Forest Genetic Resources
Conservation and Management

National Consultative Workshops of Seven South and Southeast Asian Countries

K.Y. Choo, R. Jalonen, L.T. Hong and H.C. Sim *editors*

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The Forest Research Institute Malaysia (FRIM) is the national forestry research organization of Malaysia. It was first established in 1929 as the Forest Research Institute, the research arm of the Peninsular Malayan (later Malaysian) Forest Department, and in 1985 was reorganized into the present FRIM, a statutory body.

FRIM's research focus and efforts through nearly a century's existence has meant that FRIM has not only built up a strong tradition of research, but backs this up with experience, expertise and supporting facilities perhaps unmatched anywhere in the tropics. Basic studies of the tropical forests conducted at FRIM had produced publications before and just after World War II that remain classic books in their field till today. Among the more notable ones are Symington's *Manual of Dipterocarps*, Watson's *Mangrove Forests of the Malay Peninsula*, and Wyatt-Smith's *Manual of Silviculture of Lowland Forests*.

Past research has also left behind many living laboratories in the field – a number of arboreta, sample plots and various experimental plantations of both local and exotic tree species. These sample plots and experimental areas are not just confined to the FRIM campus, which is located in the northern suburb 16 km outside the capital city of Kuala Lumpur; but are spread throughout peninsular Malaysia, covering various forest types and terrains.

FRIM has maintained a number of collections including a herbarium, an insect collection, and collections of wood and soil samples, which are widely regarded as reference collections for researchers and scientists in these fields. The many well-equipped laboratories in FRIM, which have been constantly and continuously upgraded, have put FRIM among the top forestry and forest products research institutions.

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Bioversity International

Bioversity International (Bioversity) an autonomous international scientific organization, supported by the Consultative Group on International Agricultural Research (CGIAR). Bioversity's mandate is to advance the conservation and use of genetic diversity for the well-being of present and future generations. Bioveristy's headquarters is based in Rome, Italy, with offices in another 15 countries worldwide. It operates through three programmes: (1) the Plant Genetic Resources Programme, (2) the CGIAR Genetic Resources Support Programme, and (3) the International Network for the Improvement of Banana and Plantain (INIBAP).

The international status of Bioversity is conferred under an Establishment Agreement which, by January 1999, had been signed and ratified by the Governments of Algeria, Australia, Belgium, Benin, Bolivia, Brazil, Burkina Faso, Cameroon, Chile, China, Congo, Costa Rica, Côte d'Ivoire, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, Greece, Guinea, Hungary, India, Indonesia, Iran, Israel, Italy, Jordan, Kenya, Malaysia, Mauritania, Morocco, Norway, Pakistan, Panama, Peru, Poland, Portugal, Romania, Russia, Senegal, Slovakia, Sudan, Switzerland, Syria, Tunisia, Turkey, Uganda and Ukraine.

Financial support for the Research Agenda of Bioversity is provided by the Governments of Australia, Austria, Belgium, Brazil, Bulgaria, Canada, China, Croatia, Cyprus, Czech Republic, Denmark, Estonia, F.R. Yugoslavia (Serbia and Montenegro), Finland, France, Germany, Greece, Hungary, Iceland, India, Ireland, Israel, Italy, Japan, Republic of Korea, Latvia, Lithuania, Luxembourg, Macedonia (F.Y.R.), Malta, Malaysia, Mexico, Monaco, the Netherlands, Norway, Peru, the Philippines, Poland, Portugal, Romania, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, the UK, the USA and by the Asian Development Bank, Common Fund for Commodities, Technical Centre for Agricultural and Rural Cooperation (CTA), European Union, Food and Agriculture Organization of the United Nations (FAO), International Development Research Centre (IDRC), International Fund for Agricultural Development (IFAD), International Association for the Promotion of Cooperation with Scientists from the New Independent States of the former Soviet Union (INTAS), Interamerican Development Bank, Natural Resources Institute (NRI), Centre de Coopération internationale en recherche agronomique pour le développement (CIRAD), Nordic Genebank, Rockefeller Foundation, United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), Taiwan Banana Research Institute (TBRI) and the World Bank.

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APAFRI

The Asia Pacific Association of Forestry Research Institutions (APAFRI) is an association of Institutions with an active interest in forestry research, conservation, management and other forestry related matters in the Asia Pacific. Its objective is to promote collaboration among institutions to enhance and increase the forestry research and conservation capacity in the Asia Pacific.

The establishment of APAFRI was prompted by the need to provide a viable institutional framework for research collaboration in the region. Since 1991, the Forestry Research Support Programme for Asia and the Pacific (FORSPA) has been fulfilling the networking function.

Countries in the region and the donor community wish to develop a more self-reliant, sustainable and participatory institutional mechanism as a logical follow-up of FORSPA. The feasibility of establishment of an Association was discussed in the FORSPA Pre-implementation seminar held at Kuala Lumpur in January 1992. A draft constitution was prepared and circulated and subsequently a drafting committee prepared a revision. This was discussed, modified and adopted during the meeting of Heads of Forestry Research Organizations in the Asia Pacific in Bogor on 21st February 1995, and resulted in the establishment of APAFRI.

The International Union of Forestry Research Organizations (IUFRO) has recognised APAFRI as its Asia Pacific chapter. APAFRI has been collaborating closely with the IUFRO Special Programme for Developing Countries (SPDC) in strengthening research in the Asia Pacific region. Extending from that, APAFRI's Executive Director also acts as the Asia Pacific Regional Coordinator for IUFRO-SPDC.

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The **International Tropical Timber Organization (ITTO)** is the only intergovernmental organization that brings together countries that produce and consume tropical timber to discuss and exchange information and develop policies on all aspects of the world tropical timber economy and the management of the tropical timber resource base –tropical forests. As of November 2008, ITTO had 60 members, including the European Community, which together represent 90% of world trade in tropical timber and 80% of the world's closed tropical forests.

Under the ITTA 2006, ITTO has two closely related overarching objectives:

- To promote the expansion and diversification of international trade in tropical timber from sustainably managed and legally harvested forests
- To promote the sustainable management of tropical timber-producing forests.

The ITTA 2006 sets out the Organization’s longstanding aims of enhancing the capacity of members to export tropical timber from sustainably managed forests and to improve market transparency, forest-based enterprises and sustainable forest management (SFM). It also expands the scope of previous agreements to include objectives related to poverty alleviation, forest law enforcement, non-timber forest products and environmental services, voluntary market mechanisms such as certification, and the role of forest-dependent communities.

ITTO develops internationally agreed policy documents to promote SFM and forest conservation. It assists tropical member countries to adapt such policies to local circumstances and to implement them in the field through projects. In addition, ITTO collects, analyses and disseminates data on the production and trade of tropical timber and funds a range of projects and other actions aimed at developing industries at both community and industrial scales.

By November 2008 the Organization had provided more than US$300 million to finance over 800 projects designed to encourage SFM, increase the efficiency of forest industries, and improve market intelligence and statistics. The vast majority of these projects were made possible through the voluntary financial contributions of consumer member countries. ITTO also supports capacity building through the development of manuals, workshops and a fellowship fund that supports young professionals.

ITTO cooperates closely with other international organizations with forest-related mandates. It is a founding member of the Collaborative Partnership on Forests (CPF), which was established in 2000 to support the work of the United Nations Forum on Forests (UNFF) and to enhance coordination among the international conventions, organizations and institutions with forest-related mandates. ITTO also cooperates with a wide range of regional and national-level organizations and other civil-society and private-sector stakeholders.

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APFORGEN

The Asia Pacific Forest Genetic Resources Programme (**APFORGEN**) was initiated in 2003. APFORGEN is a regional programme with a holistic approach to conservation and management of forest genetic resources. Its aim is to enhance technical and scientific cooperation, training and information exchange among countries in the region. It is managed by the Asia Pacific Association of Forestry Research Institutions (**APAFRI**) with technical support from Bioversity International (**Bioversity**). Target beneficiaries of this programme include forest research institutions, policy-makers, local communities, government forestry departments, NGOs and private forestry companies. Other international and regional organizations such as FAO are also participating in the development of the programme and its activities.

The objective of APFORGEN is to manage tropical forest genetic diversity more equitably, productively and sustainably in the participating countries, specifically the programme aims to:

- Strengthen national programmes on forest genetic diversity
- Enhance regional networking and collaboration
- Facilitate to locate and conserve genetic diversity of selected priority forest species
- Increase sustainable use of genetic diversity in natural and man-made forests

APFORGEN currently has fourteen participating country organizations from Bangladesh (*Bangladesh Forest Research Institute*), India (*Indian Council for Forestry Research and Education*), Nepal (*Department of Forest Research and Survey*), Pakistan (*Pakistan Forest Institute*), Sri Lanka (*Forest Department*), Cambodia (*Department of Forestry and Wildlife*), China (*Research Institute of Forestry, Chinese Academy of Forestry*), Indonesia (Centre for Plantation Research and Development, Bogor), Lao PDR (*Forest Research Centre*), Malaysia (*Forest Research Institute Malaysia*), Myanmar (*Forest Research Institute, Yezin*), Philippines (*College of Forestry and Natural Resources, University of Philippines Los Banos*), Thailand (*Royal Forest Department/National Park, Wildlife and Plant Conservation Department*) and Viet Nam (*Forest Science Institute of Viet Nam*).

The programme has held five meetings (2003 to 2007) in which the National Coordinators of each of the participating organizations attended. A draft action plan for the programme was drawn up for implementation. Currently, some activities of APFORGEN are partially supported by APAFRI and Bioversity. The bulk of the funding comes from the ITTO Project PD 199/03 Rev. 3(F) which has a duration of three years (2006–2009). The project has been extended for another year till February 2010.

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Preface

The ITTO funded project on forest genetic resources, PD/199/03 Rev. 3(F): Strengthening National Capacity and Regional Collaboration for Sustainable Use of Forest Genetic Resources in Tropical Asia in February 2006 for a duration of three years. The project has a number of activities that required inputs from the seven participating countries: Cambodia, India, Indonesia, Malaysia, Myanmar, the Philippines and Thailand. To facilitate collaboration and better participation, as well as soliciting inputs, each participating country has been invited to nominate a person as a National Focal Point (NFP). These NFPs were nominated by the forestry administrations of these countries, so that he or she has the necessary mandate to organize activities and solicit inputs contributing to the project. The frequent structural changes and personnel movements had resulted in many changes of NFPs within the short period of the project duration and disrupting the smooth running of the project to achieve its stated objectives. The NFPs, and their affiliated agencies, of the seven countries are as follows:

Organizations Participating in the Project	**National Focal Point**	
	Originally appointed	*Current*
Forestry and Wildlife Science Research Institute, Forestry Administration, CAMBODIA	Mr. Sok Srun	Mr. Chann Sophal
Indian Council of Forestry Research & Education, INDIA	Dr. Mudit Kumar Singh	Dr. G.S. Rawat (Dr. M. Surya Prakash)
Centre for Plantation Forest Research and Development (CPF), Forestry Research and Development Agency, Ministry of Forestry, INDONESIA	Dr. Nur Masripatin	Dr. Harry Santoso
Forest Research Institute Malaysia (FRIM), MALAYSIA	Dr. Lee Soon Leong	Dr. Lee Soon Leong
Forest Research Institute, Yezin, MYANMAR	Mr. Thuang Naing Oo	Mr. Aung Zaw Moe (Mr. Lwin Ko Oo)
Institute of Renewable Natural Resources, College of Forestry and Natural Resources, University of the Philippines Los Banos, PHILIPPINES	Dr. Enrique L. Tolentino Jr.	Dr. Enrique L. Tolentino Jr.
National Park, Wildlife and Plant Conservation Department, THAILAND	Mr. Vichien Sumantakul	Dr. Suwan Tangmitcharoen

Note: Those names within parentheses were former NFPs before the current ones.

From the original proposal of the project, the following inputs are required from the National Focal Points (NFPs):

1. Assessment of capacity building needs
2. Reviewing of progress in FGR conservation
3. Developing/revising national FGR strategies
4. Assist to establish national FGR programme
5. Assessment of national R&D needs for improved FGR conservation

6. Information on FGR conservation & use (including *in situ* and *ex situ* conservation of priority species)

These inputs from NFPs could be prepared by either:

- Informal communications/discussions/meetings led by the National Focal Point with a number of key stakeholders
- Consensus from a formally established national taskforce/committee/workgroup
- Summarizing from the proceedings of a national workshop/meeting involving all stakeholders

There is no preferred means, as countries differ in many aspects. The involvement of stakeholders in preparing the inputs, however, must be noticeable and evident throughout the process; and appropriately indicated and documented.

The project provided partial support for these activities. Each of the National Focal Points was requested to prepare a workplan for those inputs mentioned above. Together with the budget and a schedule to achieve those inputs, the workplan would then be forwarded to the Technical Working Group (TWG), which is responsible to implement the project, for approval. The Project Coordinator, and members of the TWG, could provide appropriate technical assistance to the NFP for meeting the deadlines.

All the National Focal Points of the participating countries had chosen to organize one-day consultative workshops which had the participation of the relevant stakeholders. These workshops were organized to achieve the following objectives

1. Update and validate the previous recommendations and plans in the FGR national workshop.
2. Identify problems and other constraints in operationalising a national FGR programme.
3. Recommend solutions or courses of actions to address FGR issues and concerns.
4. Solicit inputs in crafting a viable research and development national agenda for FGR conservation and management.
5. Determine capacity-building activities for a vibrant national FGR programme.
6. Generate support and commitment from institutions and other stakeholders to implement programmes for FGR conservation and development in their regions.

Upon the completion of the national workshop, a country report was compiled with the following expected outputs:

1. A review of the national *in-situ* and *ex-situ* FGR conservation and development programmes, including the priority tree species.
2. Identification of capacity-building needs of the stakeholders in support of the national FGR programmes.
3. Establishment of a National Coordinating Committee to support the FGR programmes.
4. Identifying the R & D needs necessary to support the FGR conservation and development programmes.
5. Proposal for national FGR strategies and programmes
6. Commitments and support from institutions and individuals to be part of regional and National Coordinating Committee for FGR.

7. Updated information on FGR conservation and use (including *in situ* and *ex situ* FGR conservation programmes)

The seven participating countries, Cambodia, India, Indonesia, Malaysia, Myanmar, the Philippines and Thailand, organized their one-day national consultative workshops during 2007 and 2008. The NFPs who organized the workshop and the date of each national consultative workshop are as listed below:

Country	National Focal Point	Date of Workshop	Venue
Philippines	Dr Enrique Tolentino	6 February 2007	Manila
Indonesia	Dr Harry Santoso	1 March 2007	Bogor
India	Dr. M. Surya Prakash	11 July 2007	Coimbatore
Cambodia	Mr. Chann Sophal	12 February 2008	Phnom Penh
Thailand	Dr. Suwan Tangmitcharoen	12 March 2008	Bangkok
Myanmar	Mr Lwin Ko Oo	26 February 2008	Yezin
Malaysia	Dr. Lee Soon Leong	30 July 2008	Kuala Lumpur

These workshops followed the format: half-day of presentations on key relevant issues, and half-day with break-away discussion groups formulating recommendations on specific issues.

The reports of these national consultative workshops submitted by the NFPs have been compiled into a single volume, both to serve as a record for this project and more importantly as a collective source of updates on the activities of the participating countries during the project duration (February 2006 – January 2009). These reports are certainly valuable references on issues related to forest genetic resources conservation and management for the forest administrators and policy makers in these countries. Three of these reports, that of India, Indonesia and the Philippines, had been published in an earlier volume, but are included here again to complete this compilation.

The compiling of these reports requires contributions from many individuals. Besides the NFPs of the seven participating countries, colleagues from the implementing agency of the ITTO Project, the Forest Research Institute Malaysia (FRIM), the collaborating agencies the Asia Pacific Association of Forestry Research Institutions (APAFRI) and Bioversity International had contributed substantially towards the publishing of this volume.

The Editors
August 2009

Acknowledgements

We gratefully acknowledge the contributions of the National Focal Points of the seven countries participating in the ITTO Project PD 199/03Rev. 3(F): Strengthening National Capacity and Regional Collaboration for Sustainable Use of Forest Genetic Resources in Tropical Asia. They are Chann Sophal (Cambodia), M.Surya Prakash/GS Rawat (India), Harry Santoso (Indonesia), Lee SoonLeong (Malaysia), Lwin Ko Oo (Myanmar), Enrique L. Tolentino Jr. (Philippines) and Suwan Tangmitcharoen (Thailand).

Colleagues in FRIM, APAFRI and Bioversity International who contributed in various ways to the compilation and publishing of this volume are also gratefully acknowledged.

We are indebted to the International Tropical Timber Organization (ITTO), Yokohama, Japan, for support via the ITTO Project PD199/03 Rev.3 (F).

Cambodia National Consultative Workshop on Forest Genetic Resources Conservation and Management

Chann Sophal
Forestry and Wildlife Science Research Institute

Introduction

One of the activities of the project "Strengthening National Capacity and Regional Collaboration for Sustainable Use of Forest Genetic Resources in Tropical Asia" is for National Focal Points of the seven participating countries to carry out national level activities and to organize national workshops on the conservation and management of forest genetic resources (FGR).

