total cost of RM 2.2 billion. To date, six companies have been selected to plant a total of 16,100 ha and loans amounting to RM 80.34 million have been disbursed to them. Under this initiative, the Government provides RM 5,400 and RM 3,200 for companies to plant 1 ha of *Hevea* species (rubber trees) and non-*Hevea* species respectively, where upon harvesting the matured trees the companies have to repay the Government at 3.5 percent for the soft loans provided to them.

In addition, Sabah also has set a target to establish 500,000 ha of forest plantation by the year 2020, while Sarawak is expected to have a total of 1.2 million ha of established forest plantations that will be ready for harvesting from 2011 onwards, as currently it has awarded 39 Licenses for Planted Forest, covering 2.4 million ha, to the private sector to establish forest plantations, besides the Government's forest plantation project covering another 500,000 ha.

Wood-based industries

In 2005, the primary wood-based industry in Malaysia comprised 1,138 sawmills and 176 plywood and veneer mills. Among the other wood-based industries found in Malaysia are 345 moulding plants, 13 chipboard plants, 14 medium density fibreboard plants, 15 woodchip plants, 27 parquet flooring plants, 46 laminated board plants, 3 pencil factories, one integrated pulp and paper mill, 237 kiln drying plants, 158 wood preservation plants, and 2,363 furniture/woodworking/joinery factories. The distribution of these wood-based industries by regions in Malaysia is shown in Table 11.

Table 11. Number of wood-based industries by regions, 2005 (numbers)

Type	Region			
	Peninsular Malaysia	Sabah	Sarawak	Total
Sawmill	664	184	290	1,138
Plywood/veneer mill	52	69	55	176
Moulding plant	167	150	28	345
Chipboard plant	12	-	1	13
Medium density fibreboard plant	9	2	3	14
Furniture/woodworking/joinery factory	1,774	200	389	2,363
Woodchip plant	6	5	4	15
Parquet flooring plant	26	-	1	27
Pulp and paper mill	-	1	-	1
Laminated board plant	34	-	12	46
Pencil factory	3	-	-	3
Kiln drying plant	123	68	46	237
Wood preservation plant	118	40	-	158

Source: MTIB, FD Sabah.

At the end of 2005, the total investment in the primary wood-based industry in Malaysia was estimated to be RM 47.58 million, while its combined total annual installed capacity was estimated to be 30.95 million m^3, of which 19.78 million m^3 were for the sawmills and 11.17 million m^3 for the plywood/veneer mills. The total roundlog consumption in 2005 by the sawmills in Malaysia was estimated to be 9.37 million m^3 or 47.4 percent of their installed capacity while consumption by the plywood/veneer mills was estimated to be 10.34 million m^3 or 92.6 percent of their installed capacity. In this context, most of the excess capacity of the sawmills and plywood/veneer mills is in Peninsular Malaysia where the 664 sawmills and 52 plywood/veneer mills only utilized 46.7 percent and 35.4 percent of their installed capacity respectively. The annual installed capacity, annual roundlog consumption and investment in the primary wood-based industry by regions in Malaysia are summarized in Table 12.

Table 12. Annual installed capacity, annual roundlog consumption and investment in the primary wood-based industry by regions, 2005

Region	Primary processing industry	Annual installed capacity (million m^3)	Annual log consumption (million m^3)	Total investment (million RM)
Peninsular Malaysia	Sawmill	10.95	5.11	1.01
	Plywood/veneer mill	1.78	0.63	0.63
Sabah	Sawmill	3.39	1.68	1.75
	Plywood/veneer mill	4.96	3.53	3.29
Sarawak	Sawmill	5.44	2.58	1.00
	Plywood/veneer mill	4.43	6.18	39.90
Malaysia	Sawmill	19.78	9.37	3.76
	Plywood/veneer mill	11.17	10.34	43.82

Source: FD Peninsular Malaysia, FD Sabah, FD Sarawak.

In 2005, the total export of timber and timber products was valued at RM 21.51 billion or 4.0 percent of the country's total export earnings of RM 533.79 billion. In fact, in the same year the forestry sector in Malaysia accounted for about 8.2 percent of the country's Gross Domestic Product of RM 262.17 billion and provided direct employment to 270,670 persons, representing 2.6 percent of the country's workforce.

Institutional frameworks

The Ministry that is directly involved in administering the forest sector in Malaysia is the Ministry of Natural Resources and Environment (NRE), and to a lesser extent the Ministry of Plantation Industries and Commodities. In this regard, the FDPM and FRIM have been place under the purview of the NRE since 27 March 2004.

More specifically, the management of the forest resources in Peninsular Malaysia, including administration, is vested in the Forestry Department Headquarters in Kuala Lumpur and its ten State Forestry Departments located throughout the Peninsula. The Forestry Department Headquarters is in charge of policy planning and implementation with respect to forestry matters, especially in the implementation of the National Forestry Policy 1978. It is also responsible for forestry sector planning, forest operational studies and development, and in the provision of technical advice and services to the States in the Peninsula, as well as training facilities. However, the Department is not directly involved in the management of wildlife reserves, bird sanctuaries and national parks as these are under the control of the Federal Government through the Department of Wildlife and National Parks Peninsular Malaysia, although the States are encouraged to manage parks that are located in the PRFs. In this regard, the State Forestry Department is responsible for administration and regulation of forest harvesting, forest revenue collection, management and development of the forest resources and to plan and coordinate the development of the forest-based industries in the State.

In Sabah, the Forestry Department is responsible for all aspects of forest administration, management, planning and development of the forest resources in the State. It also includes the regulation of forest harvesting, forest revenue collection and the development of the forest-based industries in the State. However, the wildlife reserves and sanctuaries, and

national parks in Sabah are managed by the Wildlife Department and the Parks Department of Sabah respectively.

In the case of Sarawak, the responsibilities of the Forest Department of Sarawak are similar to those of Sabah except that the Department is also responsible for the administration, management, planning and development of all the national parks and wildlife reserves and sanctuaries in the State. However, since the launching of the Sarawak Forestry Corporation Sdn. Bhd. in June 2003, the responsibility of managing the forest resources in Sarawak has now been placed under this new authority, leaving the Forest Department of Sarawak to concentrate on forest policy planning and to attend to statutory and regulatory matters.

R&D activities in Malaysia are mainly undertaken by FRIM which was established in 1929 as a research unit of the Forestry Department, Peninsular Malaysia. However, as of 1 October 1985, the status of the Institute has been changed from a Government organization to that of a statutory body with the establishment of the Malaysian Forest Research and Development Board (MFRDP). Similar R&D activities are also being carried out by the Forestry Department of Sabah and the Sarawak Forestry Corporation Sdn. Bhd., as well as local public universities, while the Forestry Department of Peninsular Malaysia has embarked on forestry research with a focus on operational research.

In this regard, FRIM is responsible for carrying out research on all aspects of forestry and forest products. Research in ecology and silviculture is carried out with the objective of developing suitable management and silvicultural systems for the forests in Malaysia. Research is also directed towards fuller assessment of the properties of wood and other characteristics associated with the growth and requirements of selected species, as well as other species that may be suitable for forest plantation. Research in forest products is directed towards more efficient and diversified utilization of the nation's forest resources, aiming at promoting higher operational efficiency in existing production systems through the introduction of innovative technological systems. This will result in reducing wood-waste and extending the utilization of the under-utilized timber species.

Currently, further R&D activities will be accorded to sustainable forest management, and in particular, to the conservation of biological diversity during forest harvesting, protection of water resources and the management of watershed areas. Furthermore, with the establishment of the Bio-Valley and the National Biodiversity and Biotechnology Council in 2001 to further elaborate on related issues and provide strategy and direction for the conservation of biological diversity and in the development of biotechnology in the country, R&D in Malaysia will focus on genetic engineering, molecular biology and genomics. Thus far, the program has produced patented innovations, one for an anti-cancer agent drug and another for a compound found in a local plant known traditionally for its aphrodisiac properties.

Greater attention will also be given by FRIM to the commercialization of R&D results, as well as to accelerate the transfer of technology and know-how to the private sector to enable its full commercial application.

Currently, the roles and responsibility in developing the wood-based industries in Malaysia, the trade of timber and timber products in the international market, and the establishment of industrial wood plantations are under the purview of the Ministry of Plantation Industries and Commodities. In fact, this Ministry oversees the development of the plantation and commodity sector covering R&D, wood and wood-based products, rubber, palm oil, cocoa, pepper and tobacco. The Ministry will foster and enhance the competitiveness of the primary commodity industries through improvement in productivity, quality and efficiency, and effective management practices, as well as to achieve higher value-added products through downstream processing, and promote the marketing of semi-processed and processed products.

In this context, a number of agencies, namely the MTIB, MTC and the MTCC, under the Ministry of Plantation Industries and Commodities, as well as the Sarawak Timber Industry Development Corporation (STIDC) are directly involved in developing the timber industries in Malaysia, and the trade of timber and timber products in the both the domestic and overseas markets.

The MTIB is a statutory body established in 1973 by an Act of Parliament to promote and coordinate the overall development of the timber industry in Malaysia, as well as to enhance its sustainable growth through the provision of a conducive environment and continuous extension of quality services. In this regard, the MTIB is responsible for initiating appropriate development in the various sectors of the timber industry and in providing the necessary assistance to ensure its continued growth as a modern and thriving sector of the economy.

To achieve its mandate, the MTIB regulates the registration of timber exporters, suppliers, kiln drying and preservation operators, timber graders and jetty operators, as well as export licenses. In this context, the MTIB was appointed in August 2001 as an additional management authority to implement the provisions of CITES in Peninsular Malaysia, although the Principal Management Authority in Peninsular Malaysia is the Department of Wildlife and National Parks Peninsular Malaysia, which is under the purview of the Ministry of Natural Resources and Environment.