APAFRI assisted Cambodia, one of the seven participating countries in the ITTO project, to organize this workshop on 12 February 2008 with the major objectives to review and develop a strategy for the conservation and management of forest genetic resources. It was attended by 32 participants from central and regional forestry administration offices. The programme of the workshop is in Appendix 1.

Opening of the Workshop

During the inauguration of the workshop, Mr. Chann Sophal, National Coordinator for APFORGEN and National Focal Point for the ITTO-funded Project gave the welcome address on behalf of H. E. Ty Sokhun, Director General of Forestry Administration. Dr Daniel Baskaran Krishnapillay, Executive Secretary of APAFRI, and representative of FRIM gave the introduction and overview of the ITTO project and APFORGEN activities.

Presentations

A total of four presentations were presented at the workshop.

1. **Forest Gene Conservation by Mr. Uorn Sam Ol, Deputy Chief of Reforestation Office;**

   The presentation by Mr. Uorn Sam Ol on forest gene conservation strategies in Cambodia highlighted two methods, i.e. *in situ* conservation (within natural forest) and *ex situ* conservation (planting outside natural habitat).

   In situ conservation as formed by
   1. best conservation strategy within natural habitat,
   2. cost-efficient,
   3. participatory approach and community option,
   4. thirty-six seed sources/ conservation stands identified.

   Ex situ conservation, in turn, can be described as
   1. better protected,
   2. expensive but secure,
   3. better options for seed improvement,
   4. ten stands of *ex situ* conservation were established in Khbal Chhay and additional locations are under consideration. The presentation concluded that

further work would be required to develop, review and improve the Cambodian Plant Conservation Strategy and Action Plan in the context of gene conservation and promoting its implementation.

2. **Cambodia's Forest and Wildlife Conservation Status by Mr. Chheang Dany, Deputy Chief of Wildlife Protection Office;**

   Mr. Chheang Dany highlighted the abundance of forest and wildlife in Cambodia as well as the biodiversity richness. Among the total land area of 181,035 Km^2, the total forest area occupies 11,104,293 ha or about 61.15%. The figures on different forest functions, i.e. protection forest (7%), concession forest (19%), protected forest (18%), other forest (17%), and non-forest area (39%) were highlighted. The Cambodian forests are variously dominated by Dipterocarpaceae, Leguminosae, Lythraceae, or Fagaceae, and in some places Pinaceae, Podocarpaceae, or bamboo. The flora of lower altitudes is typical of the Indochinese floristic province (and so contrasts with that of the Chinese, Indo-Burman and Indo-Malayan provinces), whilst the higher altitudes share affinity with those of the Indo-Malayan region (Dy Phon 1982). It is indicated that Cambodia possesses 2,308 of the 8,000 species described in the Flore Generale de l'Indochine. These 2,308 species belong to 852 genera in 164 families. Based on Dy Phon (1982), species of fauna documented in Cambodia include mammals 125 species, birds 630, reptiles 73, amphibians 40, butterflies and moths 300, and fishes 850. In the status of *in situ* conservation, Mr. Chheang Dany showed that there are 6 Protected Forests (include 1 Sarus Crane Reserve and 1 Biodiversity Conservation Area) , 7 National Parks, 10 Wildlife Sanctuaries, 1 RAMSAR Site, 3 Multiple Use Areas, 3 Protected Landscapes, 1 Biosphere Reserves, and 20 Forest Seed Sources Sites. In the status of *ex situ* conservation, he showed that there are 1 Wildlife Rescue Centre, 5 Private Zoo and 5 Animal Breeding Farms and 50 Tree Nurseries. The presentation concluded by showing some key wildlife species recorded in the surveyed areas from 1998-2004.

3. ***Ex situ* Conservation of Indigenous Species in Khbal Chhay Area by Mr. Moy Ratha, Senior Officer of the Cambodian Tree Seed Project;**

   In his presentation, he showed the viability of forest trees in a changing climate and their habitats. The *ex situ* conservation is conservation of genetic resources of any species outside its origin. He also mentioned that 21 species have been planted in triels in an *ex situ* conservation area, i.e. *Afzelia xylocarpa*, *Aquilaria crassna*, *Archidendron quocense*, *Azadirachta indica*, *Casia fistula*, *Casia siamea*, *Dalbegia bariensis*, *Dalbegia cochinchinensis*, *Dipterocarpus alatus*, *Dipterocarpus retusus*, *Hopea recopel*, *Hopea odrata*, *Irvingia malayana*, *Khaya senegalensis*, *Leucaena leucocephala*, *Peltophorum dasyrrhachis*, *Pterocarpus macrocarpus*, *Shorea guiso*, *Sterculia lychnophora*, *Syzygium cumini*, *Terrietia javanica*. After 3 years of planting he observed that some species would be suitable selection for the tree planting programme. Mr. Moy Ratha concluded that taking into consideration of growth performance and survival rates on the 21 species trial in Khbal Chhay, *Dalbergia cochinchinensis*, *Hopea odorata*, *Khaya senegalensis*, and *Peltophorum dasyrrhachis* would be the most appropriate species identified for the tree planting programme. All of these species are fast growing and have a high survival rate. If seedlings are not available species such as *Aquilaria crassna*, *Casia siamea*, *Hopea recopi*, *Pterocarpus macrocarpus*, and *Terrietia javanica* would make a good second choice.

4. **Participatory Approach of Forest Gene Conservation by Mr. Uorn Sam Ol, Deputy Chief of Reforestation Office;**

   Mr. Uorn Sam Ol began his presentation by expressing the importance of participation and participatory approach in forest gene conservation. Mr. Uorn Sam Ol informed that one example of unsuccessful conservation was due to the non-participation of people in Cambodia and the best solution in forest gene conservation would be the participatory approach. He concluded by saying that further work would be required to develop, review and improve the Cambodian Plant Conservation Strategy and Action Plan in the context of participatory approach of forest gene conservation and promoting its implementation.

Group Discussions

In the afternoon, the participants were divided into two groups of 16 each with focus on:-

1. Research and development needs for forest genetic resources conservation and management;
2. Capacity building for forest genetic resources conservation and management.

Output Summary

The first group on research and development needs for forest genetic resources conservation and management focused on two topics: (i) what is needed? and (ii) how to do?

What is needed?

The group proposed the followings:

- General knowledge
- More workshops and seminars to be organized
- Documentation work in Cambodian language
- Study tours as a means of knowledge sharing
- Status of forest resources evaluated
- Linkages between policy, science and technology
- Compilation and documentation on forest genetic resources conservation
- Extension by TV, radio, e-mail, websites
- Support from stakeholders and local administrative governors
- Technical and financial supports
- Documentation
- Extension services

How to do?

The group proposed the followings:

- Government's commitment
- Identification of stakeholders and users
- Enhance the existing human resources through capacity building
- Compilation of data base
- Strengthening of partnership with public and private sectors
- National and international support such as technology, budget and equipments
- Participation from national and regional institutions on FGR
- Information sharing and networks cooperation.

The second group on capacity-building needs for forest genetic resources conservation and management focused on the two topics of (i) capacity building needs to enhance forest genetic resources and (ii) training needs on forest genetic resources conservation and management.

Capacity building needs to enhance forest genetic resources conservation and management

The group proposed the followings:

a) Education and training

- Conduct training for regional foresters with skilled practices
- Conduct training for local administrative governors and local communities
- Conduct training for the private sector
- Provide funds, transportation, and required equipment and materials

b) Public awareness

- Participation from forestry institutions
- Participation from concerned institutions
- Participation from the public
- Support from the Royal Government of Cambodia (RGC) and non-governmental organizations (NGOs)

c) Extension programme

- Include the teaching of forest conservation and management into the primary school curriculum
- Workshops, seminars, extension at the level of local communities
- Radio, TV, e-mail, websites
- National and international study tours

Training needs on forest genetic resources conservation and management

The group proposed the followings:

Strategy on forest resources conservation and management

- Seed selection and seed source preparation
- Seed storage
- Seed procurement
- Forestry statistics

***In situ* conservation**

- Methodology on mother tree selection
- Natural stand management
- Avoiding farm land encroachment
- Methodology on solving the dispute in forest resources management

***Ex situ* conservation**

- Methodology for the preparation of experimental plots
- Methodology for tree planting
- Methodology for data collection
- Methodology for data analyzing and data assessment.

The participants were enthusiastic about being part of the national/regional task force on FGR. A short plenary session ensued after the workshop to discuss issues arising from the previous reports. The participants also agreed to form an internet-group communication that will sustain and enhance the information exchange between forestry practitioners, scientists, researchers and policy makers.

Closing of the Workshop

Mr. Chann Sophal, National Coordinator for APFORGEN and National Focal Point for the ITTO-funded Project on Forest Genetic Resources Conservation and Management gave the closing address on behalf of H. E. Ty Sokhun, Director General of Forestry Administration. This was followed by the closing remarks by Dr Sim Heok-Choh, Executive Director of APAFRI. Dr Sim Heok-Choh congratulated the national focal point, Mr. Chann Sophal and his team, for organizing a very successful workshop. He also thanked all participants sincerely for sharing their experiences during the workshop, and further expressed the desire of looking forward to closer collaboration and enhanced contributions to the project.

Participants of the National Consultative Workshop on Forest Genetic Resources Conservation and Management, 12 February 2008.

Appendix 1

Cambodia National FGR Consultation Workshop

12 February 2008
Phnom Penh

PROGRAMME

08:00–08:30	Registration
Opening	
08:30–09:30	Welcome Address Opening Remarks Impression Remarks Self Introduction of Participants Group Photos
09:30–10:00	Forest Genetic Resources Conservation Strategy
10:00–10:30	Cambodia's Forest and Wildlife Conservation Status
10:30–11:00	*Coffee/Tea Break*
11:00–11:30	*Ex situ* Conservation of Indigenous Species in Khbal Chhay Area
11:30–12:00	Participatory Approach of Forest Gene Conservation
12:00–14:00	*Lunch*
14:00–15:30	Group Discussion
15:30–16:00	*Coffee/Tea Break*
16:00–17:00	Presentation the Outcomes of Group Discussion
17:00–17:30	Summary/Conclusion Remarks and Closing of the Workshop

India National Consultative Workshop to Identify Stakeholders and Capacity Building Needs in Forest Genetic Resources Conservation and Management

M. Surya Prakash
Institute of Forest Genetics and Tree Breeding
Coimbatore

Background

Genetic resources are renewable, provided they are well managed. Valuable genetic material is being lost from nature because of unsustainable harvest and various other anthropogenic activities. In order to protect these resources efforts have been made to conserve them *in situ* and *ex situ.* Protected areas, like Biosphere reserves, National parks and sanctuaries, gene pool gardens, provenance resource stands, seed stands, clone banks are some of the efforts made in our country in this direction. Lack of adequate information on available forest resources is the major constraint encountered in their sustainable utilization. At this juncture, sharing of information among all stakeholders on various aspects of such resources will go a long way in prioritizing them for further intensive studies and sustainable utilization.

In order to bring all stakeholders in one platform to discuss various issues a 'National workshop to Identify Stakeholders and Capacity Building Needs in Forest Genetic Resource Conservation' was organized at the Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore on 11 July 2007. The workshop was supported by Asia Pacific Forest Genetic Resources Conservation Programme (APFORGEN) via the ITTO-funded project on *Strengthening National Capacity and Regional Collaboration for Sustainable Use of Forest Genetic Resources in Tropical Asia, PD 199/03 Rev.3(F)*. The workshop with a day-long programme (Appendix 1) was attended by 60 participants from various agencies and universities (Appendix 2).

Objectives

The objectives of the workshop were to (i) assess the status of Forest Genetic Resources (FGR) activities, (ii) identify research gaps and (iii) find out the capacity building needs for the conservation of FGRs in India.

Highlights

During the inauguration of the workshop, Dr. M. Surya Prakash, Director of the Institute and Country Coordinator for Asia Pacific Forest Genetic Resource Conservation (APFORGEN) programme welcomed the delegates and highlighted the theme and aim of the workshop.

Mr. Hong L. T., Forest Genetic Resources Specialist, Bioversity International, Malaysia gave the rationale of the workshop. He gave an over all picture of the APFORGEN Programme and the role of Asia Pacific Association of Forest Research Institutions (APAFRI), Malaysia. He stated that seven countries have been involved in the project '*Strengthening national capacity and regional collaboration for sustainable use of Forest Genetic resources in Tropical Asia*' funded by International Timber Trade Organization (ITTO), Japan.

This project was being executed by FRIM in collaboration with APAFRI and Bioversity International. National focal points have been identified for the seven ITTO member country organizations participating in it. He also provided a briefing on FGR operational programmes including conservation and sustainable use of priority forestry species.

Dr. Lee Soon Leong, Senior Scientist, Forest Research Institute (FRIM), Malaysia and Shri P. N. Unnikrishnan, Chief Conservator of Forests, Kerala felicitated the workshop. Shri Unnikrishnan highlighted the tribal bill and deliberated on the rights of tribals, role of the forest department in conservation of genetic resources in the changed scenario.

Dr. M. Sanjappa, Director, Botanical Survey of India, Kolkatta, gave the presidential address. In his address, he highlighted the rich diversity of India, stating that India is one of the twelve mega biodiversity centres with three hotspots abound in biodiversity. He emphasized the need for development of databases on FGRs, institutional co-operation, research needs and strategies in sustainable utilization and conservation of genetic resources especially the indigenous species.

Technical Session I: Review of National scenario of Forest Genetic Resources Activities in India

The Session was chaired by Dr. Rohini Kumar Singh, Director, Institute of Bio-resources and Sustainable Development, Imphal, India and co-chaired by Shri. D. K. Pandey, Chief Conservator of Forests (R & D), Andhra Pradesh Forest Department., Hyderabad, with two rapporteurs, Shri Maria Dominic Savio and Ms D. Thangamanu of IFGTB, Coimbatore, India.

Dr. M. Surya Prakash, the country coordinator of APFORGEN for India presented a detailed review on the "Status and management of Forest Genetic Resources in India". He informed the gathering about the importance of FGR conservation and how the FGRs were protected in India. The review highlighted the following six broad aspects:

- Geography of the country, the biogeographical regions, agro-climatic zones, forest types and biodiversity wealth of the country;
- Policy frame work, Legislations and International commitments to protect the country's biodiversity, salient features of Indian Forest Act 1927; Forest (Conservation) Act 1980, Environment Protection Act 1986; National Forest Policy 1988, National Forestry Action Programme, National Biodiversity Strategy and Action plan (NBSAP);.
- Conservation programmes – declaration of vast areas as National Parks, Wildlife Sanctuaries, MABs. Area and theme oriented programmes launched in the country for conservation of project Tiger, Project elephant, Conservation of mangroves and medicinal plants apart from network programmes on botanical gardens;
- Administrative machinery installed in the country to convert the policy into legislation, programmes and mechanisms to implement programmes in the field;
- Organizations and Institutions established to provide support for policy, programmes and to conduct research, impart education and training to various agencies involved in conservation of forest genetic resources; and
- Tree improvement, under which he discussed about the various Tree Improvement programmes carried out in India since 1961.

The review initiated discussion on various aspects like microbial diversity, role of Biodiversity board, Indian Botanic Garden network etc. The house recommended strengthening the conservation of FGR with special emphasis to encompass other biological diversities viz. insects, fishes and agriculture, etc.

Technical Session II: Identification of Stakeholders and their Role

The session was chaired by Shri P.N. Unnikrishnan, Chief Conservator of Forests, Kerala Forest Department, Thiruvananthapuram, Kerala, India and co-chaired by Dr. C.J.S.K. Emmanuel, Scientist, Arid Forest Research Institute, Jodhpur, India with two rapporteurs, Dr. Maheshwar T. Hegde and Dr. A. Shanthi from IFGTB, Coimbatore, India.

Discussions were held on identification of stakeholders and their role in FGR conservation. Dr. Sanjappa, Director, BSI, opined that State Forest departments were main stakeholders in conservation of Forest Genetic Resources and the State Forest Departments should prioritize species in their respective states. He mentioned the importance of the Red sanders and their conservation. During this session clarifications were sought from the state forest department officials whether any list of RET and economically important species were available in all the states, whether any studies on carrying capacity of highly extracted species were available, whether cultivation methods were available on all such species. Some representatives informed the house that the list of NTFPs collected from the forest were available with some of the state forest departments. No studies on carrying capacity with regards to highly exploited species were available. After long deliberations various stakeholders were identified as detailed hereunder:

1. Forest department
2. Communities within forest
3. Forest dependent communities
4. Industries
5. Research institutes / Educational Institutions
6. Farmers

Certain important research needs have been identified and it was recommended that each of the stakeholders should carry out research work as detailed below:

- Endemic and RET plant species for each state be identified and conservation plots in multiple sites be established. (Role: State Forest Departments.);
- Germplasm collections encompassing the natural distribution of the species be undertaken for all economically important species and mass propagation technologies be developed (Role: State Forest Departments and Research Institutes);
- DNA fingerprinting (Bar coding) of germplasm of important species / varieties to be taken up for identifying genotypes (Role: Research institutes);
- Assessment of carrying capacity and harvestable produce for each locality on sustainable basis be studied. They should advise the governments and departments to declare the minimum procurement price for each non wood forest produce (Role: Research institutes and State Forest Departments);
- Forest departments should undertake planting of medicinally important tree species as captive plantations. Establish seed centres for planting material and develop protocols for propagation and cultivation of important species.(Role: Research Institutes State Forest Departments);
- Package of practices for cultivation of important tree species should be made available to the farmers to make cultivation economically viable (Role: Research institutes, Pharmaceutical industries and State Forest Departments);
- Development of sustainable harvesting methods for FGRs (Role: Research institutes, State Forest Departments and farmers);
- Strengthening capacities of State Forest Departments for protection of three biodiversity hotspots of the country.

Technical Session III: Capacity Building Needs

The session was chaired by Dr. S. Ganeshan, Director, Tropical Botanical Gardens Research Institute, Thiruvananthapuram, India and co-chaired by Dr. D. Narasimhan, Reader, Madras Christian College, Chennai, India with two rapporteurs, Dr. A. Vijayaraghavan and Dr. V.K.W. Bachpai from IFGTB, Coimbatore, India.

There were discussions on whether the training, if any, given to the stakeholders, in view of the large area and huge population of more than one billion, could reach all the communities of the country. It was pointed out the need to develop models of training that could be replicated in other places. The Chairperson, Dr. S. Ganeshan, Director, TBGRI, pointed out the importance of selection of sites for developing training models and taking professional help in selection. In general the forum felt Forest Genetic Resources should not be confused with general Biodiversity and FGR is a much more focused topic. The co-chair person highlighted three areas for training namely (i) Basic Forest Genetic Resources documentation, (ii) Conservation studies and (iii) Documentation of traditional knowledge. In this connection Mr. Hong L. T. from Bioversity International told the forum about the model developed for documentation of traditional knowledge. This exercise was very important to safe guard the IPR rights of the communities. The forum collectively identified the following major disciplines for imparting training.

1. Documentation of FGR
2. Documentation of associated traditional knowledge
3. Conservation Biology
4. Sustainable harvest of FGR
5. Best Cultivation practices
6. Database Management
7. Sensitization programmes for all stake holders regarding FGR conservation

The forum also identified the following Generic Institutes:

1. All Institutes of ICFRE, ICAR and CSIR
2. SFDs (State Forest Departments)
3. Universities
4. Botanical Survey of India and its circles
5. National and State Research Institutes such as TBGRI, KFRI, etc.

The list of organizations was only indicative and not exhaustive

Plenary Session

The session was chaired by Dr. M. Sanjappa, Director, Botanical Survey of India, Kolkatta, India and co-chaired by Mr. Hong L. T., FGR specialist and APFORGEN facilitator, Bioversity International, Malaysia with two rapporteurs, Dr. K. R. Sasidharan and Dr. R. Anandalakshmi from IFGTB, Coimbatore, India.

The Chairperson presented the recommendations of the technical sessions of the workshop and requested the house to scrutinize it one by one.

Discussion on Recommendations of Technical Session I

The chairperson informed that the documentation of microbial diversity has already been taken out of Forest Genetic Resource (FGR). With reference to the recommendation on "strengthening the FGR to encompass other diversities viz. insects, agriculture etc.", Dr. M. Surya Prakash opined that when the ecosystem was conserved all the constituent species including insects would be conserved. The Chairperson clarified that when species specific conservation was practised, even insects have to be taken into consideration. Dr. M.

Ruhinikumar Singh said that FGR included not only animals and plants, but also many aquatic organisms. The Co-chairman clarified that FGR encompassed plants and animals, including insects. Shri P.N. Unnikrishnan underlined the need for prioritizing conservation programmes.

Discussion on Recommendations of Technical Session II

Dr. C. Narayanan and Dr. A. N. Arunkumar suggested the inclusion of NGOs as stakeholders. But, Shri P.N. Unnikrishnan clarified that NGOs could not be considered as stakeholders.

Recommendation No.1: It was unanimously decided to take out the word "important" and replaced with "all endemic species". Dr. G. V. S. Murthy asked whether animals could be included, for which Dr. M. Surya Prakash said that animals should not be included.

Recommendation No.2: The Chairman opined that all species commercially exploited to be considered as "economically important" species. Shri M. S. Gauder informed that the FRLHT has listed the economically important medicinal plant species. Shri P.N. Unnikrishnan said that the States would be in a position to identify economically important species occurring in their jurisdiction. Dr. C. Narayanan brought to the notice that the first and second recommendations contained certain overlapping points. Dr. M. Surya Prakash pointed out that any economically important species may become rare sooner. Dr. Ruhinikumar Singh said that it need not be true in all the cases. It was decided to delete "establishment of *ex- situ* plots" from the recommendation.

Recommendation No.3: Dr. Ruhinikumar Singh suggested the study of intra-specific variations. The Chairman proposed to change the wording to "important species/ varieties".

Recommendation No.4: Shri H. Nagesh Prabhu suggested that, to encourage cultivation of medicinally important species, the supply of raw materials from forest areas should be regulated. Dr. R. C. Pandalai informed that the medicinal plants were mostly collected without authorization. Dr. M. Surya Prakash enquired whether any studies on carrying capacity of medicinal plants were undertaken so far. Shri Gauder suggested adding "assessment of carrying capacity of harvestable produce". Shri Vaigai Manisankar informed that all fair price details of medicinal plants would be available.

Recommendation No.5: Shri M. S. Gauder suggested modifying it by adding "establish seed centres for planting materials and develop protocols for important species". The Chairperson observed that in almost all recommendations of the session, only medicinal plants were mentioned. Dr. Murthy opined that it could be modified to "economically important/ medicinal plants". Shri A.V Santhosh kumar cited an example, "Canes were economically important, but not medicinal" and hence suggested to include the word "economically important".

Recommendation No.6: As per the request of many members "suitable harvesting methods" was added to the recommendation. Shri Nagesh Prabhu pointed out that we have three hot spots of biodiversity and the condition of these hot spots was deteriorating. He urged the house to pass recommendation for strengthening the conservation measures in the hot spots. Dr. D. Narasimhan said that protection of hot spots was an entirely different concept. Shri Nagesh Prabhu asked that without protecting the hot spots, how we could achieve the conservation of FGRs. Shri K. Ravichandran suggested starting an ENVIS centre for FGR. This suggestion was accepted by the house.

Discussion on Recommendations of Technical Session III

The Chairperson after going through the recommendations opined that during the session-III, the training needs were already identified. Dr. Ruhinikumar Singh wanted to know whether 'bioinformatics' was important in the recommendations, as it was directly related to genes. Hence he suggested modifying it to "biodiversity data management". Dr. Narasimhan also endorsed the suggestion made by Dr. Ruhinikumar Singh.

Mr. Hong L. T. thanked all the participants and also congratulated Dr. M. Surya Prakash and his team. He informed that for any activity/ project, getting funding would not be easy. He expressed that it was a fruitful workshop and all its objectives have been met.

Dr. M. Surya Prakash, the APFORGEN National Coordinator, thanked the Chairpersons and the Co-Chairpersons for efficiently conducting the Plenary Session. Dr. C. Kunhikannan, proposed the vote of thanks and the workshop came to an end.

Outcomes of the Workshop

Identification of Stakeholders and Their Role

The following stakeholders were identified by the workshop:

1. Forest department
2. Communities within forest
3. Forest dependent communities
4. Industries
5. Research institutes / Educational Institutions
6. Farmers

The roles identified for the stake holders are as follows:

- Endemic and RET plant species for each state should be identified and conservation plots in multiple sites should be established. (Role: State Forest Departments) – **(Recommendation 1)**
- Germplasm collections encompassing the natural distribution of the species should be undertaken for all economically important species and mass propagation technologies should be developed. (Role: State Forest Departments and Research Institutes) – **(Recommendation 2)**
- DNA fingerprinting (Bar coding) of germplasm of important species / varieties to be taken up for identifying genotypes. (Role: Research institutes) **– (Recommendation 3)**
- Assess the carrying capacity and harvestable produce for each locality on sustainable basis and decide the minimum procurement price for each non wood forest produce. (Role: Research institutes and State Forest Departments) **– (Recommendation 4)**
- Forest departments should undertake planting of medicinally important tree species in captive plantations. Establish seed centres for planting materials and develop protocols for propagation and cultivation of important species. (Role: Research institutes State Forest Departments) **– (Recommendation 5)**
- Package of practices for cultivation of important tree species should be made available to the farmers to make cultivation economically viable. (Role: Research institutes, Pharmaceutical industries and State Forest Departments) **– (Recommendation 6)**

- Development of sustainable harvesting methods for FGR. (Role: Research institutes, State Forest Departments and farmers) **– (Recommendation 6)**
- Strengthening capacities of SFDs for protection of three biodiversity hotspots of the country. (Role: MoEF and State Forest Departments) **– (Recommendation 6)**
- Creation of ENVIS centre for FGR for compilation and dissemination of information. (Role: MoEF, ICFRE) **– (Recommendation 6)**

Capacity Building Needs for FGR Conservation

The following areas were identified for capacity building:

1. Documentation of FGR
2. Documentation of associated traditional knowledge
3. Conservation Biology
4. Sustainable harvesting of FGR
5. Best Cultivation practices
6. Database Management
7. Sensitization programme for all stakeholders regarding FGR conservation

Organizations for the Support of Capacity Building Needs in FGR Conservation

1. All Institutes of ICFRE, ICAR and CSIR
2. State Forest Departments
3. Universities
4. Botanical Survey of India and its circles
5. National and State Research Institutes such as TBGRI, KFRI, etc.

General

The Workshop also recommended strengthening the conservation of Forest Genetic Resources with special emphasis to encompass diversity of insects, fishes and wild relatives of agriculture and horticulture crops.

Appendix 1

National Workshop to Identify Stakeholders and Capacity Building Needs in FGR conservation

Institute of Forest Genetics and Tree Breeding, Coimbatore, India
12 July 2007

PROGRAMME

Inaugural Session

09:00 – 09:10	Registration
09:10 – 09:12	Prayer
09:12 – 09:20	Welcome address – Dr. M. Surya Prakash, Director, IFGTB, Coimbatore
09:20 – 09:30	Rationale of the workshop – Mr. Hong L.T., Bioversity International
09:30 – 09:35	Felicitations address – Dr. Lee Soon Leong, FRIM, Malaysia
09:35 – 09:40	Felicitations address – Shri. P.N. Unnikrishnan Chief Conservator of Forests, Kerala Forest Department
09:40 – 10:10	Presidential address – Dr. M. Sanjappa, Director, Botanical Survey of India
10:10 – 10:20	Vote of thanks – Shri. T. Gunasekaran, Group Co-ordinator, IFGTB, Coimbatore
10:20 – 11:00	Tea and refreshments

First Technical Session

11:00 – 13:00	Review of national scenario of forest genetic resource activities in India – Dr. M. Surya Prakash, Director, IFGTB, Coimbatore
13:00 – 14:00	***Lunch***

Second Technical Session

14:00 – 15:30	Identification of stakeholders and their Role Chair: Prof. Rohinikumar Singh Director, Inst. Bioresources & Sustainable Development Takyelpat, Imphal, Manipur

Third Technical Session

15:31 – 17:00	Identification of training needs and training institutions. Chair: Shri. P. N. Unnikrishnan Chief Conservator of Forests, Kerala Forest Department

Plenary Session

17:00 – 18:00	Drafting of recommendations Chair: Dr. M. Sanjappa, Director, Botanical Survery of India Co-Chair: Mr. Hong L. T., Bioversity International

Appendix 2

List of Participants

Representatives from Collaborating Organizations of ITTO funded Project & APFORGEN

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Indonesia National Consultative Workshop to Identify Stakeholders and Capacity Building Needs on Forest Genetic Resources Conservation and Management

Harry Santoso
Centre of Plantation Forests Research and Development, Bogor

Background

Indonesia is one of the few countries with rich biological diversity and faces the problem of forest degradation, which could lead to the lost of biodiversity. Various efforts have been taken to halt further damage to FGR and forest resources in general. Relevant regulations have been put into effect and a national task force dealing with all genetic resources including FGR was in the final stage of establishment. Many activities relevant to FGR conservation and management have been executed by various institutions and organizations with different objectives and focuses.

Centre for Plantation Forest Research and Development (CPFRD) in its capacity as the National Coordinator for APFORGEN have carried out activities under the TOR of the NCs as stated in the joint letter of assignment from IPGRI (now Bioversity)-APAFRI. A National APFORGEN Secretariat has been established at the CPFRD in 2004 with annual activities in line with national forestry policies as well as the APFORGEN Action Plan 2005-2007. The Secretariat issues publications such as a bi-monthly Newsletter on national level APFORGEN activities, leaflets, flyers, as well as workshop proceedings.

A National workshop on FGR conservation and management has been organized by CPFRD annually since 2004. The first workshop (2004) was intended to identify stakeholders, sharing information on the status of research and development on FGR, as well as gathering relevant inputs for FGR conservation and management. The outputs of the workshop were brought to the SEA National Coordinators meeting in Kuala Lumpur in 2004 as inputs from Indonesia for the draft of APFORGEN Action Plan 2005–2007.

The second national workshop was conducted in 2005 that focused on reviewing the policy on FGR and introduction of a concept on village level FGR conservation and management (Indonesian*: Konservasi Sumberdaya Genetik Tanaman Hutan Tingkat Desa [KSDGTH-TD]),* and identified stakeholders to carry out the relevant tasks. The concept was introduced with the consideration that the huge challenges faced by Indonesia in large scale FGR-CM, both *in situ* and *ex situ* needed to be complemented with smaller scale FGR-CM as models for implementation.

The third workshop was held in November 2006, to discuss scientific consideration in KSDGTH-TD, formulate technical detail of KSDGTH-TD, and assess institutional aspects to enable early actions in the field. It was clearly stated in the opening speech of the Minister of Forestry, that effective follow up after the workshop would be critical for KSDGTH-TD. Furthermore, the recent workshop recommended a number of immediate follow up actions which needed to be discussed further with key stakeholders.

The present workshop was held on 1 March 2007 at the Braja Mustika Hotel in Bogor, Indonesia (Appendix 1). About 50 participants attended the workshop and they came from key stakeholders representing government institutions, research institutions, universities, local government, NGOs and individuals working on FGR-CM (Appendix 2).

Objectives

1. To identify further status of knowledge and technology relevant to FGR-CM as well as human resources working on FGR-CM related areas.
2. To use this information to identify R & D as well as capacity building needs.
3. To identify stakeholders interested in "village level FGR conservation and management (KSDGTH-TD)" and (if possible) to agree on the next steps.

Expected Outputs

1. Information on the status of knowledge and technology relevant to FGR-CM and human resources, as the basis for setting up long-term, medium and short-term plans on FGR-CM in Indonesia.
2. Information on R & D and capacity buildings needs on FGR-CM.
3. Stakeholders or partners for early start of KSDGTH-TD establishment as a means for learning from setting up model sites.

Results

General Discussion

Two keynote speakers gave the introductory presentations for the subsequent discussions. Prof. Dr. Ir. Endang Sukara presented the information on the state of the art of the genetic resources conservation and also the importance of biodiversity conservation and management models involved in biodiversity mainstreaming. Dr. Nur Masripatin presented the implementation of conservation of FGR-CM at village level, which has been supported by adequate research results and human resources.

Group Discussions

The workshop was divided into two parts, general discussion and group discussion. In the group discussion, participants were divided into 2 groups. Each groups discussed a different topic.

The Group I participants from research, national parks and natural resources conservation institutions discussed the status of Science and Technology and R & D activities and also human resources development capacities improvement. This group was facilitated by Dr. Setijati D. Sastrapradja.

The Group II participants from local government related to forestry, the private sector, and NGOs, discussed the implementation of FGR-CM at village level. This group was facilitated by Ir. Adi Susmianto.

The results of the group discussions (with reference to the Director General of FORDA's remarks and the keynote speakers), can be categorized as follows:

1. The village has been adopted as a conservation unit because Indonesia has 70.000 villages. If a village could conserve 1 species, Indonesia would be able to conserve at least 4000 species, assuming that not all villages would be involved in this activity.
2. Some institutions have initiated efforts, which could be categorized as forest plantation genetic resources conservation efforts at village level. Examples are:

Under Government Institutions –

- Directorate General of Forest Protection and Conservation, Ministry of Forestry has 132 model villages surrounding National Parks. They carried out mostly fauna conservation
- Directorate General of Rehabilitation and Social Forestry, Ministry of Forestry has demonstration plots on seedlings managed by farmer groups or villages.
- CPFRD has demonstration plots on FRG-CM at village level in Gunungkidul and Cilacap, Central Java.

Under Local Government –

- Cilacap permanent seed orchard.
- Banyumas – 20 ha demonstration plot.

Under the NGO –

- LATIN – the village model of conservation sited in East Java (Jember 7 ha) and West Java (Halimun and Ciremai).
- KEHATI – Yapen Papua for pandan conservation; DAS Barito on the development of rattan and non timber forest products and Mt Murai for local herbal plant plantation.

Under the private sector –

- PT Wira Karya Sakti provided 9000 ha in the forest production area for jernang, gaharu and petai exploitation in collaboration with local NGO and local government.

Support from Science and Technology required for implementation

1. Information about species to be converted and justification to determine the priority species to be conserved.
2. Information about endangered and endemic species to be conserved.
3. Technical information on each species, for example life cycle, type of reproduction, growth conditions and also the number of individual trees to fulfill conditions of genetic conservation.
4. Technical assistances and guidances to fulfill the financial, social and environmental requirements of groups or villages, which have initiated conservation efforts.