The MTIB also provides skills training to assist the value-added processing sector in overcoming the shortage of skilled personnel through its established Wood Industry Skills Development Centres (WISDECs) that are located in Selangor and Sabah. Training programs conducted include the application of technology and operations of wood working machinery, product costing and budgeting, material management and inventory, furniture designing and model making, wood identification, timber grading rules, etc.

The role of the STIDC, established in June 1973, is to stimulate the planned development of the timber industries in Sarawak towards the optimum and efficient utilization of timber resources by encouraging downstream processing and product diversification. It also controls and coordinates the manufacturing standards and trade practices of the timber industries, and provides training in various aspects of logging operations, as well as activities connected with timber processing, such as sawmilling, and sales and marketing of timber and timber products.

The MTC was established at the initiative of the timber industry and incorporated under the Companies Act 1965 as a company limited by guarantee in January 1992. The role of the MTC is to promote the development of the timber-based industry in Malaysia and the marketing of timber products. It is governed by a Board of Trustees appointed by the Minister of Plantation Industries and Commodities.

The MTC's mission is to ensure the sustainability of the Malaysian timber industry by improving its competitiveness, enhancing market access and creating trade opportunities, while its objectives are to promote timber trade and develop the market for timber products; provide technical services and other activities to the timber industry; augment the supply of raw materials for the timber processing industries; and provide information services to the timber trade and industry.

The MTCC, a company limited by guarantee and not having a share capital, was formed under the Companies Act 1965 in October 1998, which was formerly known as the National Timber Certification Council, Malaysia. It is a non-profit company managed by a Board of Trustees comprising a chairperson and two representatives each from academic or research

and development institutions, timber industry, NGOs and government agencies, but excluding the Forestry Departments, which manage the forest resources.

The MTCC, among other things, develops and implements a timber certification scheme to ensure sustainable forest management, as well as to facilitate the trade in timber from Malaysia. Based on a phased approach, the MTCC launched its Timber Certification Scheme in October 2001 which was developed from the 1998 International Tropical Timber Organization (ITTO)'s *Criteria and Indicators for Sustainable Management of Natural Tropical Forests*.

Hence, the MTCC, as the timber certification body, receives and processes applications for certification, as well as arranging for assessments to be carried out by its registered independent third party assessors. The assessment report for forest certification will be subjected to a peer review process by qualified individuals who are registered with the MTCC for this purpose. The MTCC also provides an appeals procedure, should there be parties which are not satisfied with its decisions. In undertaking this activity, the MTCC has established a Certification Committee, comprising four Trustees representing each of the stakeholder groups of the MTCC Board, which will make the decision as to whether the applicant merits the award of the MTCC certificates.

In August 2004, the MTCC adopted a new set of criteria and indicators for forest certification entitled "*Malaysian Criteria and Indicators for Forest Management Certification (MC&I)*". This set of criteria and indicators which is currently used for forest certification is technically compatible with the Forest Stewardship Council's Principles and Criteria for Forest Stewardship (FSC's P&C) as it has followed the structure and format of the FSC's P&C.

The MTCC has also been a member of the Programme for the Endorsement of Forest Certification schemes (PEFC) since November 2002, and is currently taking steps to submit its scheme for endorsement within the PEFC's framework for mutual recognition.

International commitments

Malaysia participated actively in the debate of forest and forest-related matters at the United Nations Conference on Environment and Development (UNCED) that was held in Rio de Janeiro, Brazil in June 1992, and the follow up deliberations at the United Nations Intergovernmental Panel on Forests (IPF) and its successor, the Intergovernmental Forum on Forests (IFF), as well as at the current UNFF.

Presently, Malaysia is a party to the RAMSAR Convention on Wetlands which Malaysia ratified on 10 November 1994 and came into force in Malaysia on 10 March 1995; the Convention on Biological Diversity (CBD) which Malaysia ratified on 24 June 1994 and came into force in Malaysia on 22 September 1994; and the United Nations Framework Convention on Climate Change (UNFCCC) which Malaysia ratified on 13 July 1994 and came into force in Malaysia on 11 October 1994, as well as the Kyoto Protocol to the UNFCCC which Malaysia ratified on 4 September 2002 and came into force in Malaysia on 16 February 2005. Malaysia had also ratified the Cartagena Protocol on Biosafety to the CBD on 3 September 20003 which came into force in Malaysia on 2 December 2003, as well as signed and ratified the International Tropical Timber Agreement (ITTA), 1983 and the ITTA, 1994 on 14 February 1985 and 1 March 1995 respectively, and acceded to CITES in October 1977 and ratified the Convention in 1978.

3. TRENDS AND CHALLENGES IN THE FORESTRY SECTOR

Extent of forest resources

For the past 20 years between 1985 and 2005, the total forest areas in Malaysia had declined from 20.42 million ha in 1985 to 18.31 million ha in 2005, a decrease of an estimated 2.11 million ha or at an average annual rate of slightly more than 100 000 ha a year as shown in Table 13. This loss of forest area was mainly due to the conversion of forest lands to permanent non-forest uses, such as in the establishment of oil palm plantations, and in providing land for the landless, as well as to meet the demand of the growing population.

In fact, over the period 1985 to 2005, the total area under perennial agricultural tree crops had increased from 3.75 million ha to 5.55 million ha, an increase of 1.80 million ha, with areas under oil palm plantations more than doubling from 1.47 million ha in 1985 to 4.05 million ha in 2005. Over the same period, the population in Malaysia had also grown from 15.68 million in 1985 to 26.75 million in 2005 or an increase of 70.6 percent over the 20-year period.

It is foreseen that there will be no new opening of lands for the large-scale planting of perennial agricultural tree crops in Peninsular Malaysia, especially oil palm, as under the Third National Agriculture Policy, 1998-2010, such new plantings will only occur in Sabah and Sarawak where there is still ample land available. As such, the pressure to convert forest lands in Peninsular Malaysia to permanent non-forestry uses will be reduced while allowing the Forestry Departments in the Peninsula to double their efforts to manage the forests sustainably.

Table 13. Extent of forested land by regions for 1985, 1990, 1995, 2000 and 2005 (million ha)

Region	Year				
	1985	1990	1995	2000	2005
Peninsular Malaysia	6.35	6.27	5.89	5.94	5.88
Sabah	4.67	4.44	4.52	4.42	4.36
Sarawak	9.40	8.71	8.70	8.20	8.07
Malaysia	20.42	19.42	19.11	18.56	18.31

Source: FD Peninsular Malaysia, FD Sabah, FD Sarawak.

The forested lands gazetted as PRFs that are managed for permanent forest uses in Malaysia have increased steadily over the years, for example, from a total of 14.19 million ha in 1995 to 15.30 million ha in 2005, an increase of more than 1 million ha, as shown in Table 14. Most of the increase over the ten-year period was recorded in Sarawak, albeit that it was for productive purposes.

Table 14. Extent of PRFs by regions for 1995 and 2005 (million ha)

Region	Year					
	1995			2005		
	Protection forest	Production forest	Total	Protection forest	Production forest	Total
Peninsular Malaysia	1.80	2.80	4.60	1.52	3.18	4.70
Sabah	0.86	2.73	3.59	0.59	3.01	3.60
Sarawak	1.00	5.00	6.00	1.00	6.00	7.00
Total	**3.66**	**10.53**	**14.19**	**3.11**	**12.19**	**15.30**

Source: FD Peninsular Malaysia, FD Sabah, FD Sarawak.

Forest plantations in Malaysia had also increased from 62.65 000 ha in 1985 to 403.89 000 ha in 2005 as shown in Table 15. This increase of 341.24 000 ha over the period occurred mainly in Sabah where over a 20-year period from 1985 to 2005 the area established with forest plantations had increased from a low of 50.31 000 ha to 199.89 000 ha, an increase of 149.58 000 ha or at an average annual rate of 14.9 percent. However, at the end of 2005, forest plantations in Malaysia only represent a mere 2.2 percent of the total forested lands or 1.2 percent of its land areas.

Table 15. Extent of forest plantation by regions for 1985, 1990, 1995, 2000 and 2005 (thousand ha)

Region	Year				
	1985	1990	1995	2000	2005
Peninsular Malaysia	10.43	48.79	65.78	74.00	74.00
Sabah	50.31	49.29	112.68	154.64	199.89
Sarawak	1.91	5.38	13.15	26.88	130.00
Malaysia	62.65	103.46	191.61	255.52	403.89

Source: FD Peninsular Malaysia, FD Sabah, FD Sarawak.

Currently, all forest lands in Malaysia are owned by the Government, especially by the 13 State Governments, except for an area of 836.24 000 ha in Sabah which is owned by the private sector. Of the privately owned area in Sabah, a total of 761.24 000 ha is natural forest with the balance of 75.00 000 ha being forest plantation. Sabah also has an area of 570 ha of forest land owned by indigenous communities.

Forest management

Malaysia is fully committed to manage its forest resources sustainably in the overall context of sustainable development. Hence, in 1994, a National Committee on Sustainable Forest Management in Malaysia was established to coordinate the implementation of all the activities required to ensure that the forest resources in Malaysia are sustainably managed. This has led to the development of a set of Malaysian criteria and indicators for sustainable forest management (MC&I) at the national and forest management unit levels which is based on the International Tropical Timber Organization (ITTO) criteria and indicators for sustainable forest management of natural tropical forests. The MC&I have been used for monitoring, assessment and reporting of Malaysia's progress towards the attainment of sustainable forest management.

However, a study conducted in Malaysia has shown that the initial costs required to fully implement the MC&I, especially in forest harvesting operations as compared to current practices, would increase by RM 2,473.82 or 62.6 percent per ha or in terms of logs extracted it would increase by RM 81.49 or 69.6 percent per m^3 (FRIM/ITTO 2001). Nevertheless, for Malaysia to achieve sustainable forest management it would require huge investments not only in financial resources, but also in human resources, institutional and physical infrastructure. In this regard, a study conducted in 1997 has indicated that Malaysia would require a sum of RM 2,884.71 million to enable the forest resources in Malaysia to be sustainably managed, including the need for research, infrastructure and human resources development.

Malaysia will report its progress towards the achievement of sustainable forest management to the UNFF in accordance with its Multi-year Program of Work (MYPOW), 2007-2015 to ITTO in the context of achieving the ITTO Year 2000 Objective and to FAO. Malaysia will also report its progress in achieving sustainable forest management at both the national and forest management level to the Association of Southeast Asian Nations (ASEAN) Secretariat using the "ASEAN Criteria and Indicators for Sustainable Management of Tropical Forests" and the "Monitoring, Assessment and Reporting Format for Sustainable Forest Management in ASEAN" that were recently adopted by the Tenth Meeting of the ASEAN Senior Officials on Forestry (ASOF) that was held from 12 to 13 July 2007 in Vientiane, Lao PDR.

In this context, if forest is to be sustainably managed, the people must be convinced that land as an asset will remain more valuable under forest than under any other forms of land use. As such, it is necessary to develop techniques to compare these values with that of alternative forms of land use. Furthermore, current economic valuation of forest resources based on the monetary costs of extraction and distribution has often resulted in inadequate incentives for sustainable resource use, which in turn induce overconsumption of forest products and environmental degradation. Hence, the system of incentives and penalties will have to be reexamined and reoriented to fully reflect the full costs of forest goods and services, including environmental costs. The internalization of environmental costs will dispel the assumption that the environment is a free good.

National policies and development projects will have to take full account of their effects on the environment and include the cost of forest depletion in the valuation of environmental quality in national accounting systems as widely used economic indicators, such as gross national product (GNP), do not reflect the sustainability of the forest resource in the overall development process. In this sense, environmental resource accounting is a necessary precondition for full-cost resource pricing of forest goods and services. This will also facilitate a paradigm shift from a *post facto* approach to an anticipatory approach in addressing forest resource use and environmental degradation at their roots.

As land is a finite resource, one would have to integrate forestry with agriculture, especially in rural development, so as to enhance employment opportunities and supplement income earning and raise the livelihoods of the rural communities, as well as to contain and further reduce the practice of shifting cultivation which is currently estimated to exceed 4 million ha, mainly in Sabah and Sarawak. This is consistent with the target of the Government to completely eliminate hardcore poverty and halve the overall poverty to 2.8 percent by 2010, although the incidence of overall poverty had declined substantially from 22.8 percent in 1990 to 5.7 percent in 2004 (Anon 2006a).

Actions will have to be taken to further develop environmentally sound and economically viable forest harvesting systems that reduce the extent of inevitable damage to the residual stand and the soil surface during forest harvesting operation, and promote the optimal use of a wider range of timber species, especially the less-promoted species, to reduce wastage during harvesting and processing them into their final products.

In the coming years, more attention will have to be directed to the importance of NWFPs, especially herbs and medicinal plants, as it has been estimated that the current market value of RM 4.56 billion of herbal and medicinal products in Malaysia will grow at an annual rate of 10 to 15 percent; the rattan and bamboo industry will be revitalized as well.

Moreover, in a globalized world without borders and with rapidly changing societal demands placed on forests, adaptive management approaches will have to be adopted as they will be better able to assimilate new information and knowledge as it becomes available, and hence, help forest managers to correct policies and practices before irreversible damage is done to the forest ecosystem, even though such approaches are time-consuming consultative processes and require careful coordination of activities among governments and institutions, both at the national and local levels.

Forest conservation and protection

It is now being accepted that it is unrealistic to aspire to have extensive national parks and nature reserves in remote areas of developing countries from which all anthropogenic activities are prohibited, as they are economically and socially not viable in the overall context of sustainable development. Hence, the challenge for biological conservation in Malaysia, therefore, is not to 'halt deforestation' but to secure a minimum set of strategically located primary forests in representative areas having high diversity and endemism, taking into account the need for biological corridors linking them or 'stepping stones' between them. This would require some hard decisions from policy-makers as choices will have to be made to prioritize one habitat or species over another.

In this context, actions should be taken to enhance *in situ* conservation of biological diversity in production forests, especially during forest harvesting, as totally protected areas in Malaysia will most likely not be adequate to ensure the effective conservation of the full range of biological diversity found in Malaysia as envisaged under the National Policy on Biological Diversity 1998.

The cost in protecting and managing the existing biological reserves and the opportunity cost foregone in implementing *in situ* conservation of biological diversity and its potential use in the light of advances in biotechnologies in using the resources should be quantified. This will enable the development of effective joint management mechanisms in conserving biological diversity between the owners and users of the resource, as well as ensuring equitable returns to both parties. In this regard, the issue of patents and intellectual property rights (IPRs) and patents of products, including biotechnological products derived from the use of forest genetic resources should be addressed, taking into account the National Biotechnology Policy 2005.

In line with the Policy, efforts will also be intensified towards the development of biotechnology in the agriculture, healthcare and manufacturing sectors. These efforts will include improving the regulatory framework for biotechnology investments; enhancing access to funding; increasing the rate of R&D commercialization; increasing the number of skilled biotechnology workers and researchers; and attracting quality foreign partners for R&D; through, among other things, optimizing the rich forest biological diversity found in the country.

In addition, the strategies of the National Environment Policy 2002 will guide Malaysia's growth towards sustainable development through a comprehensive approach in managing the environment and natural resources where natural resource areas, particularly those containing biologically rich habitats and ecosystems will be established and maintained as zones for the conservation and protection of indigenous flora and fauna and genetic resources so as to ensure the integrity of biological diversity and life support systems.

With regard to the wetlands in Malaysia, the adopted National Wetlands Policy in 2004 will enhance the protection and conservation of these areas in Malaysia, as well as improve their management. More specifically, mangroves and other coastal habitats will be rehabilitated to mitigate the impact of coastal erosion and tsunami, as well as to ensure a continuous supply of resources, such as poles, charcoal, and breeding grounds for fish resources.

In Malaysia, the water crisis is not prevalent but this cannot be disregarded as evidenced in 1998 when the 1.8 million residents in the Klang Valley suffered a serious water crisis. It has been projected that the demand for water in Malaysia will increase to 20 billion m^3 by 2020 from the demand of 11.6 billion m^3 in 1997; it is highly dependent on the rivers and streams in the watershed areas of water sources. The total demand for domestic and industrial water, and that for irrigation by 2020 have been projected to increase to 5.8 billion m^3 and 13.2 billion m^3 respectively, while the demand for non-consumptive and other uses of water is expected to increase to about 1 billion m^3 or 5 percent of the total water consumption by the year 2020 (Fauzi 1997).

As such, it is pertinent to demonstrate the economic and financial feasibility and benefits of integrating watershed management measures into multiple-use forest management practices. More specifically, the relationship between upstream and downstream activities such as, on-site and off-site productivity and impact (biophysical aspects), water yield and quality, erosion and sedimentation, as well as stream flow patterns (water aspects). For example, upland rehabilitation and reforestation may be the responsibility of the Forestry Department, but major beneficiaries of erosion control may be a hydropower plant and water resource users downstream. Hence, the separation between those who pay from those who benefit should also be quantified to the extent possible so that the costs and benefits can be equitably distributed. This is important as the monetary benefits generated downstream through watershed management measures taken upstream by forest managers will provide further financial incentives for forest managers to undertake watershed management activities.

Emphasis should also be accorded to watershed management in order to enhance food production in high-yield areas. Links between forestry and food production should be strengthened through an integrated approach with watershed management, and incentives provided to rehabilitate degraded watershed areas. This will enhance the agriculture sector, the third engine of growth under the current Ninth Malaysia Plan, 2006-2010, which is expected to record annual growth of 5.0 percent where the focus will be on replanting, land consolidation and rehabilitation, greater utilization of high yielding clones and breeds, farm mechanization and good agronomic practices towards productivity improvements.

Currently, Malaysia is still in the process of formulating a National Water Policy that will guide the development of water sector strategies; provide support for the water resources to be managed sustainably on a river basin basis, thus, minimizing the need for expensive inter-basin transfers; support demand management and conservation; and ensure appropriate allocations for environmental and ecosystem needs; as well as in the protection of watershed areas and wetlands in Malaysia. It will also attach greater importance to the development of hydropower in the country in the overall context of clean and efficient energy production.

Protecting forest resources is an integral part of good forest management. In addition to the protection of watershed areas to preserve soil cover and the yield and quality of water and aquatic systems; the protection of representative areas of ecosystems and their diversity of flora and fauna and of genetic resources; the protection of production forest against encroachment and illegal forest harvesting is also of paramount importance as uncontrolled encroachment and illegal logging impede efforts taken to achieve sustainable forest management.

In this regard, the Government of Malaysia has shown considerable commitment to combating illegal logging both domestically and regionally. In 2003, Malaysia sponsored a joint ASEAN-European Union initiative to combat illegal logging and trade in illegally sourced timber and timber products. In fact, illegal logging is no longer a serious problem in Malaysia as strenuous efforts have been taken to put an end to illegal forest harvesting and to a very large extent these efforts have been successful. A study conducted by WWF-Malaysia, sponsored by the World Bank and presented at the Workshop on Illegal Logging in East Asia in Jakarta, Indonesia from 27-28 August 2000, found that the level of illegal logging in Sabah and Sarawak to be small, in the order of 1 percent or less, compared to the legal wood products trade (Blakeney 2001), while illegal logging in Peninsular Malaysia is well under control.