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Human resources support required for implementation

1. Genetic conservation and silviculture researchers who are capable to guide and provide scientific information to the FGR-CM implementers.
2. Field extension and forestry technicians who are able to support FGR-CM implementer groups in planning and executing the activity.
3. Improvement of implementer capability through training on plant propagation, multiplication and exploitation technology.

Government policy support needed

1. An integrated programme for FGR-CM implementation at the village level in order to empower the community.
2. Policy which enables the community to have access to the resources in forest areas.
3. Policy for the spatial planning.

Follow-up Activities for FGR-CM Implementation

1. Conduct data collection and evaluation of the group which carried out FGR-CM implementation, identify the conservation activity and clarify the support required in the conservation efforts.
2. Provide secretariat support to serve as information exchange, provide technical support and to facilitate implementers to liaise with other institutions, which could give the support that is needed.
3. Develop database, of groups which implement the FGR-CM activity, priority species to be conserved and technical information of the priority species.
4. Monitor and evaluate groups that implement the FGR-CM activities at village level.
5. To design the research activity based on scientific and technical information needs to support FGR-CM implementation.

Follow-up of the Workshop

The follow up on the workshop was proposed based on the workshop recommendations.

1. Set up a working group/task force on FGR to support the implementation of FGR-CM at village level. The task force/working groups meetings would be facilitated by the Indonesia APFORGEN secretariat at CPFRD.
2. The APFORGEN secretariat and the working group would collect information on initiations of FGR-CM. Based on the information collected the APFORGEN secretariat would select several groups to be supported as demonstration plots.

Appendix 1

National Workshop: Forest Genetic Resources Conservation and Management in Indonesia

Bogor, 1 March 2007

Programme

08.30-09.00	Registration	
09.00-09.15	Welcome Speech	Director, CPFRD
09.15-09.45	Opening Speech	Director General, FORDA
09.45-10.00	Coffee Break	
	Session I	Moderator: Dr.Ir. Harry Santoso Secretary: Ir. C. Nugroho S. Priyono Rapporteur: Restu W. & Kristina Y.
10.00-10.45	Keynote Speaker	Prof.Dr. Endang Sukara Deputy Dean, Natural Sciences, LIPI
10.45-11.30	Keynote Speaker	Dr.Ir. Nur Masripatin Secretary, FORDA
11.30-12.00	Discussion	
12.00-13.00	Lunch	
	Session II	Group discussions
13.00-15.30 Ball Room Group I	Status of Science and Technology; R & D Activity and Human Resources Development Capacities of FGRCM	Facilitator: Dr. Setyati D. Sastrapraja Secretary: Dr. AYPBC Widyatmoko
Mustika V Room Group II	Implementation of FGRCM at Village Level by Interest Groups and its Progress	Facilitator: Ir. Adi Susmianto, M.Sc Secretary: Ir. M. Kudeng Sallata, M.Sc
15.30-16.00	Coffee Break	
	Session III	
16.00-16.15	Presentation Group I	Group I Leader
16.15-16-30	Presentation Group II	Group II Leader
16.30-16.45	Discussion	
16.45-17.00	Closing	Director, CPFRD

Appendix 2

List of Participants

	NAME	INSTITUTION
1.	M. Sigid S	Centre for Natural Resource Conservation – West Java II
2.	Herdiana	Kepulauan Seribu National Park
3.	Dewi Winarsih	Centre for Research on Biotechnology and Forest Tree Improvement – Jogjakarta
4.	Rina Bogidarmanti	Centre for Plantatation Forest Research and Development
5.	Ir. Charomaini	Centre for Research on Biotechnology and Forest Tree Improvement – Jogjakarta
6.	Yudi F. Hudaya, S.Hut	Centre for Research on Biotechnology and Forest Tree Improvement – Jogjakarta
7.	Prama Wirasena, S.Hut	Centre for Natural Resource Conservation – South Sulawesi I
8.	Ir. Sri Purwanti, M.Si	Forestry and Plantation Services Kendal District – Central Java
9.	I Gede Gelgel Darma, S.Hut	Centre for Natural Resource Conservation – West Java I
10.	Harry Santoso	Centre for Plantatation Forest Research and Development
11.	Susilo D	Centre for Coordination on Forestry Development – Regional II
12.	M. Kudeng Sallata	Centre for Plantatation Forest Research and Development
13.	Ir. J.R. Pattiwael, MS	Province Forestry Services, North Maluku Province
14.	Nur Masripatin	Secretary of FORDA
15.	Herry D. Susilo	Directorate of Biodiversity Conservation
16.	Ilham Hatta	Science and Techno;logy Research Centre _ Serpong
17.	Dede Kusmawan	Science and Techno;logy Research Centre _ Serpong
18.	Harbagung	Centre for Plantatation Forest Research and Development
19.	Sofwan Bustomi	Centre for Plantatation Forest Research and Development
20.	Dendy W	Karimunjawa National Park
21.	Ir. Syamsu Hariadi	Forestry and Plantation Services, Blitar District
22.	Yunita Lisnawati	Centre for Plantatation Forest Research and Development
23.	Rita Liana	Directorate General Land Rehabilitation and Social Forestry
24.	Dra. Illa Anggraeni	Centre for Plantatation Forest Research and Development
25.	Setijati Sastrapradja	Naturindo Foundation
26.	Darman MK	Science and Techno;logy Research Centre _ Serpong
27.	Bambang A.	Wira Karya Sakti Plantation Forest Company - Jambi
28.	Arief Dariyanto	Arara Abadi Plantation Forest Company
29.	Hendromono	Centre for Plantatation Forest Research and Development
30.	Ismayadi S.	Centre for Natural Forest and Natural Conservation Research and Development
31.	Wida Darwiati	Centre for Plantatation Forest Research and Development

32.	Harianto	Karimunjawa National Park
33.	Adi Susmianto	Centre for Natural Forest and Natural Conservation Research and Development
34.	Maulana Budi	Bromo Tengger Semeru National Park
35.	Dr. M. Herman	Biogen Company
36.	Hudiyono	Alas Purwo National Park
37.	Bagus Subiantoro	Centre for Coordination on Forestry Development – Regional II
38.	Ir. Joko Suwarno, M.Si	Centre for Coordination on Forestry Development – Regional II
39.	Liliek Haryjanto	Centre for Research on Biotechnology and Forest Tree Improvement – Jogjakarta
40.	Jayusman	Centre for Research on Biotechnology and Forest Tree Improvement – Jogjakarta B2PBTH
41.	Dyah Puspasari	Social- Economic and Policy Research Centre
42.	Tedi Sutedi	Berbak National Park
43	Cece Yusuf	Forestry and Plantation Services Banyumas District- Central Java
44.	Sigit Widayanto	Forestry and Plantation Services Cilacap District- Central Java
45.	Endang Sukara	Indonesia Sientific Bearau
46.	Fitty M	Karimunjawa National Park
47.	Hardjono P.	Bina Usaha Lingkungan Foundation
48.	Suwarso	SBA Wood Forest Company
49.	Agus Tridoso	Centre for Coordination on Forestry Development – Regional IV
50.	Ahmad Suwarno	LATIN Foundation
51	Agustinus R.L	Centre for Natural Resource Conservation. North Sulawesi
52.	Indah Budiani	Kehati Foundation
53.	C. Nugroho Sulistyo P.	Centre for Plantatation Forest Research and Development
54.	Bagus Novianto	Centre for Plantatation Forest Research and Development

Malaysia National Workshop on Forest Genetic Resources Conservation and Management

Lee Soon Leong
Forest Research Institute Malaysia

Background

Forest genetic resources (FGR) can be defined as genetic material of real or potential value. Within this broad definition, the scope of the FGR includes species of trees, bushes, shrubs or ground cover plants not exclusively limited to agricultural cultivation. Forest genetic resources are associated with the different levels of diversity that exist in nature, from ecosystems to species, populations, individuals and genes. Biological scientists argue that almost all genetic resources are potentially valuable and hence should be conserved. It is assumed that all genetic material has a potential value, because the future technologies and environmental conditions are not known. Consequently, the future value of existing genetic resources cannot be determined at present. Thus, the ultimate goal of FGR conservation is the preservation and improvement of these resources, conserving their capacity to evolve and guaranteeing their use for future generations.

Malaysia is fortunate to have extensive areas of valuable natural tropical rainforests. The combination of warm equatorial climate and the variation of geographical, edaphic and climatic features have given Malaysia an extremely rich forest biodiversity. Over the years, in spite of the fact that the country has lost some of its forests due to agricultural development and timber exploitation, 59.5% of the land area is still under forest cover. The needs of a biodiversity conservation programme arose as a consequence of the national forestry policy in Malaysia and in response to the international agreements made by Malaysia in relation to forests and biodiversity conservation. However, the absence of an integrated FGR conservation component in the national plan for biodiversity conservation limits the scope of the programme. Therefore, a consultative workshop was organized to suggest a Malaysian strategy on FGR conservation and to bring to fore the urgent need to integrate FGR conservation in the wider programme of biodiversity conservation.

Objectives

1. To assess the status of FGR in Malaysia.
2. To identify priority species for FGR conservation.
3. To determine a Malaysian strategy on FGR conservation.
4. To identify capacity building needs for FGR conservation.

Expected Outputs

1. Priority listing of species for FGR conservation.
2. Proposed Malaysian strategy on FGR conservation.
3. Capacity building needs and strategies for FGR conservation

Workshop Format

The detailed programme of the workshop is given in Appendix 1. The programme was divided into two plenary sessions and three workshops. In order to have an effective discussion during the workshops, three draft documents for reference were prepared in advance before the workshop. These are:-

1. Proposed priority plant species for FGR conservation (Appendix 2);
2. Proposed Malaysian strategy on FGR conservation (Appendix 3); and
3. Proposed capacity building needs and strategies for FGR conservation (Appendix 4).

These draft documents were sent to the stakeholders/policy makers one month before the workshop for comments and recommendations and served as a guide for final discussion during the workshop. The list of participants is given in Appendix 5. In brief, this workshop involved participants from Ministry of Natural Resources and Environment (NRE), Forest Department of Peninsular Malaysia, various State Forest Departments, Forest Research Institute Malaysia (FRIM), Bioversity International, Asia Pacific Association of Forestry Research Institutions (APAFRI), Universiti Malaysia Sarawak, Sarawak Forestry Corporation, Malaysia Furniture Industry Council, Institute for Environment and Development UKM, WWF Malaysia, and Perak ITC Sdn. Bhd.

Participants at the *Malaysia National Workshop on Forest Genetic Resources Conservation and Management*

Outputs

Workshop 1: Identification of Priority Species for FGR Conservation

The tropical rainforest of Malaysia is a unique natural heritage which has evolved over millions of years and is rich and varied in plant and animal life. Due to their sheer numbers, the exact numbers for each group is not completely known. Malaysia's known flora species diversity to date, according to a recent assessment of biological diversity in Malaysia, was estimated to be 15 000 species (Anon 1997). However, the level of knowledge on plant species composition in Malaysia varies widely between the different groups of plants as some are better studied than others. The Tree Flora of Malaya (Whitmore 1972, 1973; Ng 1978, 1989) covers all tree species of Peninsular Malaysia, except dipterocarps, which were covered earlier by Symington (1943). The four volumes had covered nearly 2,830 species of woody plants, of which 746 are endemic, while 511 species are estimated to be endangered as they are rare, hyper-endemic or their habitats are under threat (Ng 1991).

A project on Tree Flora of Sabah and Sarawak is currently ongoing and so far, six volumes have been published (Soepadmo and Wong 1995; Soepadmo *et al.* 1996; Soepadmo and Saw 2000; Soepadmo *et al.* 2002, 2004, 2007). For rattans and bamboos in Peninsular Malaysia, they have been respectively documented by Dransfield (1979) and Wong (1995). Herbaceous plants, on the other hand, have been somewhat neglected in the study of taxonomic and ecological aspects. About 2,600 species of herbaceous plants, of which 850 species belong to the orchid family, 650 species of ferns and fern allies, have been recorded for Peninsular Malaysia; at least 2,500 herbaceous species are expected in Sabah and Sarawak (Anon 1997).

Through this consultative workshop and by referring to Draft Document 1 (Appendix 2), 30 plant species were identified as priority species for FGR conservation using the following criteria: economic importance (1) and endemic/rare distribution (2) (Table 1).

Table 1. Priority plant species for FGR consvation.

No	Species	Criteria
1	*Agathis borneensis*	1
2	*Calamus manan*	1
3	*Callophylum lanigerum*	1
4	*Canarium pseudosumatranum*	1
5	*Dyera costulata*	1
6	*Eusideroxylon zwageri*	1
7	*Ganua motleyana*	1
8	*Gonystylus bancanus*	1
9	*Intsia palembanica*	1
10	*Koompassia excelsa*	1
11	*Neesia altissima*	1
12	*Neobalanocarpus heimii*	1
13	*Protoxylon melagangai*	1
14	*Shorea albida*	1
15	*Shorea macrophylla*	1
16	*Shorea singkawang*	1
17	*Begonia eiromischa*	2
18	*Begonia rajah*	2
19	*Dactylocladus stenostachys*	2
20	*Dipterocarpus oblongifolius*	2
21	*Dipterocarpus perakensis*	2
22	*Dipterocarpus sarawakensis*	2
23	*Dryobalanops beccarii*	2
24	*Dryobalanops rappa*	2
25	*Eugenia johorensis*	2
26	*Johannesteijsmannia perakensis*	2
27	*Mangifera pajang*	2
28	*Nepenthes rajah*	2
29	*Shorea bentongensis*	2
30	*Shorea kudatensis*	2

Workshop 2: Malaysian Strategy on FGR Conservation

The Conference of the Parties (COP) to the Convention on Biological Diversity (CBD), at its sixth meeting in 2002, adopted the decision VI/9 on the Global Strategy for Plant Conservation. The focus of the Global Strategy is to reduce drastically by 2010 the rate of loss of plant species worldwide, as part of the global agenda of the World Summit in Johannesburg to significantly reduce the rate of biodiversity loss within that time frame. Using the framework established by the Global Strategy for Plant Conservation under the CBD, recently, a Malaysian National Strategy for Plant Conservation was initiated to consolidate past and existing efforts towards biological diversity conservation. The strategy emphasized on ecosystem approach, outlined five objectives and has 17 targets designed specifically to address how Malaysia could progress forward in plant conservation, taking into cognizance the rationale behind each target and the current situation. Conservation of genetic diversity was emphasized in Target 10 (70% of the genetic diversity of crops and other major socio-economically valuable plant species conserved, and associated indigenous and local knowledge protected).

As an extension, through this consultative workshop and by referring to Draft Document 2 (Appendix 3), a Malaysian strategy on plant FGR conservation was formulated. This strategy emphasized on genetic diversity outlined four objectives and has nine targets designed specifically to address the concern of plant FGR conservation in Malaysia (Table 2).

Table 2. Malaysian strategy on forest plant genetic resources conservation.

Objective 1: Understanding genetic diversity of forest plant species		Duration
Target 1	Development of research methodologies to understand genetic diversity and other biological information of forest plant species	2008-2011
Target 2	Development of models with protocols for gene conservation of forest plant species	2008-2013
Target 3	Development of models with protocols for sustainable utilization of forest plant species	2008-2013
Target 4	Development of models with protocols for forest rehabilitation	2008-2013
Target 5	Development of models with protocols for species reintroduction of critically endangered forest plant species	2008-2013
Objective 2: Conserving forest plant species in *in situ* and *ex situ*		
Target 6	Application of models and protocols developed from Target 2 to conserve *in situ* and *ex situ* of 30 forest plant species of socio-economic importance or endemic/rare distribution	2013-2020
Objective 3: Using forest plant species sustainably		
Target 7	Application of models and protocols developed from Target 3 to utilize forest plant species from natural sources that are sustainably managed	2013-2020
Objective 4: Rehabilitating forest and species reintroduction		
Target 8	Application of models and protocols developed from Target 4 to rehabilitate of at least 10,000 ha of heavily disturbed forests with consideration of genetic diversity	2013-2020
Target 9	Application of models and protocols developed from Target 5 to reintroduce of at least two critically endangered forest plant species into natural habitats	2013-2020

Workshop 3: Capacity Building Needs and Strategies for FGR Conservation

To undertake activities to achieve the targets of Malaysian strategy on plant FGR conservation requires that the existing national capacity in the relevant fields be increased manifold and that the infrastructure to support this increased capacity is developed fairly rapidly. Capacity building in the area of FGR conservation covers training of manpower in various biological and management disciplines, at various levels and in the use of various technologies. It requires training of various stakeholders – government personnel, NGOs and communities. Adequate funding is a prerequisite for building capacity for the conservation of FGR. Identification of gaps on capacity building needs for FGR conservation in the current situation in Malaysia are as given in Figure 1 below.

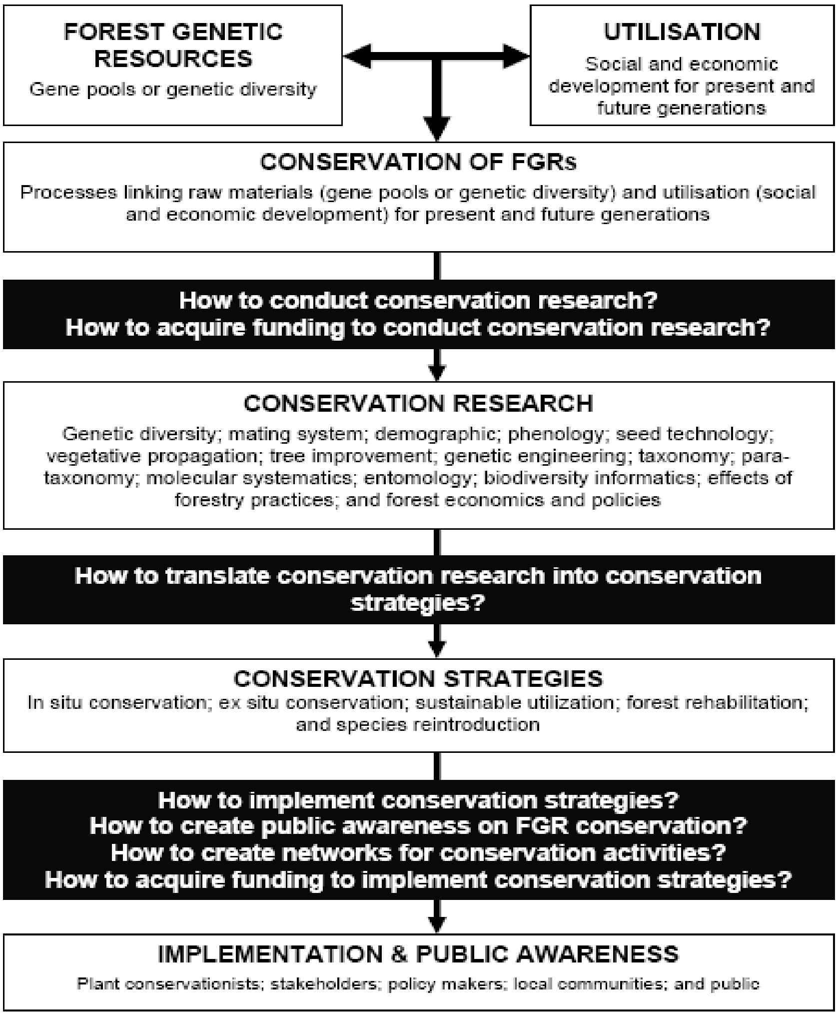

Figure 1. Identification of gaps on capacity building needs for FGR conservation in Malaysia

In general, seven questions can be used as the guide for gap identifications:

1. How to conduct conservation research?
2. How to acquire funding to conduct conservation research?
3. How to translate conservation research into conservation strategies?
4. How to implement conservation strategies?
5. How to create public awareness on FGR conservation?
6. How to create networks for conservation activities?
7. How to acquire funding to implement conservation strategies?

Through this consultative workshop and by referring to Draft Document 3 (Appendix 4), the following strategies were formulated as shown in Table 3.

Table 3. Capacity building needs and strategies for FGR conservation

Capacity building needs	Gap	Strategies
Human resources and infrastructure development ▪ How to conduct conservation research? ▪ How to translate conservation research into conservation strategies? ▪ How to implement conservation strategies?	▪ Lack of trained population geneticists, molecular biologists and conservation biologists. ▪ Lack of trained and dedicated field managers to implement FGR conservation strategies. ▪ Lack of molecular biology facilities in research institutions and universities. ▪ Lack of policy makers that fully understand the importance of FGR conservation.	▪ Encourage institutes of higher learning to train population geneticists, molecular biologists and conservation biologists. ▪ Recruitment of trained and dedicated field managers for the implementation of FGR conservation strategies ▪ Equip the molecular biology facilities in research institutions and universities especially in Sabah and Sarawak. ▪ Policy makers should be enlightened on the importance of FGR conservation towards environmental protection and for the use of future generations.
Communication ▪ How to create public awareness on FGR conservation? ▪ How to create networks for conservation activities?	▪ Lack of publications related to FGR conservation for public. ▪ Lack of coordination, communication and networking among institutions, scientists and policy makers on FGR conservation issues. ▪ Lack of coordination and commitment among policy makers on FGR conservation issues. ▪ Lack of regional and international networking and communication on FGR conservation.	▪ Encourage scientists to participate in the production of articles, commentaries, and films related to FGR conservation. ▪ Establish rapport with mainstream journalists and media agencies. ▪ Encourage local scientists to publish in international journal to increase their exposure and networking. ▪ Incentives and recognition for scientists to be prolific in production of popular media. ▪ Suggest to institutions to offer courses on combining FGR conservation and journalism. ▪ Support from government to ensure commitment among policy makers on FGR conservation issues. ▪ Set up a coordinating body to coordinate activities among institutions and/or scientists. ▪ Encourage more exchange of students and staff within and among countries.
Funding mechanism ▪ How to acquire funding to conduct conservation research? ▪ How to acquire funding to implement conservation strategies?	▪ Severe lack of funding for fundamental conservation research ▪ Lack of funding to implement FGR conservation strategies. ▪ Unbalanced funding and coordination for biodiversity programmes ▪ Lack of funding for training in postgraduate programmes. ▪ Lack of funds to participate in the international FGRs conservation events.	▪ Governmental research funding should proportionally cover both biotechnology and conservation activities. ▪ The spending of 'timber cess and levy' income should be extended to support fundamental conservation research and to implement conservation strategies. ▪ Local scientists should be encouraged to tap international funds available for fundamental research. ▪ Scholarships and financial assistance should be made available to postgraduates to pursue degrees in population genetics, molecular biology and conservation biology. ▪ Dedicated fund should be made available for local scientists to participate in important international symposia/congress

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Appendix 1

National Workshop on Forest Genetic Resources Conservation and Management
30 July 2008
Hotel Melia, Kuala Lumpur

Programme

0800-0900	Registration	APAFRI
0900-0915	Welcome Address and Opening Remarks	Dato' Dr. Abdul Rashid Ab. Malik, DDG, FRIM
0915-0930	Photo Session	
0930-0945	Introduction of AFORGEN/ITTO Project	Hong LT
0945-1000	Introduction of Workshop	Lee SL
1000-1030	Tea Break	
1030-1100	Paper 1: Current Status of FGR Conservation in Malaysia	Lee SL
1100-1130	Paper 2: Malaysia National Strategy for Plant Conservation	Saw LG
1130-1300	Workshop 1: Identification of Priority Species for FGR Conservation	Dato' Shaharuddin (Chairman) Ng Chin Hong (Rapporteur) Norlia Basherudin (Rapporteur) Lee SL (Rapporteur)
1300-1400	Lunch Break	
1400-1530	Workshop 2: Malaysian Strategy on FGR Conservation	Saw LG (Chairman) Norwati Adnan (Rapporteur) Kevin Ng (Rapporteur) Lee SL (Rapporteur)
1530-1600	Tea break	
1600-1730	Workshop 3: Capacity Building Needs for FGR Conservation	Dato' Shaharuddin (Chairman) Kevin Ng (Rapporteur) Norwati Adnan (Rapporteur) Lee SL (Rapporteur)
1730-1800	Closing	Hong LT

Appendix 2

Draft Document 1: Proposed priority plant species for FGR conservation

The tropical rainforest of Malaysia is a unique natural heritage which has evolved over million of years and is rich and varied in plant and animal life. Due to their sheer numbers, the exact numbers for each group is not completely known. Malaysia's known flora species diversity to date, according to the recently assessment of biological diversity in Malaysia was estimated to be 15,000 species (Anon 1997). However, the level of knowledge on plant species composition in Malaysia varies widely between the different groups of plants as some are better studied than others. The Tree Flora of Malaya (Whitmore 1972, 1973; Ng 1978, 1989) covers all tree species of Peninsular Malaysia, except dipterocarps, which were covered earlier by Symington (1943). The four volumes had covered nearly 2,830 species of woody plants, in which, 746 are endemic, while 511 species are estimated to be endangered as they are rare, hyper-endemic or their habitat under threat (Ng 1991). A project on Tree Flora of Sabah and Sarawak is currently ongoing and so far, six volumes have been published (Soepadmo and Wong 1995; Soepadmo *et al*. 1996; Soepadmo and Saw 2000; Soepadmo *et al*. 2002, 2004, 2007). For rattans and bamboos in Peninsular Malaysia, they have been respectively documented by Dransfield (1979) and Wong (1995). Herbaceous plants, on the other hand, have been somewhat neglected in the study of taxonomic and ecological aspects. About 2,600 species of herbaceous plants, of which 850 species belong to the orchid family, 650 species of ferns and fern allies, have been recorded for Peninsular Malaysia; at least 2,500 herbaceous species are expected in Sabah and Sarawak (Anon 1997).

Selections of the potential priority plant species were primarily based on the following criteria:

- ***Species of current socio-economic importance***
- ***Species with clear potential of future value***
- ***Species with endemic and rare distribution***

They consist mainly of currently popular timber species for forest plantation (e.g., *Azadirachta excelsa* and *Dyera costulata*), currently popular medicinal plants (e.g., *Eurycoma longifolia* and *Labisia pumila*) and valuable timber species (e.g., *Neobalanocarpus heimii* and *Eusideroxylon zwageri*). Beside, the list also includes other important timber species which are not popular at the moment for forest plantation (e.g., *Shorea glauca*, *Shorea curtisii* and *Shorea platyclados*), medicinal plants with clear potential or future value (e.g., *Calophyllum lanigerum* var. *austrocoriaceum*, *Andrographis paniculata* and *Goniothalamus velutinus*), species for agroforestry (e.g., *Calamus* sp.), ornamental plants (e.g., *Cycas* sp., *Nepenthes* sp. and *Johannesteijsmannia* sp.), fruit trees (e.g., *Nephelium* sp. and *Durio* sp.) and mangrove species (e.g., *Avicennia alba* and *Sonneratia alba*). The following species are protected by law in Sarawak: *Antiaris toxicaria*, *Aquilaria malaccensis*, *Avicennia alba*, *Casuarina equisetifolia*, *Dipterocarpus oblongifolius*, *Eurycoma longifolia*, *Goniothalamus velutinus*, *Koompassia malaccensis*, *Nepenthes* sp., *Paphiopedilum* sp., *Rafflesia* sp., *Shorea hemsleyana*, *Shorea macrophylla*, *Shorea splendida*, *Shorea stenoptera* and *Sonneratia alba* (Anon 1999). Some information on these important species can be found in Ng and Tang (1974); Patrick and Muhammad (1980); Anon (1991); Saw and Raja Barizan (1991); Appanah and Weinland (1993); Dransfield and Manokaran (1993); Soerianegara and Lemmens (1994); Dransfield and Widjaja (1995); Saw (1998); Teo (1998); and de Padua *et al*. (1999).

Identifications of endemic and rare species were circumscribed to the species that are listed in IUCN categories (1998) and species that have been reported by Chin and Kiew (1985), Kiew *et al*. (1985), Jacobson (1987), Weber (1988), Kiew (1989), Abdul Latiff and Mat-

Salleh (1991), Kiew (1991a, b), Kiew and Pearce (1991), Abdul Latiff (1998a, b), Kiew (1998a, b, c), Soepadmo (1998) and Wong (1998). A species is said to be endemic when it is found naturally in only a single geographical area and nowhere else. A species is said to be rare when its population is small and can be found only in one or very few places. It is also considered rare if it is only represented by a few individuals over a large area. Endemic and rare species are automatically endangered because of their narrow distribution ranges or small population size and should receive special attention.

Potential priority plant species for FGR conservation in Malaysia based on the following criteria: species of current socio-economic importance (1); species with clear potential of future value (2); and species with endemic and rare distribution (3):

No.	Species (family)	Criteria	Comments
1	*Acalypha hispada* (Euphorbiaceae)	2	
2	*Acorus calamus* (Araceae)	2	
3	*Acrymia ajugiflora* (Labiatae)	3	
4	*Actinodaphne cuspidata* (Lauraceae)	3	
5	*Agathis borneensis* (Coniferae)	1	
6	*Aglaia densitricha* (Meliaceae)	3	
7	*Alangium serraca* (Alangiaceae)	2	
8	*Alphonsea kingii* (Annonaceae)	3	
9	*Alstonia scholaris* (Apocynaceae)	2	
10	*Andrographis paniculata* (Acanthaceae)	2	
11	*Anisoptera costata* (Dipterocarpaceae)	1	
12	*Anisoptera curtisi* (Dipterocarpaceae)	1	
13	*Antiaris toxicaria* (Moraceae)	1	
14	*Aquilaria malaccensis* (Thymelaeaceae)	1	
15	*Ardisia langkawiensis* (Myrsinaceae)	3	
16	*Artocarpus elasticus* (Moraceaae)	1	
17	*Artocarpus lanceifolius* (Moraceae)	1	
18	*Avicennia alba* (Verbanaceae)	1	
19	*Azadirachta excelsa* (Meliaceae)	1	
20	*Begonia eiromischa* (Begoniaceae)	3	
21	*Begonia rajah* (Begoniaceae)	3	
22	*Beilschmiedia* penangiana (Lauraceae)	3	
23	*Browniowia velutina* (Tiliaceae)	3	
24	*Brucea javanica* (Simaroubaceae)	2	
25	*Calamus balingensis* (Palmae)	3	
26	*Calamus manan* (Palmae)	1	
27	*Calamus subinermis* (Palmae)	1	
28	*Calamus viminalis* (Palmae)	3	
29	*Callophylum lanigerum* var. *austrocoriaceum*	1	
30	*Cantella assiatica* (Umbelliferae)	1	
31	*Castanopsis catappaefolia* (Fagaceae)	3	
32	*Casuarina equisetifolia* (Casuarinaceae)	1	
33	*Chukrasia tabularis* (Meliaceae)	1	
34	*Cleistanthus major* (Euphorbiaceae)	3	
35	*Cotylelobium lanceolatum* (Dipterocarpaceae)	1	
36	*Croton macrocarpus* (Euphorbiaceae)	3	

37	*Cryptocoryne elliptica* (Araceae)	3
38	*Cycas pectinata* (Cycadaceae)	3
39	*Dendrobium langkawiense* (Orchidaceae)	3
40	*Didymocarpus pumilus* (Gesneriaceae)	3
41	*Dillenia grandifolia* (Dilleniaceae)	1
42	*Diplodiscus hookerianus* (Tiliaceae)	3
43	*Dipterocarpus baudii* (Dipterocarpaceae)	1
44	*Dipterocarpus cornutus* (Dipterocarpaceae)	1
45	*Dipterocarpus costulatus* (Dipterocarpaceae)	1
46	*Dipterocarpus crinitus* (Dipterocarpaceae)	1
47	*Dipterocarpus grandiflorus* (Dipterocarpaceae)	1
48	*Dipterocarpus lamellatus* (Dipterocarpaceae)	3
49	*Dipterocarpus oblongifolius* (Dipterocarpaceae)	1
50	*Dipterocarpus perakensis* (Dipterocarpaceae)	3
51	*Dipterocarpus rotundifolius* (Dipterocarpaceae)	3
52	*Dryobalanops aromatica* (Dipterocarpaceae)	1
53	*Dryobalanops oblongifolia* (Dipterocarpaceae)	1
54	*Durio* sp. (Bombacaceae)	1
55	*Dyera costulata* (Apocynaceae)	1
56	*Endospermum diadenum* (Euphorbiaceae)	1
57	*Eugenia camptophylla* (Myrtaceae)	3
58	*Eugenia gageana* (Myrtaceae)	3
59	*Eugenia johorensis* (Myrtaceae)	3
60	*Eugenia klossii* (Myrtaceae)	3
61	*Eugenia scalarinervis* (Myrtaceae)	3
62	*Eugenia taipingensis* (Myrtaceae)	3
63	*Eurycoma longifolia* (Simaroubaceae)	1
64	*Eusideroxylon zwageri* (Lauraceae)	1
65	*Fagraea fragrans* (Loganiaceae)	1
66	*Ficus deltoidea* (Moraceae)	2
67	*Garcinia* sp. (Guttiferae)	1
68	*Gigantochloa scortechinii* (Gramineae)	1
69	*Glycosmis crassifolia* (Rutaceae)	3
70	*Glycosmis monticola* (Rutaceae)	3
71	*Glycosmis tomentella* (Rutaceae)	3
72	*Goniothalamus subevenius* (Annonaceae)	3
73	*Goniothalamus velutinus* (Anonaceae)	1
74	*Gonystylus bancanus* (Thymelaeaceae)	1
75	*Heritiera javanica* (Sterculiaceae)	1
76	*Hexapora curtisii* (Lauraceae)	3
77	*Homalium spathulatum* (Flacourtiaceae)	3
78	*Hopea auriculata* (Dipterocarpaceae)	3
79	*Hopea depressinerva* (Dipterocarpaceae)	3
80	*Hopea johorensis* (Dipterocarpaceae)	3
81	*Hopea nervosa* (Dipterocarpaceae)	1
82	*Hopea nutans* (Dipterocarpaceae)	1
83	*Hopea odorata* (Diptreocarpaceae)	1
84	*Hopea polyalthioides* (Dipterocarpaceae)	3