Production and trade in major wood products

Over the period 1985 to 2005, the production of industrial roundwood recorded a peak in production of 49.98 million m^3 in 1990 and then decreased to 28.23 million m^3 in 2005, with the production of sawnwood showing similar trends as shown in Table 16. However, the production of wood-based panels and paper and paperboard recorded increasing trends from 1985 to 2005. In the case of wood-based panels, they recorded an increase from 1.38 million m^3 in 1985 to 7.12 million m^3 in 2005, while paper and paperboard increased from 0.05 million tonnes in 1985 to 0.95 million tonnes in 2005. This was mainly due to the Government policy of promoting value-added products and for the wood-based industry to remain competitive in the international market, as well as the demand of paper and paper board products, especially printing and writing paper, by a growing population that is more educated. In the case of woodfuel, it recorded a decline in production from 7.64 million m^3 in 1985 to 3.07 million m^3 in 2005.

Table 16. Production of industrial roundwood, sawnwood, wood-based panels, paper and paperboard, and woodfuel in Malaysia for 1985, 1990, 1995, 2000 and 2005

Year	Product				
	Industrial roundwood ('000 m^3)	Sawnwood ('000 m^3)	Wood-based panels ('000 m^3)	Paper and paperboard ('000 tonnes)	Woodfuel ('000 m^3)
1985	37,514	5,494	1,383	53	7,643
1990	49,979	8,849	1,953	275	8,719
1995	42,855	8,382	6,556	665	7,102
2000	18,441	5,590	5,788	791	3,346
2005	28,237	5,173	7,124	954	3,068

Source: FAO Yearbooks: Forest Products Statistics Series for the Years 1994 (1983-1994), 1999 (1995-1999), 2001 (1997-2001) and 2005 (2001-2005).

Although from 1985 to 2005 the import of industrial roundwood into Malaysia had shown a declining trend from a high of 0.39 million m^3 in 1985 to 0.08 million m^3 in 2005, except for the year 2000 where a total of 0.76 million m^3 was imported; the import of sawnwood increased from a mere 0.08 million m^3 in 1985 to 1.10 million m^3 in 2005. This trend was also observed for the imports of wood-based panels and paper and paperboard as shown in Table 17, where in 2005 the recorded imports of wood-based panels and paper and paperboard were 0.40 million m^3 and 2.21 million tonnes respectively. The decline in the import of industrial roundwood could be due to more producer countries that export logs undertaking more domestic processing to add value to the production chain, while the increase in import of

paper and paperboard products is due to the rising demand of a growing population that is more educated. However, the import of woodfuel from 1985 to 2005 declined from a high of 0.37 million m^3 in 1985 to just 2,000 m^3 in 2005.

Table 17. Imports of industrial roundwood, sawnwood, wood-based panels, paper and paperboard, and woodfuel in Malaysia for 1985, 1990, 1995, 2000 and 2005

Year	Product				
	Industrial roundwood ('000 m^3)	Sawnwood ('000 m^3)	Wood-based panels ('000 m^3)	Paper and paperboard ('000 tonnes)	Woodfuel ('000 m^3)
1985	386	81	41	311	367
1990	294	28	60	612	283
1995	215	409	176	808	0
2000	758	488	189	1,013	-
2005	80	1,097	400	2,215	2

Source: FAO Yearbooks: Forest Products Statistics Series for the Years 1994 (1983-1994), 1999 (1995-1999), 2001 (1997-2001) and 2005 (2001-2005).

From Table 18 it is evident that while the export of industrial roundwood from Malaysia had declined significantly from 20.25 million m^3 in 1985 to 5.84 million m^3 in 2005, a decrease of 71.2 percent, the export of wood-based panels had increased substantially from 0.78 million m^3 in 1985 to 6.62 million m^3 in 2005, an increase of 5.84 million m^3 over the two years. These trends are mainly as a result of the wood-based industry being able to increasingly produce competitive value-added products through secondary and tertiary processing for the export market which is consistent with the Government policy to enhance the resilience of the wood-based industry in Malaysia. In fact, Malaysia was among the top five leading exporters of wood-based panels in the world in 2005 (FAO 2005). In 2005, Malaysia also exported 0.26 million tonnes of paper and paperboard while no exports were recorded for woodfuel.

Table 18. Exports of industrial roundwood, sawnwood, wood-based panels, paper and paperboard, and woodfuel in Malaysia for 1985, 1990, 1995, 2000 and 2005

Year	Product				
	Industrial roundwood ('000 m^3)	Sawnwood ('000 m^3)	Wood-based panels ('000 m^3)	Paper and paperboard ('000 tonnes)	Woodfuel ('000 m^3)
1985	20,251	2,830	784	-	116
1990	18,222	5,332	1,390	89	77
1995	7,964	4,296	4,360	41	3
2000	6,845	2,650	5,234	139	-
2005	5,836	3,263	6,617	260	-

Source: FAO Yearbooks: Forest Products Statistics Series for the Years 1994 (1983-1994), 1999 (1995-1999), 2001 (1997-2001) and 2005 (2001-2005)

The increasing demand for timber and timber products that are produced legally and from sustainably managed sources by the international market, especially from environmentally

sensitive markets such as in Europe, and the need for them to be certified by independent third party assessors through recognized timber certification schemes pushed Malaysia to initiate independent third party forest management certification in 1998 with the establishment of the MTCC. To date, nine Forest Management Units (FMUs) covering 4.73 million ha of the PRFs have been certified using the Malaysian Criteria, Indicators, Activities and Standards of Performance for Forest Management Certification *[MC&I(2001)]* and have been awarded the MTCC Certificate for Forest Management. In addition, as of June 2007, a total of 102 timber companies have also been awarded the Certificate for Chain-of-Custody as they have fulfilled the MTCC Requirements for Chain-of-Custody Certification (RCOC).

Currently, MTCC-certified sawntimber, mouldings, laminated finger-jointed timber, plywood and furniture have been exported to the Netherlands, Belgium, Germany, the United Kingdom, France, Australia, Greece, Denmark, Poland, Italy, Norway, Indonesia, Mauritius, South Africa, South Korea and the USA.

Furthermore, the Deramakot Forest Reserve covering 55,084 ha in Sabah and a forest concessionaire, the Perak Integrated Timber Complex (ITC) Sdn. Bhd. in Perak, with an area of 9,000 ha were also certified in 1997 and 2002 respectively as being 'well-managed forests' under the FSC P&C. Two other companies, namely, Asiaprima RCF Sdn. Bhd. and Golden Hope Plantations Bhd. have also been awarded the FSC forest management certificates, while presently 66 companies in Malaysia have been awarded the FSC Chain-of-Custody certificates. In this regard, in January 2007, Malaysia established the Forest Stewardship Malaysia Sdn. Bhd., a non-profit company, to develop a set of FSC standards for timber certification.

However, the costs incurred in undertaking forest management certification and in the certification of the chain-of-custody have not been adequately reflected in the prices of certified timber and timber products traded in the international market. For example, the cost incurred in undertaking the main assessment for forest management certification in Malaysia was estimated to be RM 20.15 per 100 ha with subsequent yearly reassessment at RM 4.95 per 100 ha during the 3-year validity of the MTCC Certificate for Forest Management, while that for the chain-of-custody certification for a given company was estimated to be RM 6,000.00 with half-yearly reassessment at RM 3,500.00 during the 5-year validity of the MTCC Certificate for Chain-of-Custody (Thang 2004). This could have impeded the rapid adoption of timber certification in Malaysia as such additional costs would make Malaysian timber and timber products less competitive in the market place.

As the export earnings from timber and timber products in Malaysia, which are exported to more than 150 countries, have increased steadily over the years, for example from RM 21.51 billion in 2005 to RM 23.4 billion in 2006, the management practices of the PRFs and forest plantations will have to enable these forests to be certifiable not only in that the practices are legal but that the forests are sustainably managed in accordance with internationally agreed criteria and indicators for sustainable forest management.

In this regard, Malaysia is currently negotiating with the European Union on its Forest Law Enforcement, Governance and Trade (FLEGT) Voluntary Partnership Agreements, a licensing scheme that would exclude illegal raw timber, sawnwood, plywood and veneer from entering the European market, as well as taking steps to submit the MTCC timber certification scheme for endorsement within the PEFC's framework for mutual recognition as the MTCC has been a member of the PEFC since November 2002.

Nevertheless, the efficiency of using timber certification, a market driven instrument, to promote sustainable forest management is still subject to considerable debates at the international level. At best, the application of timber certification in assessing sustainable forest management has created greater awareness among forest managers and forest workers

of their social responsibility in minimizing the loss of biological diversity and in protecting the environment during forest harvesting.

Estimated future log production

The average annual production of industrial logs in Malaysia is estimated at 24.63 million m^3 for the period under the Ninth Malaysia Plan, 2006-2010; 29.23 million m^3 for the next five years from 2011-2015, and 32.47 million m^3 for the period 2016-2020 as shown in **Table 19**.

It is evident from Table 19 that Sarawak is projected to increase its average annual log production from 13.45 million m^3 during the period 2006-2010 to 25.00 million m^3 for the period 2016-2020, mainly from its aggressive forest plantation programs, while in Peninsular Malaysia and Sabah the estimated average annual log productions are expected to decline due to more stringent enforcement of the annual allowable coupe and the level of permissible cut under sustainable forest management from their respective PRFs. This will also enable the forests to be certifiable by independent third party assessors in the overall context of timber certification.

In this regard, the average annual log production from the production forests of the PRFs which are under sustainable forest management in Malaysia for the five-year periods 2006-2010, 2011-2015 and 2016-2020 is estimated to be 18.10 million m^3, 24.12 million m^3 and 27.62 million m^3 respectively, with most of the production emanating from Sarawak as shown in Table 20. The decline in the average annual log production in Peninsular Malaysia and Sabah, especially from the natural forests, over the three five-year periods is mainly due to more conservational forest harvesting practices in the overall context of sustainable forest management. However, the substantive increase in log production in Sarawak is envisaged to emanate from its aggressive forest plantation programs as mentioned earlier, especially from 2011 onwards.

Table 19. Projected average total annual log production by regions in Malaysia by five year periods from 2006 to 2020 (million m^3)

Five year period	Source	Peninsular Malaysia	Sabah	Sarawak
2006 - 2010	Natural forest	3.80	4.05	11.50
	Forest plantation	0.75	0.47	1.95
	Rubber plantation	2.10	0.01	*
	Total	**6.65**	**4.53**	**13.45**
2011 - 2015	Natural forest	3	2.50	10
	Forest plantation	0.83	0.60	10.40
	Rubber plantation	1.85	0.05	*
	Total	**5.68**	**3.15**	**20.40**
2016 - 2020	Natural forest	2.51	1.50	10
	Forest plantation	0.91	0.80	15
	Rubber plantation	1.67	0.08	*
	Total	**5.09**	**2.38**	**25**

Source: FD Peninsular Malaysia, FDSabah, FD Sarawak.

***** Negligible.

Table 20. Projected average annual log production from the permanent reserved forests (prfs) by regions in Malaysia by five year periods from 2006 to 2020 (million m^3)

Five year period	Source	Peninsular Malaysia	Sabah	Sarawak
2006 -2010	Natural forest	3.13	3.77	8.50
	Forest plantation	0.75	-	1.95
	Total	**3.88**	**3.77**	**10.45**
2011 - 2015	Natural forest	2.51	2.38	8
	Forest plantation	0.83	-	10.40
	Total	**3.34**	**2.38**	**18.40**
2016 -2020	Natural forest	2.01	1.50	8
	Forest plantation	0.91	0.20	15
	Total	**2.92**	**1.70**	**23**

Source: FD Peninsular Malaysia, FD Sabah, FD Sarawak.

Wood-based industries

The wood-based industry in Malaysia is a major contributor to value-added export earnings and employment in the manufacturing sector. It has extensive backward linkages with the primary sector, the forest and timber industries, and forward linkages to metals, and machinery and equipment industries.

Under the Third Industrial Master Plan (IMP3), 2006-2020, total investments in the wood-based industry during the period were targeted to be RM 25.4 billion or RM 1.7 billion per annum, while exports are targeted to grow at an annual rate of 6.4 percent to reach RM 53 billion by 2020, mainly from downstream products, such as furniture, medium density fibreboard, plywood and panel products (Anon 2006b).

To achieve the targets of the wood-based industry under the IMP3, eight strategic thrusts were formulated, namely:

(i) developing regional production and supply chains where domestic manufacturers will be encouraged to outsource raw materials and other semi-finished components through outward investments in resource-rich countries;

(ii) promoting the efficient and effective management of forest resources and forest plantations, including more intensive use of agricultural wastes, bamboo, rattan and kenaf;

(iii) expanding market access through intensified marketing and promotion of Malaysia's 'green' image of the industry through sustainable forest management;

(iv) developing and promoting the growth potential in utilizing lesser promoted species, non-wood fibres and wood waste materials, and producing higher value-added wood products;

(v) expanding the production of own design an brand furniture through, among others, collaborations or joint ventures between local furniture manufactures with established manufacturers or international design houses in developed markets;

(vi) enhancing R&D and technology development, especially in diversifying the use of panel products, improving production technology to minimize wood waste and in using new resources, such as oil palm fibre and kenaf, for the production of composites and bio-composites;

(vii) increasing the supply of highly skilled workforces to enable the industry to move up the value chain; and

(viii) strengthening the institutional support and improving the delivery system related to the industry.

It is imperative to address the overcapacity of the primary wood-based industries in Peninsular Malaysia and Sabah *vis-à-vis* their respective log availability, where the combined annual installed capacity of the sawmills and plywood/veneer mills in Peninsular Malaysia and Sabah in 2005, which were estimated to be 12.73 million m^3 and 8.35 million m^3 had far exceeded their log production of 5.74 million m^3 or 54.9 percent and 6.56 million m^3 or 21.4 percent in 2005 respectively. This could involve the withdrawal or cancellation of mill licenses, especially those that are not in operation for prolonged periods. For example, in Peninsular Malaysia, of the 664 licensed sawmills and 52 licensed plywood/veneer mills only 450 sawmills and 33 plywood/veneer mills were in full operation in 2005, mainly due to inadequate raw material supplies. In fact, Peninsular Malaysia has a policy to close down the primary processing mills if they are unable to operate continuously for two years.

This is pertinent as with trade liberalization and a globalized market, the shortage of logs to meet the primary wood-based industries in Peninsular Malaysia and Sabah could open the possibility of externalizing the problems associated with timber harvesting to other countries. For example, a study conducted in 2004 indicated that as much as 70 percent of Malaysian log imports might be of illegal origin (Seneca Creek Associates & Wood Resources International, 2004), which was also reported in the State of the Environment in Asia and the Pacific 2005: Economic Growth and Sustainability by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). In this regard, Malaysia has never condoned the import of illegal logs into the country.

Employment in the forestry sector in Malaysia, especially in the wood-based industries, registered a steady increase from 1985 to 2000 from 147.24 000 workers in 1985 to 274.38 000 workers in 2000, but with a slight decline to 270.67 000 workers in 2005 as shown in Table 21.

Table 21. Employment in the forestry sector[2] by regions for 1985, 1990, 1995, 2000 and 2005 (thousands of persons employed)

Region	Year				
	1985	1990	1995	2000	2005
Peninsular Malaysia	61.10	75.60	87.51	86.91	104.72
Sabah	34.14	49.03	92.31	89.77	71.45
Sarawak	52.00	62.50	94.00	97.70	94.50
Malaysia	147.24	187.13	273.82	274.38	270.67

Source: FD Peninsular Malaysia, FD Sabah, FD Sarawak.

In this context, the population in Malaysia is expected to grow at an average annual rate of 1.6 percent for the period 2006-2010 to 28.96 million people by 2010 as compared with the average annual growth rate of 2.6 percent for the period 1996-2005. This is in light of the fact that more Malaysians are pursuing higher education and career development leading to delayed marriages, as well as having smaller families (Anon 2006a).

Hence, by 2010 the population in the working age group of 15-64 years is expected to account for 63.6 percent of the total population while those aged 65 years and above should increase to 4.7 percent. The share of the population living in urban areas has been projected to increase to 63.8 percent in 2010, while employment will grow at 1.9 percent over the period 2006-2010, although an unemployment rate of 3.5 percent is projected for 2010.

Forest ecosystem services

In the past two years there has been increasing interest in "payment for environmental services", especially those related to watershed management and carbon sequestration. However, the participants of the recently concluded Inter-regional Workshop on Financial Mechanisms for Sustainable Forest Management: Sharing Experiences from Latin America and Asia-Pacific that was held from 20-22 November 2006 in Chiang Mai, Thailand were of the view that while many of the mechanisms are interesting and innovative, the extent to which they have been successfully adopted and applied is very limited. This is in light of the fact that many of these approaches appear to be little more than public subsidies and their efficacy and viability have yet to be fully analyzed.

Nevertheless, under the Ninth Malaysia Plan, 2006-2010, emphasis has been given, among other things, to further promoting ecotourism in Malaysia through the preservation of natural attractions, such as wilderness and wildlife areas, nature and forest recreational parks, highlands and islands, besides cultural and historical heritage sites, which will be guided by the National Ecotourism Plan.

In this regard, under the Eighth Malaysia Plan, 2001-2005, tourist arrivals had increased at an average rate of 10 percent per annum while foreign exchange earnings from tourism had increased at an average annual growth rate of 12.4 percent, from RM 17.3 billion in 2000 to RM 31.0 billion in 2005. The number of domestic trips had also increased by 30.1 percent from 12.3 million in 2000 to 16 million in 2005. This is in tandem with rising household income, improved quality of life and regular travel becoming increasingly a part of the

[2] Workers in the wood-based industry, logging industry and the public sector, including R&D institutions and universities.

Malaysian lifestyle, as well as family recreation and youth camps being held at various tourist destinations around the country (Anon 2006a).

For the period 2006-2010, tourist arrivals are expected to grow at an average annual rate of 8.4 percent and to reach 24.6 million in 2010 while tourist receipts are set to rise at an average annual rate of 13.9 percent to RM 59.4 billion in 2010.

In this context, the various Forestry Departments in Malaysia, especially those in Peninsular Malaysia have developed a total of 116 forest recreational parks and 2 nature parks located through the Peninsula to cater for the projected increase of tourist arrivals, both domestic and foreign. This will provide the added impetus for Malaysia to conserve and protect its rich natural forests.

Management of water resources in Malaysia under the Ninth Malaysia Plan, 2006-2010, will focus on maintaining and enhancing the ecosystem functions of river systems through the restoration and maintenance of highland catchments, wetlands, river buffers and riparian zones. The suitability of market-based instruments will also be explored to internalize environmental costs, including scarcity, into water pricing systems.

In this regard, under the Plan, water demand is expected to grow at an average rate of 6.6 percent per annum to 16,270 million litres per day in 2010 in tandem with the projected average annual population growth of 1.6 percent as compared to 2.6 percent under the Eighth Malaysia Plan, 2001-2005. As such, the government in 2005 had initiated a "Study for the Effective Implementation of Integrated Water Resources Management (IWRM) in Malaysia". This study is expected to be completed under the Ninth Malaysia Plan. The IWRM is a holistic approach to address land, including forest land, and water issues in an integrated manner.