85	*Hopea subalata* (Dipterocarpaceae)	3
86	*Horsfieldia sessilifolia* (Myristicacceae)	3
87	*Hydnocarpus scortechinii* (Flacourtiaceae)	3
88	*Ilex pauciflora* (Aquifoliaceae)	3
89	*Intsia palembanica* (Leguminosae)	1
90	*Johannesteijsmannia lanceolata* (Palmae)	3
91	*Johannesteijsmannia magnifica* (Palmae)	3
92	*Justicia subalternans* (Acanthaceae)	3
93	*Kibatalia borneensis* (Apocynaceae)	3
94	*Koilodepas ferrugineum* (Euphorbiaceae)	3
95	*Koompassia malaccensis* (Leguminosae)	1
96	*Kostermanthus malayus* (Chrysobalanaceae)	3
97	*Labisia pumila* (Myrsinaceae)	1
98	*Lagerstroemia langkawiensis* (Lythraceae)	3
99	*Litsea scortechinii* (Lauraceae)	3
100	*Maclurochloa montana* (Gramineae)	3
101	*Madhuca calcicola* (Sapodaceae)	3
102	*Mallotus smilaciformis* (Euphorbiaceae)	3
103	*Mangifera superba* (Anacardiaceae)	3
104	*Metroxylon rumphii* (Palmae)	1
105	*Metroxylon sagu* (Palmae)	1
106	*Mezzettia herveyana* (Annonaceae)	3
107	*Neobalanocarpus heimii* (Dipterocarpaceae)	1
108	*Nepenthes gracillima* (Napenthaceae)	3
109	*Nepenthes northiana* (Napenthaceae)	3
110	*Nephelium* sp. (Sapindaceae)	1
111	*Oberonia calcicola* (Orchidaceae)	3
112	*Oncosperma tigillarium* (Palmae)	1
113	*Orthosiphon grandiflorus* (Labiatae)	2
114	*Palaquium maingayi* (Sapotaceae)	1
115	*Palaquium rostratum* (Sapotaceae)	1
116	*Paphiopedilum niveum* (Orchidaceae)	3
117	*Paphiopedilum phillippinense* (Orchidaceae)	3
118	*Parashorea lucida* (Dipterocarpaceae)	1
119	*Parashorea stellata* (Dipterocarpaceae)	1
120	*Parkia javanica* (Leguminosae)	1
121	*Parkia speciosa* (Leguminosae)	1
122	*Peperomia maxwelliana* (Piperaceae)	3
123	*Phalaenopsis* sp. (Orchidaceae)	1
124	*Phyllagathis stonei* (Melastomataceae)	3
125	*Polyalthia glabra* (Annonaceae)	3
126	*Polyalthia hirtifolia* (Annonaceae)	3
127	*Popowia pauciflora* (Annonaceae)	3
128	*Popowia velutina* (Annonaceae)	3
129	*Pseudoeugenia tenuifolia* (Myrtaceae)	3
130	*Pterocarpus indicus* (Leguminosae)	1
131	*Rafflesia kerrii* (Rafflesiaceae)	3
132	*Santiria laevigata* (Burseraceae)	1

133	*Sauropus elegantissimus* (Euphorbiaceae)	3
134	*Schefflera cephalotes* (Araliaceae)	3
135	*Schefflera kuchingensis* (Araliaceae)	3
136	*Schima wallichii* (Theaceae)	1
137	*Schoutenia cornerii* (Tiliaceae)	3
138	*Senna alata* (Leguminosae)	2
139	*Shorea acuminata* (Dipterocarpaceae)	1
140	*Shorea bentongensis* (Dipterocarpaceae)	3
141	*Shorea bracteolata* (Dipterocarpaceae)	1
142	*Shorea curtisii* (Dipterocarpaceae)	1
143	*Shorea glauca* (Dipterocarpaceae)	1
144	*Shorea hemsleyana* (Dipterocarpaceae)	1
145	*Shorea kuantanensis* (Dipterocarpaceae)	3
146	*Shorea kudatensis* (Dipterocarpaceae)	3
147	*Shorea kunstleri* (Dipterocarpaceae)	1
148	*Shorea laevis* (Dipterocarpaceae)	1
149	*Shorea lepidota* (Dipterocarpaceae)	1
150	*Shorea leprosula* (Dipterocarpaceae)	1
151	*Shorea longisperma* (Dipterocarpaceae)	1
152	*Shorea lumutensis* (Dipterocarpaceae)	3
153	*Shorea macrophylla* (Dipterocarpaceae)	1
154	*Shorea macroptera* (Dipterocarpaceae)	1
155	*Shorea maxima* (Dipterocarpaceae)	3
156	*Shorea maxwelliana* (Dipterocarpaceae)	1
157	*Shorea multiflora* (Dipterocarpaceae)	1
158	*Shorea ovalis* (Dipterocarpaceae)	1
159	*Shorea palembanica* (Dipterocarpaceae)	3
160	*Shorea parvifolia* (Dipterocarpaceae)	1
161	*Shorea pauciflora* (Dipterocarpaceae)	1
162	*Shorea platyclados* (Dipterocarpaceae)	1
163	*Shorea resinosa* (Dipterocarpaceae)	1
164	*Shorea roxburghii* (Dipterocarpaceae)	1
165	*Shorea singkawang* ssp. *scabrosa* (Dipterocarpaceae)	3
166	*Shorea splendida* (Dipterocarpaceae)	1
167	*Shorea stenoptera* (Dipterocarpaceae)	1
168	*Sindora coriacea* (Leguminosae)	1
169	*Sonneratia alba* (Sonneratiaceae)	1
170	*Strobilanthes pachyphyllus* (Acanthaceae)	3
171	*Symplocos nivea* (Symplocaceae)	3
172	*Tinospora crispa* (Menispermaceae)	2
173	*Toona sinensis* (Meliaceae)	1
174	*Toona sureni* (Meliaceae)	1
175	*Tristania pontianensis* (Myrtaceae)	3
176	*Vaccinium whitmorei* (Ericaceae)	3
177	*Vatica flavida* (Dipterocarpaceae)	3
178	*Vatica maingayi* (Dipterocarpaceae)	1
179	*Vatica pauciflora* (Dipterocarpaceae)	1
180	*Zollingeria borneensis* (Sapindaceae)	3

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Appendix 3

Draft Document 2: Proposed Malaysian strategy on FGR conservation

Forest genetic resources (FGR) can be defined as genetic materials of real or potential value. Within this broad definition, the scope of the FGR include species of trees, bushes, shrubs or ground cover plants not exclusively limited to agricultural cultivation. Forest genetic resources are associated with the different levels of diversity that exist in nature, from ecosystems to species, populations, individuals and genes. Biological scientists argue that almost all genetic resources are potentially valuable and hence should be conserved. It is assumed that all genetic materials have potential value, because the future technologies and environmental conditions are not known. Consequently, the future value of existing genetic resources cannot be determined at present. Thus, the ultimate goal of FGR conservation is the preservation and improvement of these resources, conserving their capacity to evolve and guaranteeing their use for future generations.

Malaysia has been fortunate to be accomplished with extensive areas of valuable natural tropical rainforest. The combination of warm equatorial climate and the variation of geographical, edaphic and climatic features have given Malaysia with extremely rich of forest biodiversity. Over the years, in spite of the fact that, the country has lost some of its forest due to agricultural development and timber exploitation, 55.8% of the land area is still under forest cover. The needs of biodiversity conservation programme arose as a consequence of national forestry policy in Malaysia and in response to the international agreements made by Malaysia in relation to forests and biodiversity conservation.

Environment-related agencies under the Ministries, government research institutions, universities and non-governmental organizations (NGOs) have long been involved in various ways in addressing issues of management and conservation of biodiversity resources. These attempts are commendable and, in many cases, have been instrumental in changing the direction of policy making and management with respect to the environment and conservation. The very nature of the vast complexities and interlinkages between the essential functions and uses of biological resources however demand that persisting issues be addressed through a more holistic and integrated approach. In Malaysia, the management of biological resources and the environment are sectorally based. Prior to the formation of the Ministry of Natural Resources and Environment (NRE), the management was coordinated by many Ministries, often resulting in weak coordination. In addition, useful end-products of programmes and activities were not made available to those managing the resources. When NRE was established in 2004, many of the existing sector-based institutional frameworks were integrated and this included programmes relating to the conservation of plant resources. This integration allows a holistic framework to be developed for plant diversity management and conservation in order to bridge the gap between conservation and sustainable utilization.

The Conference of the Parties (COP) to the Convention on Biological Diversity (CBD), at its sixth meeting in 2002, adopted decision VI/9 on the Global Strategy for Plant Conservation. The focus of the Global Strategy is to reduce drastically by 2010 the rate of loss of plant species worldwide, as part of the global agenda of the World Summit in Johannesburg to significantly reduce the rate of biodiversity loss within that time frame. Using the framework established by the Global Strategy for Plant Conservation under the CBD, recently, a Malaysian National Strategy for Plant Conservation was initiated to consolidate past and existing efforts towards biological diversity conservation. The strategy emphasised on ecosystem approach, outlined five objectives and has 17 targets designed specifically to address how Malaysia could progress forward in plant conservation, taking into cognizance the rationale behind each target and the current situation. Three targets are related to understanding and documenting plant diversity while six targets deal with conserving plant diversity. Five, one and two targets elaborate on using plant diversity sustainably, promoting education and awareness about plant diversity and building capacity for the conservation of plant diversity respectively. Conservation of genetic diversity was emphasized in Target 10 (70% of the genetic diversity of crops and other major socio-economically valuable plant species conserved, and associated indigenous and local knowledge protected). As a continuation, this proposed strategy using species approach outlined additional 12 targets to fill the gap and can be integrated into the existing Malaysian National Strategy for Plant Conservation.

Objective 1: Identifying priority forest plant species		**Proposed duration**
Target 1	Identify 30 forest plant species of socio-economic importance or clear potential of future value	2008
Target 2	Identify 20 forest plant species with endemic and rare distribution	2008
Objective 2: Understanding genetic diversity of forest plant species		
Target 3	Development of research methodologies to understand genetic diversity and other biological information of forest plant species	2008–2012
Target 4	Development of models with protocols for gene conservation of forest plant species	2008–2012
Objective 3: Conserving priority forest plant species *in situ*		
Target 5	30 forest plant species of socio-economic importance or clear potential of future value conserve *in situ*	2008–2017
Target 6	20 forest plant species with endemic and rare distribution conserve *in situ*	2008–2017
Objective 4: Conserving priority forest plant species *ex situ*		
Target 7	30 forest plant species of socio-economic importance or clear potential of future value conserve *ex situ*	2008–2017
Target 8	20 forest plant species with endemic and rare distribution conserve *ex situ*	2008–2017
Objective 5: Rehabilitating forest and species reintroduction		
Target 9	Rehabilitation of at least 10,000 ha of heavily disturbed forests with consideration of genetic diversity	2008–2017
Target 10	Reintroduction of at least two critically endangered forest plant species into natural habitats	2008–2017
Objective 6: Using priority forest plant species sustainably		
Target 11	Utilization of priority forest plant species from natural sources that are sustainably managed	2008–-2017
Target 12	Improved planting materials of at least two indigenous timber species for forest plantation and at least five indigenous medicinal plant species for cultivation	2008–2017

Appendix 4

Draft Document 3: Proposed capacity building needs and strategies for FGR conservation

To undertake activities to achieve the targets of this Strategy requires that the existing national capacity in the relevant fields be increased manifold and that the infrastructure to support this increased capacity is developed fairly rapidly. Capacity building in the area of FGR conservation covers training of manpower in various biological and management disciplines, at various levels and in the use of various technologies. It requires training of various stakeholders – government personnel, NGOs and communities. Adequate funding is a prerequisite for building capacity for the conservation of FGR. Overall, seven questions can be used as the guide for gap identifications. These are:

1. How to conduct conservation research?
2. How to acquire funding to conduct conservation research?
3. How to translate conservation research into conservation strategies?
4. How to implement conservation strategies?
5. How to create public awareness on FGR conservation?
6. How to create networks for conservation activities?
7. How to acquire funding to implement conservation strategies?

How to conduct conservation research? How to translate conservation research into conservation strategies? How to implement conservation strategies?

Gaps

- Lack of trained taxonomists, para-taxonomists and plant conservationists.
- Lack of scientists in complementary fields (i.e. population genetics, molecular marker technology, plant reproductive biology, plant ecology, phenology, seed technology, vegetative propagation, tree improvement, genetic engineering, molecular systematics, entomology, biodiversity informatics, forest economics and policies etc.).
- Lack of government posts for taxonomists and conservationists.
- Certain government institutes and agencies cannot effectively perform duties related to FGRs conservation and inventory due to lack of specialised department within their organisations.

Strategies

- Encourage institutes of higher learning to train taxonomists, para-taxonomists and plant conservationists.
- Encourage institutes of higher learning to provide courses to complement FGR conservation such as population genetics, molecular marker technology, plant reproductive biology, plant ecology, phenology, seed technology, vegetative propagation, tree improvement, genetic engineering, molecular systematics, entomology, biodiversity informatics, forest economics and policies etc.
- Explore various global initiatives that provide opportunities for training personnel in FGR conservation activities or that provide funding for such activities, and to be proactive in taking advantage of the relevant opportunities. The global initiatives may be those emanating from the CBD or from other conventions or processes.
- Encourage government to incorporate FGR conservation into current youth and school programmes to increase critical mass of nature volunteers available in the country.

- Support from government to create more post in research institutions and universities to encourage recruitment of taxonomist, para-taxonomists, plant conservationists, population geneticists, plant ecologists and plant reproductive biologists.
- To urge government institutes and agencies to create specialised department within their organisations to carry out duties related to FGR conservation and inventory.

How to acquire funding to conduct conservation research? How to acquire funding to implement conservation strategies?

Gaps

- Severe lack of funding for fundamental plant research.
- Lack of funding and coordination to conduct FGR conservation programmes.
- Unbalanced funding and coordination for biodiversity programmes.
- Lack of funds for trainings in postgraduate programmes.
- Lack of funds to participate in the international FGRs conservation events.

Strategies

- Setting up National Plant Biodiversity Coordination Centre at relevant ministry level. This centre should oversee the need of funding, coordination and implementation of programmes in research, education and public awareness.
- Urge government to provide funding on plant biodiversity programmes especially in basic and fundamental research.
- Urge funding agencies to proportionately allocate their fund to reflect the importance of FGR.
- The spending of 'timber cess and levy' income should be extended to support more research on FGR conservation and to implement conservation strategies.
- Encourage private sectors to provide complementary funds for conservation activities and to create endowments to support capacity building in taxonomy.
- Local scientists should be encouraged to tap international funds available for fundamental research.
- External fund should be proportionally covered both biotechnology and biodiversity.
- Scholarship and financial assistance, research grants and other monetary incentives should be made available to postgraduates to pursue degrees in plant taxonomy and related disciplines.
- Dedicated fund should be made available for local scientists to participate in important international symposia/congress.

How to create public awareness on FGR conservation? How to create networks for conservation activities?

Gaps

- Lack of publication (books, magazines, pamphlets and posters) related to FGR conservation for public.
- Lack of local contents for e-learning.
- Lack of interactive multimedia (games, websites and portals).
- Curriculum weakness in covering issues on FGRs conservation.
- Lack of commitment among decision makers on FGRs conservation issues.
- Lack of FGR conservation based NGOs.
- Lack of coordination and network among institutions and/or scientists.
- Lack of cooperation between NGOs for FGR conservation issues.

- Lack of regional and international networking and communication for FGR conservation.

Strategies

- Encourage scientists to participate in the production of articles, commentaries, and films related to FGR conservation.
- Establish rapport with mainstream journalists and media agencies.
- Eencourage local scientists to publish in international journal to increase their exposure and networking.
- Incentives and recognition for scientists prolific in production of information for popular media.
- Suggest to institutions to offer courses to combine FGR conservation and journalism.
- Review current school curriculum at all level and to suggest remedial inputs to strengthen our curriculum to address current concern on FGR conservation.
- Support from government to ensure commitment among decision makers on FGR conservation issues.
- Set up a coordinating body to coordinate activities among institutions and/or scientists.
- Collaborate and include NGOs in FGR conservation programmes.
- Collaborate and include biotechnologists in biodiversity and/or FGR conservation projects.
- Establishment of Botanical Society of Malaysia that will promote Special Interest Groups (SIGs) for 'hot' botany.
- Encourage more student and staff exchange within ASEAN countries.