In addition, the Pahang-Selangor Interstate Raw Water Transfer project will also be implemented under the Ninth Malaysia Plan and it was reported in *The Sun*, a local newspaper, that the Pahang State Government will receive 10 cents for every cubic metre of water channeled to Selangor, and hence, annually it will receive a sum of RM 226,000.00 for 2.26 million m^3 of water transferred to Selangor, the most developed State in Malaysia (Anon 2007).

With the increasing interest of the world community on the role played by forests in mitigating climate change, and based on the growing stock of the natural forests in Malaysia, it was estimated that in 2005 the total carbon stored in the above-ground biomass was 2,390 million tonnes, while carbon stored in below-ground biomass was 574 million tonnes. In addition, carbon stored in dead wood and in forest litter was estimated to be 445 million tonnes and 34 million tonnes respectively.

However, forests may be affected both positively and negatively by climate change. Higher mean temperatures, increased levels of atmospheric carbon dioxide (CO_2) and increased precipitation could result in increased growth rates and productivity of some species, but climate change could also induce the shifting and in a first phase a reduction of the natural ranges of trees and other living components of the forest ecosystems, loss of genetic variability, loss of species and simplification of ecosystems, massive decline of forests and increased incidence and severity of wildfire.

Institutional arrangements

On 27 March 2004, the Government of Malaysia placed FDPM, FRIM, and the Department of Minerals and Geoscience Malaysia under the newly created Ministry of Natural Resources and Environment (NRE), Malaysia instead of the Ministry of Primary Industries, Malaysia

which was renamed the Ministry of Plantation Industries and Commodities, Malaysia. Other government departments that were placed under the NRE, included the Department of Environment and the Department of Wildlife and National Parks Peninsular Malaysia which were formerly under the Ministry of Science, Technology and the Environment, Malaysia (renamed as the Ministry of Science, Technology and Innovations, Malaysia), as well as the Department of Irrigation and Drainage and the Division of Marine Parks and Recreational Fishery of the Ministry of Agriculture, Malaysia (renamed the Ministry of Agriculture and Agro-based Industry, Malaysia).

With the reorganization of a number of Ministries in Malaysia and the portfolios under them, especially those under the NRE, a more holistic, multi-disciplinary and cross-sectoral approach will be adopted to address forest and forest-related matters, as well as the further integration of forestry with the need to protect and safeguard the environment for the benefit of future generations. This will enhance Malaysia's efforts towards the attainment of sustainable forest management and in applying the Ecosystem Approach of the CBD in managing its forest resources.

Hence, one of the main strategies adopted by NRE is to balance the development between natural resources exploitation and conservation through enhanced cooperation with other government agencies at the State and Federal levels, as well as with the private sector, including NGOs, to ensure sustainable development.

However, the NRE will have to exercise a strong leadership role in ensuring effective coordination among the agencies under its control which are involved in managing the forest resources, especially the FDPM, the Department of Wildlife and National Parks Peninsular Malaysia, the Department of Minerals and Geoscience Malaysia, and the Department of Environment, so that an integrated and holistic approach is adopted and a balance is achieved between conservation needs and resource uses, as well as in protecting the stability of the environment.

Furthermore, as forestry R&D undertaken by FRIM, which is under the control of the NRE, not only addresses the management of forest resources, but also the development of forest and timber products which is under the purview of the Ministry of Plantation Industries and Commodities, it is imperative for FRIM to be able to balance and satisfy the needs of both Ministries.

There is also a need to ensure adequate trained and motivated manpower to manage, conserve and develop forest resources in Malaysia sustainably. In this context, the University Putra Malaysia alone has projected that it will produce 2,037 graduates in forestry science and 664 graduates in wood science technology between 2007 and 2020.

Nevertheless, the total expenditures for administering the forests in Malaysia by the public sector have increased from RM 162.58 million in 1985 to RM 257.33 million in 2005, an increase of 58.3 percent or at an average annual rate of 2.9 percent as shown in Table 22. It is evident from Table 22 that in 2005 most of the increases recorded were in Peninsular Malaysia and Sabah, while in Sarawak there was an actual decrease of RM 46.64 million between the years 2000 and 2005 or 53.8 percent as a result of the establishment of the Sarawak Forestry Corporation Sdn. Bhd. in 2003, which is now responsible for the management, conservation and development of the forest resources in Sarawak.

Table 22. Total expenditures for forest administration by the public sector for 1985, 1990, 1995, 2000 and 2005 (million RM)

Region	Year				
	1985	1990	1995	2000	2005
Peninsular Malaysia	41.94	56.13	82.11	81.40	122.34
Sabah	100.76	58.18	67.61	65.23	94.78
Sarawak	19.88	29.69	50.20	86.75	40.11
Malaysia	162.58	144.00	199.92	233.38	257.23

Source: FD Peninsular Malaysia, FD Sabah, FD Sarawak.

In terms of expenditures incurred by the public sector in undertaking management, conservation and development activities in the forestry sector in Malaysia, it is evident from Table 23 that the total development expenditures recorded more than a fourfold increase from RM 45.40 million in 1985 to RM 182.06 million in 2005. Of the total expenditures in 2005, it was observed that Sarawak had accounted for RM 98.54 million or 54.1 percent of the total expenditures incurred in Malaysia. Under the Ninth Malaysia Plan, 2006-2010, the total budget allocated for forest development in Malaysia has been estimated to be RM 1,335.89 million with the Forestry Departments in Peninsular Malaysia accounting for RM 926.22 million, while RM 156.84 million and RM 252.83 million have been allocated to Sabah and Sarawak respectively.

Table 23. Total expenditures for forest development by the public sector for 1985, 1990, 1995, 2000 and 2005 (million RM)

Region	Year				
	1985	1990	1995	2000	2005
Peninsular Malaysia	40.22	38.70	80.42	70.98	65.47
Sabah	2.53	9.46	30.68	22.62	18.05
Sarawak	2.65	17.10	27.99	21.72	98.54
Malaysia	45.40	65.26	139.09	115.32	182.06

Source: FD Peninsular Malaysia, FD Sabah, FD Sarawak.

The total forest revenue collected by the public sector, especially by the various Forestry Departments in Malaysia for the years 1990, 1995, 2000 and 2005 is shown in Table 24. For the year 2005 alone, 48.5 percent or RM 759.70 million of the total revenue collected by the public sector was in Sarawak, followed by Sabah at 32.7 percent or RM 512.61 million and Peninsular Malaysia at 18.8 percent or RM 294.91 million.

Table 24. Total forest revenue collected by regions for 1990, 1995, 2000 and 2005 (million RM)

Region	Year			
	1990	1995	2000	2005
Peninsular Malaysia	291.31	374.15	293.25	294.91
Sabah	844.80	626.38	360.88	512.61
Sarawak	734.83	996.60	895.71	759.70
Malaysia	1,870.94	1,997.13	1,549.84	1,567.22

Source: FD Peninsular Malaysia, FD Sabah, FD Sarawak.

4. PROBABLE SCENARIO OF THE FORESTRY SECTOR IN 2020

Based on past trends and the policy and thrusts set out in the Ninth Malaysia Plan, 2006-2010, which represents the first five-year development plan to enable Malaysia to realize its goal of becoming a developed nation by 2020 (as envisaged in its Vision 2020), it is expected that the total area under PRFs designated for permanent forestry uses in 2020 will increase by at least 1 million ha, thus, bringing the total area of the PRFs in Malaysia to 16.30 million ha or 49.6 percent of its total land area, as over the ten-year period from 1995 to 2005, Malaysia had increased its forest areas under the PRFs by 1.11 million ha. This is consistent with the goals and aspirations of the Vision 2020, which have underscored that "our valuable natural resources are not wasted. Our land must remain productive and fertile, our atmosphere clear and clean, our water unpolluted, our forest resources capable of regeneration, able to yield the needs of our national development. The beauty of our land must not be desecrated — for its own sake and for our economic advancement", as well as the aspiration of the Government to have 50 percent of its total land area under permanent forest cover as voiced by Malaysia during UNCED in 1992. However, most of these areas will not be able to be economically harvested under sustainable forest management practices as they will be located in the more hilly terrain of the country.

Nevertheless, the current level of forested land of 18.31 million ha is expected to decline by 1.58 million ha to 16.73 million ha by 2020, based on the average annual loss of 105,500 ha over the period 1985 to 2005. This decline is inevitable as new land will be needed for the expansion of the agriculture sector, and for new infrastructure development and settlements to meet the demand of the growing population which is expected to reach 28.96 million in 2010 and about 32 million in 2020 from the population of 26.75 million in 2005.

The area under forest plantations will increase by 1.75 million ha by 2020. This is in light of the Government policy to provide soft loans to the private sector to establish 375,000 ha of forest plantations in the next 15 years, where currently loans amounting to RM 80.34 million have been disbursed to the private sector to plant 16,100 ha, as well as the targeted establishment of 500,000 ha by Sabah by 2020, and the envisaged 1.2 million ha of forest plantations in Sarawak. Thus, at the end of 2020, forest plantations in Malaysia are expected to total 2.15 million ha with 55.8 percent of the planted areas located in Sarawak.

Forest harvesting techniques, especially in the production forests of the PRFs, will be more conservative and benign to the environment, as well as in conserving forest biological diversity more effectively during harvesting operations, including mitigating human-wildlife conflict in forest management practices. This is a result of the wider application of reduced impact logging and the need to meet internationally agreed criteria and indicators for sustainable forest management, as well as from the experience gained from the five-year United Nations Development Programme-Global Environment Facility project on Conservation of Biological Diversity through Improved Planning Tools that is currently being implemented in Malaysia.

By 2020, all the areas in the PRFs in Malaysia will be sustainably managed in accordance with agreed international criteria and indicators for sustainable forest management, which could be certified by independent third party assessors, if required.

By 2020, all timber and timber products produced in Malaysia will also be certifiable as legal and from sustainably managed forests by independent third party assessors consistent with internationally recognized timber certification schemes, including the Malaysian Criteria and Indicators for Forest Management [MC&I (2002)] used by the MTCC. This is in view of the advanced negotiation between Malaysia and the European Union with regard to its licensing scheme under the FLEGT's Voluntary Partnership Agreements.

More representative virgin forest areas are expected to be constituted by 2020, especially those representing the more fragile forest ecosystems, such as the lower and upper montane forests, and wetlands, consistent with the National Policy on Biological Diversity 1998 and the National Wetlands Policy 2004.

The number of national and state parks, nature reserves, wilderness and wildlife areas, and bird sanctuaries, including wildlife rehabilitation centers, are expected to increase to cater to the projected increase of domestic tourists due to higher disposable income and improved quality of life, as well as the influx of tourist arrivals which are projected to reach 24.6 million in 2010. This is consistent with the Government efforts to further promote ecotourism in Malaysia under the National Ecotourism Plan where 48 priority sites have been identified, such as Taman Negara in Peninsular Malaysia, the Bako National Park in Sarawak and the Kinabalu Park in Sabah.

It is expected that by 2020, watershed management, especially in upland forested areas, will be better integrated into multiple-use forest management practices so as to better safeguard water sources and protect agricultural land and settlements from flooding and landslides which have become more prevalent in recent years. More specifically, links between watershed management and food production areas will be strengthened through an integrated approach, while greater emphasis will also be placed on hydropower generation in the overall context of clean and efficient energy production. It is expected that more forested areas will be protected as water catchments when catchment areas for existing and future dams are rationalized with the classification of water catchment forest under section 10 (1) of the National Forestry Act 1984 and the Forest Rules. In this regard, mechanisms for the equitable sharing of benefits between managers of the forest resources and the users of water downstream will be developed.

By 2020, the total production of logs is expected to increase to 32.47 million m^3 from the 2005 level of 28.24 million m^3 in tandem with the projected increase of forest plantation, especially in Sarawak. In this regard, logs from the PRFs are expected to contribute an estimated 27.62 million m^3 with the proportion of plantation wood accounting for 58.3 percent of the production. In fact, between the periods 2006-2010 and 2016-2020, the PRFs in Malaysia will experience an increase of an average annual production of 9.52 million m^3 or 52.6 percent of wood supply, mainly as a result of their aggressive forest plantation programs.

Based from past trends and the thrusts of the IMP3 for the development of the wood-based industries till 2020, as well as the over-capacity of the primary wood-based industries, it is envisaged that the export of logs will be further reduced and will most probably be phased out by 2020 as there has been a total ban on log exports from Peninsular Malaysia since 1985, although selected bans were enforced as early as 1972, while the primary processing mills in Sabah are facing shortages in log supply.

Most of the exports from the wood-based industry in Malaysia in future will be wood-based panel products, especially furniture, and laminated scantlings (lamscants) for the production of windows and doors, including oriented strand boards, and other higher-valued products to cater for niche markets. This is with a view to achieving export earnings of RM 53 billion by 2020 through the successful implementation of the IMP3 and the National Timber Industry Policy which is currently being finalized by the Government of Malaysia.

The wood-based industry is also expected to convert wood waste materials into solid and engineered products for construction and household applications, such as floor panels, door profiles and deckings, as well as the use of natural fibres, such as oil palm biomass which is currently estimated to be about 30 million tonnes in the form of empty fruit bunches, oil palm trunks and oil palm fronds that could be processed into blockboards, moulded particle boards, medium density fibreboards and even plywood (Anon 2006b).

The rich forest biological diversity will be further optimized for the development of herbal, cosmetic and pharmaceutical products through the application of appropriate biotechnology, as well as the increasing use of rattan and bamboo for the production of value-added products for niche markets.

The number of primary processing mills, especially the sawmills in Peninsular Malaysia, will be reduced due to the unavailability of logs as most producer countries that export logs will be undertaking more domestic processing to add value to the production chain. This consolidation of the primary processing mills instead of expanding their installed capacities will ensure that the reduced installed capacities of these mills will be commensurate with the level of log production, in particular the sustainable level of harvests from the PRFs.

Furthermore, it is envisaged that Malaysia will increase its import of sawnwood, wood-based panels and, paper and paperboard to meet the rising demand of the growing population, especially printing and writing paper as the population becomes more educated in a knowledge-based society. Malaysia could even consider establishing another integrated pulp and paper mill, for example in Sarawak where there are still abundant forest resources as compared with the other States in Malaysia.

Future forestry R&D in Malaysia will focus on the improvement of sustainable management practices of natural forest, silvilculture of forest plantations, planting-stock production, biotechnology, landscape and recreation, conservation of forest biological diversity, natural-products discovery, wood processing technology, wood protection and construction application, and downstream utilization of wood residues for development of composite products, pulp and paper, and energy from biomass.

In view of the expanded roles of forest in meeting changing societal demands, future human resource development (HRD) in Malaysia will place greater emphasis on enhancing knowledge and on the development and expansion of skills, such as in managing forests for bio-energy and in mitigating climate change; in the conservation of areas with high diversity and endemism and the effective management of watershed areas; in advanced wood processing technology; and in the manufacture of bio-composites and furniture designs. In addition, the number of personnel in the forestry sector in Malaysia will also be increased so as to fully achieve multiple-resource forest management that involves the simultaneous production of forest goods and services, which is compatible with the need to conserve the forest ecosystem and protect the environment.

Depending on the outcomes of post-Kyoto, Malaysia may consider forestry projects under the Clean Development Mechanism (CDM), especially if carbon sequestered from reduced impact logging and enrichment planting can be traded in the international markets, and with regard to the protection of carbon stocks in natural forests that is currently being deliberated under the Reducing Emissions from Deforestation and Degradation (REDD) initiative that is part of the Kyoto framework.

5. CONCLUSIONS

Although the current level of forested land of 18.31 million ha is expected to decline to 16.73 million ha by 2020, the total forest areas under the PRFs in Malaysia at the end of 2020 are expected to increase by 1 million ha to 16.30 million ha, representing 49.6 percent of its total land area. This will contribute to meeting the four global objectives on forests of the Non-legally Binding Instrument on All Types of Forests, especially Global Objective 1, among others, in reversing the loss of forest cover worldwide through sustainable forest management.

By 2020, all the areas in the PRFs in Malaysia will be sustainably managed in accordance with agreed international criteria and indicators for sustainable forest management, while all timber and timber products produced in Malaysia will also be certifiable as legal and from sustainably managed forests by independent third party assessors consistent with internationally recognized timber certification schemes. This will also contribute to meeting the four global objectives on forests of the Non-legally Binding Instrument on All Types of Forests, especially Global Objective 3 in increasing significantly the area of protected forests worldwide and other areas of sustainably managed forests, as well as increasing the proportion of forest products from sustainably managed forests.

Total log production in Malaysia is expected to increase to 32.47 million m^3 by 2020 as a result of an additional 1.74 million ha of established forest plantations, especially in Sarawak. The PRFs are expected to contribute to an estimated 27.62 million m^3 with the proportion of plantation wood accounting for 58.3 percent of the production.

Watershed management, especially in upland forested areas, will be better integrated into multiple-use forest management practices so as to better safeguard water sources and protect agricultural land and settlements from flooding and landslides, while greater emphasis will also be placed on hydropower generation in the overall context of clean and efficient energy production.

The rich forest biological diversity will be further optimized for the development of herbal, cosmetic and pharmaceutical products through the application of appropriate biotechnology, while most of the exports from the wood-based industry in Malaysia in future will be wood-based panel products, especially furniture, and laminated scantlings for the production of windows and doors, including oriented strand boards, and other higher-valued products to cater for niche markets.

The number of primary processing mills, especially the sawmills in Peninsular Malaysia, will be reduced due to the unavailability of local log supply. This consolidation of the primary processing mills instead of expanding their installed capacities will ensure that the reduced installed capacities of these mills will be commensurate with the level of log production, in particular the sustainable level of harvests from the PRFs.

Future forestry research in Malaysia will focus on the improvement of sustainable management practices of natural forest, including mitigating human-wildlife conflict in forest management practices; forest plantation establishment and development; landscape and recreation; conservation of forest biological diversity and the application of biotechnology; natural-products discovery; wood processing technology and the further utilization of wood residues; and energy from biomass.

Malaysia should accord greater emphasis to integrate biological diversity and water conservation, as well as to incorporate traditional forest-related knowledge in forest management practices; establish criteria and indicators for the establishment of protected area systems, especially for the totally protected areas; and on the roles of forests in alleviating rural poverty through enhanced use of NWFPs.

6. NEXT STEPS

Actions should be taken to examine in-depth the National Forestry Act 1984 and the other forest-related laws so as to simplify them and remove contradictions, inconsistencies and overlapping jurisdictions between the laws, especially those provisions supporting sustainable forest management and in curbing illegal forest harvesting activities and trade in illegal timber products, as legal clarity contributes to compliance, reduces the possibility of arbitrary interpretation of the laws, and increases the evenness in the application of the laws by the bureaucracy and judiciary. This revision or amendments to the laws should be undertaken through an inclusive, participatory and cross-sectoral process as this will promote transparency, ensure greater equity, minimize undue influence of the privileged groups and, thus, enhance their acceptance and implementation by society at large. This revision should also be based on an examination of the financial, technical and human resources needed to effectively implement them. A prerequisite for such a revision is the need to update the National Forestry Policy 1978 as this will form the framework under which the revision of the National Forestry Act 1984 should be undertaken.