Appendix 5

List of Participant

1	Abd. Ramlizanyahhudin Mahli	Jabatan Perhutanan Negeri Pahang
2	Ahmad Hamka Mohd. Yasin	Pejabat Hutan Daerah Johor Selatan
3	Choo Kwong Yan	Bioversity International
4	Grace Yip	Malaysian Furniture Industry Council
5	Hairi Jaafar	Perak ITC Sdn. Bhd.
6	Hong Lay Thong	Bioversity International
7	Isa bin Ipor	Universiti Malaysia Sarawak
8	Ismail Jusoh (Dr.)	Universiti Malaysia Sarawak
9	Ivy Wong Abdullah	WWF Malaysia
10	Kevin Ng Kit Siong (Dr.)	Forest Research Institute Malaysia
11	Kuina Kimjus	Sabah Forestry Department
12	Lee Soon Leong (Dr.)	Forest Research Institute Malaysia
13	Lucy Chong	Sarawak Forestry Corporation
14	Malcon Denies	Sarawak Forestry Corporation
15	Ng Chin Hong (Dr.)	Forest Research Institute Malaysia
16	Nik Mohd. Shah Nik Mustafa	Jabatan Perhutanan Semenanjung Malaysia
17	Nor Haslin Abd. Halim	Conservation & Environmental Management Division, NRE
18	Norlia Basherudin (Dr.)	Forest Research Institute Malaysia
19	Norwati Adnan (Dr.)	Forest Research Institute Malaysia
20	Reuben Nilus	Sabah Forestry Department
21	Samsudin Sueet	Jabatan Perhutanan Negeri Pahang
22	Saw Leng Guan (Dr.)	Forest Research Institute Malaysia
23	Shaharuddin Mohd Ismail (Dato')	Institute for Environment and Development UKM
24	Shahidin Ahmad Juffiry	Perak ITC Sdn. Bhd.
25	Shahrulnizam Kasmani	Jabatan Perhutanan Semenanjung Malaysia
26	Sim Heok Choh (Dr.)	Asia Pacific Association of Forestry Research Institutions
27	Tan Chong Yin	Malaysian Furniture Industry Council
28	Yahaya Mohamood	Jabatan Perhutanan Negeri Johor
29	Yap Yee Hwai	Jabatan Perhutanan Negeri Perak
30	Zainal Abidin Atan	Jabatan Perhutanan Semenanjung Malaysia

National Workshop on Forest Genetic Resources Conservation and Management in Myanmar

Lwin Ko Oo
Forest Research Institute, Forest Department, Myanmar

Myanmar possesses a diverse species of flora, and among them 11 800 species, 2 371 genera and 273 families have already been identified. These have been providing a wide range of goods and services for not only environmental protection but also commercial utilization. The major factors threatening the sustainability of the forest genetic resources of Myanmar include agricultural expansion, shifting cultivation, over-exploitation, urbanization and infrastructure development, forest fires and mining. Realizing these threats that endanger the forest biodiversity of Myanmar, a number of *in situ* and *ex situ* conservation measures have been implemented to conserve the forest genetic resources.

Although it is well recognized that the forest genetic resources conservation and management play a vital role in the environmental stability and ecological balance, the conservation endeavours needed for sustainable utilization and development of forest genetic resources are not adequate due to various constraints and limitations. In order to strengthen and promote the forest genetic resources conservation and management, the Forest Research Institute (FRI), Forest Department (FD) of Myanmar, has been conducting national-level activities on forest genetic resources conservation through participating in the ITTO Project PD199/03 Rev. 3(F): "Strengthening National Capacity and Regional Collaboration for Sustainable Use of Forest Genetic Resources in Tropical Asia" since 2006. The three-year project, implemented by the Forest Research Institute Malaysia (FRIM), in collaboration with the Bioversity International and the Asia Pacific Association of Forestry Research Institutions (APAFRI), has seven participating partners from Cambodia, India, Indonesia, Malaysia, Myanmar, Philippines and Thailand. FRI Myanmar has also been an active member in the Asia Pacific Forest Genetics Resources Porgramme (APFORGEN), which initiated this ITTO Project.

Under the guidance of the Forest Department (FD), the Forest Research Institute (FRI) of Myanmar organized the National Consultative Workshop on Forest Genetic Resources on 26 February 2008. The objectives of this workshop were to review the status of forest genetic resources conservation in Myanmar, assess the capacity building needs in support of forest genetic resources conservation and management, and identity the stakeholders. This workshop was supported by the ITTO Project, and the Executive Director of APAFRI, who is the Project Coordinator, also attended this one-day workshop. The programme is as in Appendix 1.

In addition to the above stated objectives, the workshop would also contribute to the ITTO project by:

- Identifying problems and other constraints in a national FGR programme.
- Recommending solutions or courses of actions to address FGR issue and concerns.
- Soliciting inputs in crafting a viable research and development national agenda for FGR conservation and management.
- Determining capacity building activities for a vibrant national FGR programme.
- Generating support and commitment from institutions and other stakeholders to implement programmes for FGR conservation development in their regions.

The workshop was attended by 25 participants from the various ministries, research agencies, academic sectors, and non-governmental organizations (Appendix 2). The morning session has three presentations:

a. An Overview of Forest Genetic Resources Conservation in Myanmar with Reference to International Context by Htun Paw Oo and Win Myint (Appendix 3);
b. Rationale for Germplasm Conservation of Medicinal Plants and Wild Relatives of Cultivated Species by Dr. Kyaw Kyaw Khaung (Appendix 4); and
c. Present Management of the Existing Teak Resources in Myanmar by Dr. Nyi Nyi Kyaw (Appendix 5).

An Overview of Forest Genetic Resources Conservation in Myanmar with Reference to International Context

The objectives and activities of Conservation of Biological Diversity (CBD) and some definitions used in forest genetics resources conservation and management activities were explained. These were followed by brief descriptions on activities related to the Global Strategy for Plant Conservation, the World Conservation Union (IUCN), the Convention on International Trade in Endangered Species (CITIES), Food and Agriculture Organization (FAO), International Tropical Timber Organization (ITTO) and Forest Genetic Resources Conservation and Management Project (FORGENMAP).

In the second portion of this presentation, the current situations of Myanmar's forest resources, forest conservation in Myanmar and the regulatory framework of forest conservation in Myanmar were further elaborated.

Rationale for Germplasm Conservation of Medicinal Plants and Wild Relatives of Cultivated Species

This presentation explained in details the definitions, functions and utilizations of plant genetic resources. The presenter also covered genetic diversity, ecosystem and forest genetic resources including medicinal plant resources and wild relatives of cultivated species, as well as the systematic identifications of plant diversity using phenotypic and genotypic characters.

Present Management of the Existing Teak Resources in Myanmar

The current status of teak (*Tectona grandis*) genetic conservation and improvement in Myanmar and the various activities/programmes, such as establishment of seed production area (SPA); clonal seed orchards (CSO) and hedge gardens; experimentation of tissue culture method and vegetative propagation method; reproductive biology of teak and nursery techniques to achieve the superior genetic quality for teak genetic resources were presented in detail. Other related topics such as forest policies, laws and regulations, and implementation departmental agency under the Ministry of Forestry such as Forest Research Institute (FRI), and Central Forestry Development Training Centre (CFDTC), and their activities; were also discussed by the presenter.

Group discussions

In the afternoon, three workshop groups were organized to discuss the following issues:

1. Enabling Conditions for Forest Genetic Resources Conservation and Management;
2. *In Situ* Conservation for Forest Genetic Resources; and
3. *Ex Situ* Conservation for Forest Genetic Resources.

All groups also discussed the priority species for conservation in terms of their economic and ecological importance.

On the issues of **Enabling Conditions for Forest Genetic Resources Conservation and Management, Group 1** had produced the following recommendations:

1. To propose forest legislation that supports the conservation of forest genetic resources;
2. To develop adequate institutional support for the conservation of forest genetic resources;
3. To support adequately trained personnel to undertake forest genetic resources conservation activities;
4. To improve sectoral coordination in planning, monitoring, evaluation and feedback on forest genetic resources conservation among institutions;
5. To enhance information, education and communication materials on forest genetic resources;
6. To generate public awareness on the valuation and goals of forest genetic resources.

Group 2 discussed the issues of ***In Situ*** **Conservation for Forest Genetic Resources** and recommended the followings:

1. Identification and design of conservation areas
   (a) Conduct periodic forest inventory
   (b) Select the target species – Commercial, and endangered species
   (c) Phenology and morphonology
   (d) Causes of depletion
   (e) Conservation stands in Reserved Forests and Protected Public Forests

2. Management
   (a) Protect conservation areas
   (b) Retain seed trees
   (c) Execute ecological assessment
   (d) Appropriate slivilcultural treatments

3. Monitoring and Evaluation
   (a) Establish permanent sample plots
   (b) Use remote-sensing techniques and GIS

The issues of ***Ex Situ*** **Conservation for Forest Genetic Resources** were discussed by **Group 3** and the followings were recommended:

1. Selection of target species
   (a) Plant the target species in arboreta and botanical gardens
   (b) Establish seed stands, seed orchards and genes banks
   (c) Undertake provenance trails
   (d) Set up *in vitro* cryo-preservation facilities
   (e) Establish protocols for macropropagation of each of the timber species
   (f) Use of molecular genetic techniques
   (g) Use recombinant DNA techniques
   (h) Observe reproductive biology
   (i) Design computerized database system
2. Monitoring and Evaluation
   (a) Use GIS to define the location of target species
   (b) Enhance knowledge in population diversity of the target species

Participants at the Myanmar National Workshop on Forest Genetic Resources Conservation and Management

Appendix 1

National Workshop on Forest Genetic Resources Conservation and Management

26 February 2008, Yezin

Programme

08 : 00 – 08 : 30	Registrations
08 : 30 – 09 : 00	Opening Ceremony
	Opening Remark by Minister, Ministry of Forestry
	Opening Remark by APFORGEN Representatives
09 : 00 – 09 : 30	Tea Break
09 : 30 – 10 : 00	Introduction of Workshop and ITTO project
10 : 00 – 12 : 00	Paper Presentations by 3 Resources Persons
12 : 00 – 13 : 00	Lunch Break
13 : 00 – 13 : 30	Organize the Working Groups
	(1) Identify stakeholder on FGR C&M
	(2) Capacity building needed for FGR C&M
	(3) Review and plan the FGR C&M strategies
13 : 30 – 15 : 00	Working Groups Discussions
15 : 00 – 15 : 30	Tea Break
15 : 30 – 17 : 00	Working group Presentations and Recommendations
17 : 00 – 17 : 30	Closing Remarks

Appndex 2

Participant List

	Name	Occupation	Department	Remark
1.	U Ohn Winn	Director	Planning and Statistic Department (Ministry of Forestry, MOF)	NTFM
2.	Daw Khin Win Myint	Associate Professor	University of Forestry (MOF)	NTFM
3.	U Win Aye	Staff Officer	Nature and Wildlife Conservation Division (Forest Department, FD, MOF)	
4.	U Nay Myo Shwe	Range Officer	Nature and Wildlife Conservation Division (FD, MOF)	
5.	U Phya Soe Aung	Range Officer	Nature and Wildlife Conservation Division (FD, MOF)	
6.	U Kyaw Moe Aung	Staff Officer	Planning and Inventory Division (FD, MOF)	
7.	Daw Thwe Thwe Win	Range Officer	Central Forest Development & Training Center (CFDTC, FD)	
8	Dr. Nyan Htun	Group Leader	Forest Academy Association	
9.	U Aung Khin	Deputy Director	Dry Zone Greening Department (MOF)	
10.	U That Wai	Staff Officer	Dry Zone Greening Department (MOF)	
11.	U Ohn Win Maung	Deputy General Manager	Myanmar Timber Enterprise (MOF)	
12.	Daw Kyi Kyi Khing	Head Officer	National Commission on Environnemental Affaires (NCEA, MOF)	NTFM
13.	Dr. Mie Mie Aung	Lecturer	University of Agriculture (Ministry of Agriculture & Irrigation, MOA&I)	
14.	U Than Sein	Senior Researcher	Seed Bank, Department of Agricultural Research (MOA&I)	
15.	Daw Thida Shwe	Deputy Director	Department of Traditional Medicine (Ministry of Health, MOH)	
16.	Dr. Khin Myat Lwin	Lecturer	University of Science and Technology, Kyautsae (Ministry of Science and Technology, MOS&T)	
17.	Dr. Myint Aung	Lecturer	Department of Botany, University of Yangoon (Ministry of Education, MOE)	

18.	Dr. Khin Thida	Professor	Department of Botany, University of Mandaly (MOE)	
19.	U Than Nwe	Executive	Forest Resource Environment Development and Conservation Association (FREDA, NGO)	NTFM
20.	U Nyo Maung	Retired Professor	Biodiversity and Nature Conservation Association (BANCA, NGO)	NTFM
21.	U Thein Lwin Oo	Head Officer	Woodland Company Ltd., NGO	
22.	Dr. Saw Lwin	Executive	Myanmar Floriculturist Association (MFA, NGO)	
23.	Daw Thein Kyi	Assistant Director	Forest Research Institute (FRI, FD)	
24.	Daw Mu Mu Aung	Research Assistant 2	Forest Research Institute (FRI, FD)	
25.	Daw Khin Pa Pa Shwe	Research Assistant 2	Forest Research Institute (FRI, FD)	
26.	U Ohn Lwin	Assistant Director	CFDTC, FD	NTFM
27.	U Htun Paw Oo	Director	Forest Research Institute (FRI, FD)	RP
28.	Dr. Nyi Nyi Kyaw	Deputy Director	Forest Research Institute (FRI, FD)	RP, NTFM
29.	Dr. Kyaw Kyaw Khaung	Professor	Department of Botany, University of Yangon (MOE)	RP
30.	U Win Myint	Staff Officer	Forest Research Institute (FRI, FD)	RP

RP = Resource Person
NTFM = National Task Force Member

Appendix 3

An Overview of Forest Genetic Resources Conservation in Myanmar with Reference to International Context

U Htun Paw Oo and U Win Myint
Forest Research Institute
Yezin, Nay Pyi Taw

Introduction

Forest conservation was not a new term and generally known as conserving forests and forest resources. Conservation principles and cultural practices of forest conservation were already in place and practiced. However the need for conservation of genetic resources in conjunction with biological diversity conservation has received attention over past decades. In this context, forest genetic resources conservation appeared as particular objective under the overall objective of forest conservation in recent years. The new subject calls for further technology and actions added to traditional practices of forest conservation. Therefore it is worth to review forest genetic resources conservation of Myanmar with reference to international context.

International Context of Forest Genetic Resource Conservation

Conservation of Biological diversity (CBD)

Living resources essential for human survival and sustainable development are increasingly being destroyed or depleted. At the same time human demand for those resources is growing fast. With this notion, the World Conservation Strategy: Living Resource Conservation for Sustainable Development was prepared by the World Conservation Union (IUCN) with the assistance of the United Nations Environment Programme (UNEP) and the World Wildlife Fund (WWF) in 1980. The strategy stressed to conserve: ecological processes and life-support systems and genetic diversity, and to ensure the sustainable utilization of species and ecosystems. The strategy also noted that tropical forests are an important renewable resource, acting as a reservoir of genetic diversity.

The UNEP marked a landmark in conservation of biological diversity at the United Nations Conference on Environment and Development (UNCED), also known as the Rio Summit or the Earth Summit), held in 1992 by opening up the Convention on Biological Diversity (CBD) for signature. The CBD entered into force on 29 December 1993. The principle objectives of the CBD are:

- the conservation of biological diversity
- the sustainable use of biological diversity, and
- the fair and equitable sharing of benefits arising from the utilization of genetic resources.

Some Selected Terms and Definitions Provided by the Convention

Biological diversity – the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and ecosystems.

Ecosystem – a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.

Habitat – the place or type of site where an organism or population naturally occurs.

Ex situ conservation – the conservation of components of biological diversity outside their natural habitats.

In situ conservation – the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.

Protected area – a geographically defined area which is designated or regulated and managed to achieve specific conservation objectives.

Some salient points in provisions on *ex situ* conservation

- adopt measures for the *ex situ* conservation of components of biological diversity, preferable in the country of origin of such components;
- establish and maintain facilities for *ex situ* conservation of and research on plants, animals and micro-organisms, preferable in the country of origin of genetic resources;
- adopt measures for the recovery and rehabilitation of threatened species and for their reintroduction into their natural habitats under appropriate conditions;
- regulate and manage collection of biological resources from natural habitats for *ex situ* conservation purposes not to threaten ecosystems and *in situ* populations;
- prevent the introduction of control or eradicate those alien species which threaten ecosystems, habitats or species.

Article 8 and Article 9 contain key provisions on two forms of conservation measures of biological diversity: *in situ* conservation and *ex situ* conservation respectively.
Some salient points in provisions on *in situ* conservation are:

- select, establish, and manage protected areas;
- protect ecosystems, natural habitats;
- restore and rehabilitate degraded ecosystems ;
- promote the recovery of threatened species;
- sustainable development in areas adjacent to protected areas;
- manage the risks associated with the use and release of living modified organism resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and use of biological diversity, taking also into account the risks to human health.

Global Strategy for Plant Conservation

Recognizing that forests are an important repository of biological diversity, the sixth meeting of the Conference of the Parties to the Convention (CBD/COP6) held in The Hague, Netherlands in April 2002 adopted a Global Strategy for Plant Conservation as in Decision VI/9. The strategy laid down 16 outcome-oriented targets, aimed at achieving a series of measurable goals by 2010. The ultimate objective of the strategy is:

- To halt the current and continuing loss of plan diversity;
- To enhance the ecosystem approach to the conservation and sustainable use of biodiversity focusing on the vital role of plant in the structure and functioning of ecological systems.

The global targets appeared under five sub-objectives are:

- Understanding and documenting plant diversity
- Conserving plant diversity
- Using plant diversity sustainability
- Promoting education and awareness about plant diversity
- Building capacity for conservation of plant diversity.

The World Conservation Union (IUCN)

Because of the intrinsic importance of protected areas in biodiversity conservation and in order to standardize international terminology, the IUCN developed protected areas system into six categories as follows (IUCN 1994):

Ia = Strict nature Reserve: Protected area managed mainly of science.
Ib = Wilderness Area: Protected area managed mainly for wilderness protection.
II = National Park: Protected area managed mainly for ecosystem protection and recreation.
III = Natural Monument: Protected area managed mainly for conservation of specific natural features.
IV = Habitat/Species Management Area: protected area managed mainly for conservation through management intervention.
V = Protected Landscape/Seascape: Protected area managed mainly for landscape/seascape conservation and recreation.
VI = Managed Resource Protected Area: Protected area managed mainly for the sustainable use of natural ecosystems.