It is imperative that interagency coordination be further strengthened at the Federal, State and forest management unit levels in order to ensure sustainable forest management, conservation and development of the forest resources in Malaysia, such as through the establishment of interagency task forces or working groups. This will involve horizontal coordination between actors in the different sectors, but working at the same territorial level, for example, forest and wildlife officials; and vertical coordination among actors operating in the same sector, but at different levels, such as Federal, State and forest district administrators. This should also provide horizontal and vertical information flow and accountability between the different tiers of government.

Forest management, which is currently based on an ecosystem approach to produce a few forest goods and services simultaneously should be evolved to reflect and move towards the 'true' ecosystem approach of the CBD and better address intergenerational equity.

Actions should be initiated to ensure that future forest management practices place more emphasis on the linkages between the highland and lowland users of forest goods and services. Such practices should be more people-centered, which should involve more transparent participatory management, including decision-making and accountability, as well as improved governance, and with the involvement of indigenous people, forest dwellers and local communities.

Benchmarks for the quantification of watershed parameters, and in particular, the cumulative watershed effects from forest management activities, such as those involved in forest harvesting, which may impact on the long-term sustainability of the forest ecosystem need to be developed. The focus should not only be on the impacts of forest management practices on on-site water quality and yield, erosion and sedimentation, streamflow patterns etc., but also on those affecting off-site values. This is especially critical for the mangrove and peat swamp forests in Malaysia as quantitative information of the hydrological impacts of harvesting these forests is still lacking as much of the research programs thus far have been concentrated in the inland forests.

Further work is also needed: first, to develop more effective procedures for assessing changes in forest biological diversity and water quality of streams emerging from logged-over forests as compared with similar areas that are kept free from human intervention; second, to develop appropriate mechanisms to resolve disputes, conflicts and grievances, particularly those over tenure claims and use rights; third, to develop procedures for evaluating the social impact of forest operations directly affecting communities; and fourth, to document traditional forest-related knowledge and practices of indigenous people in the use of forest species or

management systems in forest operations, including the development of mechanisms or instruments for the equitable sharing of benefits arising from the commercial application of such knowledge and practices.

Steps should be taken to ensure the adequacy of the current network of representative areas for the conservation of forest biological diversity, especially those areas with high diversity and endemism, including establishing forest diversity indicators for threatened ecosystems in Malaysia, while taking into account the need for biological corridors linking them or 'stepping stones' between them.

Studies should be initiated to quantify the cost in protecting and managing the existing biological reserves in Malaysia and the opportunity cost foregone in implementing *in situ* conservation of biological diversity and its potential use in the light of advances in biotechnologies in using the resources as this will optimize allocation of resources for the conservation of biological diversity. This will provide the basis for decision-makers to provide adequate resources, especially financial resources, to conserve and protect these areas, compared to having them converted to other alternative land uses which are often more profitable.

With regard to the installed capacities of the primary processing industries in Peninsular Malaysia and Sabah that have far exceeded the local wood supply, actions should be initiated to restructure the industries so that their installed capacities are commensurate with the availability of log supply, especially the sustainable level of harvests. This could be achieved through the withdrawal and cancellation of mill licenses, while new primary processing mills or mills planning to expand their processing capacity should be made to show proof of their sources of raw materials which should be of legal origin. This is in light of the fact that over-capacity *vis-à-vis* the availability of log supply could encourage illegally logging the forests, as well as illegally importing logs from other countries. This would impact on Malaysia's ability to achieve sustainable management of its forest resources and would require additional personnel to undertake forest enforcement work instead of having such personnel implementing activities that will further enhance the management and conservation of the forest resources in Malaysia.

In view of the current high profile of forest issues in the climate change agenda, it is pertinent for Malaysia to develop and strengthen institutional capacity, expertise and make available equipment to measure, monitor and report on carbon sequestration arising from afforestation and reforestation activities, as well as from protecting the carbon stocks in natural forests.

7. **REFERENCES**

Anon. 2003. Intergovernmental Panel on Climate Change-Good Practice Guidance for Land Use, Land-use Change and Forestry. IPCC National Greenhouse Gas Inventories Programme, Technical Support Unit, IPCC, 2003.

Anon. 2005. National Physical Plan. Federal Department of Town and Country Planning, Ministry of Housing and Local Government, 25 April, 2005.

Anon. 2006a. Ninth Malaysia Plan, 2006-2010. The Economic Planning Unit, Prime Minister's Department, Putrajaya, Malaysia, 2006.

Anon. 2006b. Third Malaysia Industrial Master Plan (IMP3), 2006-2020. Ministry of International Trade and Industries, Kuala Lumpur, Malaysia, 2006.

Anon. 2007. The Sun. 14 August 2007, Kuala Lumpur, Malaysia.

Blakeney, J. 2001. Overview of Forest Law Enforcement in East Malaysia. Highlights of this report were presented at the Workshop on Illegal Logging in East Asia, Jakarta, Indonesia, 27-28 August 2000.

FAO. 2005. FAO Yearbook: Forest Products 2005 (2001-2005). Food and Agriculture Organization of the United Nations, Rome, Italy, 2005.

Fauzi A. Samad. 1997. Integrated Water Resources Management in Malaysia. Forum on National Consultation on Integrated Water Resources Management, Asia and Pacific Development Center (APDC), Kuala Lumpur, Malaysia, 1997.

Fox, J.E.D. 1978. The Natural Vegetation of Sabah, Malaysia. The Physical Environment and Classification. Tropical Ecology, Vol. 19, No. 2.

FRIM/ITTO. 2001. A Model Project for Cost Analysis to Achieve Sustainable Forest Management [PD 32/95 Rev. 3 (F)], Volume 1, Synthesis Report, FRIM/ITTO, 2001.

Seneca Creek Associates & Wood Resources International. 2004. "Illegal" Logging and Global Wood Markets: The Competitive Impacts on the U.S. Wood Products Industry. Washington DC, American Forest & Paper Association.

Thang, H.C. 2004. Malaysian Criteria and Indicators for Sustainable Forest Management, including Certification: Its Development and Experiences with Implementation. Regional Workshop on Forest Certification in China: Latest Developments and Future Strategies, Hangzhou, China, 21-23 July 2004.

Whitmore, T.C. 1975. Tropical Rain Forests of the Far East. Clarendon Press, Oxford.

WWF-Malaysia. 2007. Green Heart, Issue 02, 2007. WWF-Malaysia, Petaling Jaya, Malaysia.

8. Annex. List of species for forest plantation establishment under the approved agricultural projects

Species	Gestation period (years)
Gigantochola levis (Bamboo poring)	6
Calamus (Rotan)	8
Acacia (Acacia)	15
Anthoceplahus (Kelempayan)	15
Ceiba (Kapok)	15
Duabanga (Sawih)	15
Endospermum (Sesendok)	15
Macaranga (Mahang)	15
Mallotus (Balik angin)	15
Octomales (Binuang)	15
Paraserianthes [Albizia] (Batai/Kayu Macis)	15
Peronema canescens (Sungkai)	15
Pterospermum strafianum (Bayor)	15
Agathis (Damar minyak/Bindang)	25
Alstonia (Pulai)	25
Araucaria (Hoop pine/Klinki Pine)	25
Artocarpus (Cempedak Terap)	25
Azadirachta (Sentang/Ranggu)	25
Bischofia (Javan Cedar)	25
Camnosperma (Terentang)	25
Cinnamomum (Pokok Teja)	25
Cratoxylon (Geronggang)	25
Dacrydium (Sempilor)	25
Dillenia (Simpoh)	25
Dyera (Jelutong)	25
Endospermum (Terbulan)	25
Eucalyptus (Eucalyptus)	25
Gmelina (Yemane)	25
Hevea (Rubber)	25
Kharya (Khaya)	25
Ilex (Kordam)	25
Mangifera (Machang)	25
Palaquium (Nyatoh)	25
Parkia (Petai)	25
Pinus (Pine)	25
Pterocorpus (Angsana)	25
Pterocymbium (Melembu)	25
*Petrospremum javanicum (*Bayor Batu)	25
Santiria (Kedondong)	25
Schima (Gegatal)	25
Sandoricum (Kelampu)	25

Species	Gestation period (years)
Swietenia (Mahogany)	25
Tectona (Teak/Kayu Jati)	25
Terminalia (Talisai)	25
Anisoptera (Mersawa*)*	50
Cylophyllum (Bintangor)	50
Cananga (Kenanga)	50
Canarium (Kedondong)	50
Casuarina (Ru)	50
Chukrasia (Surian Batu)	50
Caelastegia (Punggai)	50
Dactylocladus (Jongkong)	50
Dipterocarpus (Keruing)	50
Dryobalanops (Kapur)	50
Durio (Durian)	50
Eusideroxylon zwageri (Belian)	50
Gonystylus (Ramin)	50
Heritiera (Mengkulang)	50
Hopea (Merawan)	50
Instia (Merbau)	50
*Kokoqna (*Mata Ulat)	50
Koompassia (Kempas)	50
Neobalanocarpus (Chengal)	50
Parashorea (Urat Mata/Gerutu)	50
Pentace (Melunak)	50
Pentaspadon (Pejon)	50
Pithecellobium (Kungkur)	50
Pterocymbium javanicum (Teluto)	50
Sandoricum (Sentul)	50
Scapium (Kembang Semangkok)	50
Scapium sindora (Sepetir)	50
Shorea (Meranti/Engkabang/Majau/Seroja)	50
Tetramerista (Punah)	50
Toona (Surian)	50
Vatica (Resak)	50