The Convention on International Trade in Endangered Species (CITIES)

CITES is an international treaty that regulates the international trade in wild animals and plants and their products.

Appendix I applies the most stringent controls to trade. This level of protection is reserved for those species determined to be imminently threatened with biological extinction.

Appendix II applies species currently threatened with extinction, but may become so if trade is not regulated.

Appendix III includes species listed by individual countries in an effort to obtain international cooperation to control trade from their country.

Food and Agriculture Organization (FAO)

The FAO plays a major role in strengthening national programmes and regional collaboration on forest genetic resource conservation. The Food and Agriculture Organization (FAO) Panel of Experts on Forest Gene Resources holds a series of meeting (session). The Panel observed the state of forest genetic resource (FGR) conservation in the Southeast Asia or ASEAN countries as follows:

- All countries have national forest planning (NFP).
- NFPs are generic covering the different strategic frameworks
- National programmes on FGR are not yet well established

The Panel suggested that the national programme on forest genetic resources conservation should make a full use of the existing NFP. There are collaborations between national institutions and several donor-funded projects are focusing on FGR. However, before any regional efforts can be meaningful, it is necessary that the active national programmes on FGR are operational and supported by policy makers (FAO 2002).

International Tropical Timber Organization (ITTO)

The International Tropical Timber Organization (ITTO) is dedicated to the sustainable development of tropical forests through trade, conservation and best practice forest management. With financial support by Japan and USA, an ITTO project titled "Planning Practical and Cost-Effective Strategies for Genetic Resource Conservation of Commercial Tree Species in Tropical Asia and the Pacific" was implemented. Participating countries were Brunei, Indonesia, Malaysia, the Philippines and Papua New Guinea.

Table 1. Measures adopted by countries for *in situ* conservation of plants and animals

Country	*In situ* conservation measures	
Brunei	Forest reserves-production	
		- Conservation forests
		- National parks
	Stateland forests	- Recreational forest
	Germplasm conservation	- Forest management
		- Germplasm resource areas
	Ecosystem reserves	
	Tree species conservation	
Indonesia	Protected areas	- National parks
		- Wildlife reserves
	Production forests	- Conservation programmes
		- Replanting bare sites
		- Hunting parks
		- Tree improvement programmes (provenance seed stand, seed orchard, clonal seed orchard)
		- Local community activity (biosphere reserve)
Malaysia	Total protected areas	- National parks
		- State parks
	Permanent forest reserves	- Production forests
		- Protection forests
		- Amenity
		- Research and education
		- Virgin jungle reserves
		- Genetic resource areas
		- Seed production areas
Philippines	Tree species conservation	
	Integrated protected area system	

Source: ITTO, 2000

Table 2. General list of *ex situ* conservation measures

Country	*Ex situ* activities and techniques
Brunei	
	- Trial plots of local and exotic tree species
	- *In vitro* cultures of elite genotypes
	- *In vitro* storage
	- Field gene banks
	- Seed banks and seed orchards
	- Germplasm collection
	- Forest genetic resources checklist
Indonesia	
	- Gene banks for seed and pollen
	- Clonal banks
	- Arboreta
	- Breeding populations
	- Tissue culture
	- Cryopreservation
	- Recombinant DNA
Malaysia	
	- Trial plots of local and exotic species
	- Seed stands/ orchards
	- Clonal orchards
	- Seed gene banks
	- *In vitro* gene banks
	- Cryopreservation
	- Slow growth studies
	- Tissue culture
Philippines	
	- Species and provenance trials
	- Clonal propagation
	- Macropropagation
	- Tissue culture
	- Seed banks
	- *In vitro* banks

Source: ITTO, 2000

ITTO's review of the state of FGR conservation in participating countries:

- good land use management plan is first needed
- proper management of natural forests is the cheapest and most effective way of conserving plant species
- Apart from minimizing destruction of forest, plantations preferably using indigenous species

Forest Genetic Resources Conservation and Management Project (FORGENMAP)

Thailand initiated the Forest Genetic Resources Conservation and Management Project (FORGENMAP) in cooperation with Danish International Development Agency (Danida) in 1997. The objective is to secure forest seed sources and improving seed supply for reforestation and rehabilitation purpose in Thailand. In 2001, the FORGENMAP organized a regional workshop that became the first meeting on forest genetic resources in the Southeast Asian. The International Plant Genetic Resources Institute (IPGRI, now known as Bioversity

International), the FAO Forestry Research Support Programme for Asia and the Pacific (FORSPA), the Danida Forest Seed Centre (DFSC), and the CSIRO Forestry and Forest Products, Australia provide additional support and technical contribution to the workshop. Delegates from Cambodia, Indonesia, Lao PDR, Malaysia, Philippines, Thailand and Vietnam participated in the workshop.

There remained many national and international and non-governmental institutions providing either financial or technical assistance through various national and regional programmes or projects related to forest genetic resource conservation (e.g IUFRO, IPGRI, APAFRI, CSIRO, etc).

Forest Genetic Resource Conservation in Myanmar

Rationale

Situated within a wide latitudinal range from 9′ 58″ to 28′ 29″ in the northern hemisphere and a high altitudinal variations from sea level delta regions in the south to snow caped mountains in the north, Myanmar has diverse ecosystems wherein forest vegetations are important key components. Given such a favourable geographic situation, Myanmar is a comparatively natural resource rich country in the region. Of the natural resources, forests are recognized as intergenerational resource playing an important role in social, economic and environmental dimensions of the country. In general, the status of forest conservation in Myanmar with a forest cover of about 52 % of the total land area to date is still fairly good in comparison with that of neighboring countries.

The forestry sector has been a prime pillar to the national economy in Myanmar. It was also observed that FE from timber products as well as forests products is increasing year by year and the contribution of FE from the forestry sector to the whole national income in 2004-05 is 14.61%. With regard to the rural economy, forests provide diverse goods and services directly and indirectly to the rural people, which constitute over 70% of the total population for their livelihoods. The goods vary from timbers of various wood species to non timber species including medicinal plants. The services are environmental greening effects and regulating functions for stability of soil and water conditions and climate which are the environmental assets of the rural people for agricultural productivity. The longevity of reservoirs and dams constructed for irrigation and multipurpose uses nationally relies on the healthiness of forest watershades.

However like other developing countries whose economies are based on natural resources, Myanmar is undergoing a critical phase to have optimum balance between national development activities and resource conservation. The fact of the matter is that forests are a limited natural resource in the context of changes in social demographic and economic profiles of the country. With an annual growth rate of 2.02% over the year 2001-02, Myanmar's population was estimated to reach 52.17 million in 2002-03 (Statistical Yearbook 2003). In consequences, demand on settlement and development area, agricultural land, and wood and non-wood forest products become intense. The notable proportion of rural population further aggravated pressures on forests through expansion of agricultural land including shifting cultivation and increased demand on various forest products. Charcoal and fuel wood still remained as major energy sources for cooking in rural and even in urban areas. Thus fuel wood collection has been one of the pressing problems on natural forests.

Economic reform from centralized economy to market oriented economy has taken place since 1988. This leads to increasing internal timber demand for nation building activities and external timber demand for prospering international timber markets. Based on year 1997-98, teak production increased 35.06% and hardwood 46.56% over a period of 10 years. Year

2006-07 was the year of maximum export of teak with 530,414 cu m as well as the largest export proportion of 91% leaving a small fragment of 9% for domestic consumption. Increasing domestic demand coupled with sky rocketing prices of timber induce illegal logging of commercial species. Not only timber species, but some non-timber species like rattan, orchids and medicinal plants are also over exploited.

In summary, due to the adverse effects from various pressures, deforestation, forest fragmentation, and habitat degradation are occurring. According to the Forest Resource Appraisal (2005) prepared by FAO, total forest cover of Myanmar decreased from 56% in 1990 to 50.2% in 2005, i.e. decreasing at 10.31% over a span of 15 years wherein open forests were at 5.06% and closed forests were 12.13%. Consequently, as forests host terrestrial biodiversity timber or tree species are lost together with associated flora and fauna.

Forest Resource Situation

The overall status of forest genetic resources of Myanmar in 2002 is as summarized in Tables 3 and 4. In Myanmar, reserved forests, protected public forests and protected areas system constitute permanent forest estate (PFE). The status of PFE of Myanmar in 2002 is provided in Table 5.

Table 3. Forest covers status in 2002

Category	Area (sq. km)	% of total land area
Closed Forests	252,939	37.38
Open Forests	100,808	14.90
Total Natural Forests	353,747	**52.28**
Shrubs	107,232	15.85
Forest Fallows	11,961	1.77
Total Open-wooded Lands	119,193	**17.62**
Other Lands	203,637	30.10
Total Land Area	**676,577**	**100.00**

Source: Forestry in Myanmar, 2003

Table 4. Status of major forest types in 2002

Types of forests	Area (sq.km)	% of total
Tidal forest Beach and dune forest Swamp forest	13,750	4
Tropical evergreen forest	55,004	16
Mixed deciduous forest	134,068	38
Dry forest	34,377	10
Deciduous Indaing (dipterocarp) forest	17,187	5
Hill and temperate evergreen forest	89,378	25
Fallow land	9,983	2
Total	**353,747**	**100**

Source: Forestry in Myanmar, 2003.

Table 5. Status of PFE in Myanmar in 2002

Legal classification	Area (sq. km)	% of land area
Reserved Forest	114,995	17.00
Public Protected Forest	26,799	3.96
Protected Area Systems	31,945	4.72
Total area of PFE	**173,739**	**25.68**
Unclassified forest area	**180,008**	**26.60**
Total	**353,747**	**52.28**

Source: Forestry in Myanmar, FD, 2003.

Note: Up until September 2006, number of PAS was noted to reach 34 notified and 8 proposed and total area was 19o66.9 sq.miles amounting to 7.30% of the total land area of the country.

Table 6. The plant genetic resources in Myanmar

Categories	No. of species
Plants	11800
Bamboo	96
Rattan	50
Shrubs	1696
Orchids	841

Source: Forestry Department, FD, 2003

Table 7. Areas of forest plantations by type at end of 2002

Plantation type	Area (ha)	% of total area
Commercial	418,550	55
Industrial	59,614	8
Village Supply	201,577	26
Watershed	87,776	11
Total	**767,497**	**100**

Source: Forestry in Myanmar, FD, 2003.

Forest Conservation in Myanmar

Myanmar has a long history of forest genetic conservation dating as far back as the eighteenth century. In 1752, the King Alongphaya, the architect of Kongbaung Dynasty, recognizing the prosperity of its wood in the future, announced the teak tree as "Royal Tree" throughout the country. Wherever it was growing in the country, teak trees were not allowed to be cut and used without permission by the King. Since then teak trees were somehow systematically extracted from the natural forests. As such, teak became the first kind of forest trees which have been reserved in the sense of *in situ* conservation in Myanmar.

Scientific forest conservation was commenced during the colonial period when the Myanmar Selection System was introduced by Dr. Brandis in 1856. Myanmar Selection System (MSS) is the principal in the management of Myanmar forests. It was developed on a sustainable yield basis. Exploitation of timber is controlled by the prescribed exploitable girth limit and Annual Allowable Cut (AAC).

The Burma Forest Act (1902) with respective rules and notifications served as the first comprehensive legal framework in forest genetic conservation in Myanmar. The law encompassed, among others, formation of reserved forests, notification of reserved trees, general protection of forest and forest-produce by the government. Next to the royal teak, the following trees became reserved trees in their respective localities.

Table 8. Reserved tress declared under the Forest Rule (1902)

Reserved trees	Vernacular name	Locality
Pentace burmanica	Thika	The whole of Burma
Pentace Grifithii	Thitsho	-do-
Hopea odorata	Thingan	-do-
Xylia dolabriformis	Pyinkado	-do-
Acacia catechu	Cutch	-do-
Pterocarpus macrocarpus	Padauk	-do-
Dipterocarpus spp.	Kanyin	Lower Burma
Cinnamomum inunctum	Karawe	Tvoy
Cinnamomum iners	Hmanthin	
Lagerostromia flos Reginae	Pyinma	Arakan, Bassein, Tavoy div
Prunus puddum, Roxb	Cherry	Mogok

Source: Rules under the Forest Act (1902)

Regulatory Framework of Forest Conservation

Throughout the colonial time, Myanmar was just a sub-region of India and forest management activities were based on Indian forest policy enacted in 1894. The forest policy then had the following three principles:

(a) to protect soil and natural resources with forest cover;
(b) to exploit timber and forest produces sustainably;
(c) to provide forest function for people's health and recreation.

While many countries were focusing on increasing timber production for economic concerns, Myanmar has paid attention on conservation where production has been based on an annual allowable cut (AAC) on sustainable basis.

Realizing the urgent need of an explicit policy in the face of dynamic changes of socio-economic and political facets, and in conformity with forestry principles adopted at the United Nations Conference on Environment and Development, the government formulated Myanmar Forest Policy in 1995.

The Myanmar forest policy recognizes the following six imperatives:

- Protection of soil, water, wildlife, biodiversity and environment
- Sustainability of forest resources taking into account for future generation
- Basic needs of the people for fuel, shelter, food, recreation
- Efficiency to harness in a socio-environmentally friendly manner, the full economic potential of the forest resource
- Participation of the people in conservation and utilization of the forests
- Public Awareness – on the vital role of the forests in well being and socio-economic development of the nation.

Some notable policy measures, in the context of wood industry development, described *inter alia* are:

1. to gazette 30% of the total land area of the country as reserve forest and 5% under protected area systems.
2. to reforest an area of 20,000 ha annually,
3. to select establish and manage forest reserves and protected areas system

Myanmar's Agenda 21 was formulated in 1997 to reflect a strong political commitment to achieving sustainable development nationally and to fulfill the call of the Earth Summit. Out of 19 chapters, Sustainable Forest Resources Management and Biodiversity Conservation appeared in chapter 14 and 15. The Agenda provided programme areas to be addressed together with objectives and actions to be taken for each chapter.

The National Forest Master Plan (NFMP) (2001-02 to 2030-31) was developed in 2001. The NFMP is a land mark in the development of forestry sector. It comprises as much as 19 chapters in two volumes stretching from the past events through the present and forecast the future. Volume no.1 focuses on policy and regulations, resource management for natural forests and plantation forests, biodiversity conservation and community forestry. Volume no.2 emphasizes more on harvesting, wood-based industry, pricing and trade of forest products, research and development, and monitoring and evaluation.

Under the provision of the policy, the Forest Law (1992) which replaced the Forest Act (1902) set a basic principle, among others, to carry out in accordance with international agreements relating to conservation of forests and environment. Chapter III relates to constitution of Reserved Forest and declaration of Protected Public Forest. It is also noted that any standing teak tree is owned by the State and empowers the declaration of trees and plants to be reserved if necessary in Article 8, Chapter III.

The Protection of Wildlife and Protected Areas Law was enacted in special reference to the protection of wild species of both flora and fauna, and ecosystems in the country. . With this new law, the Wildlife Protection Act (1936) was replaced. Chapter IV serves as procedures for Designation of Protected Areas and Establishment of Zoological Gardens and Botanical Gardens. Chapter V includes provisions for declaration of endangered species of wild plants in designated areas from extinction in Article 15-b and taking measures for conservation of protected wildlife species in Article 15-c.

Review Discussion

The Forest Policy (1995) provides ample room for forest resource conservation. The section of Protection and Management, policy measures and strategies emphasizes on RFs and PAS. The Forest Law (1992) also includes declaration of RFs and PPFs, and reserved trees in Chapter III. However, it is insufficientr to deal with procedures of conservation of reserved trees. It may be supposed those provisions in the law are good enough for forest conservation in a situation where resources are abundant and species population was rich as in the past. At the present critical situation of potential loss of valuable species including teak, further detailed provisions to deal with particular species are needed in the legal framework.

With regard to the Wildlife, the Protection of Wildlife and Protected Areas Law, it gives the definition of Wildlife as wild animals and wild plants. However, the role of wild plants is vague The Nature and Wildlife Division of Forest Department itself works more on wild animals. This mis-match may be because the new wildlife law was enacted only in 1994, while wildlife conservation has evolved over several decades from the inception of Burma

Stemmed from the principal Forest Policy, the Forest Law and the Wildlife and Protected Areas Law were promulgated with different specific objectives. With respect to forest trees/plan conservation, while reserved trees are to be declared under the Forest Law, endangered species of wild plants the Wildlife and Protected Areas Law. It is necessary to clarify objectives and activities for a species in the concept of FGR conservation.

Theoretically, FGR conservation is part of Sustainable Forest Management (SFM). Myanmar Selection System has been a principal tool in the achievement, to a remarkable extent, of SFM in Myanmar. The MSS has already been one and half century old. It was originally designed with specific attention to teak species and only teak bearing forests. Over ttime, the forest resource situation was totally changed against the changes in social, economic and environmental dimensions. Excessive exploitation of single or a few species, teak and/or hardwood species, led to loss of the species population. Even genetic degradation is likely to set in within a species resulting from prioritizing on elite quality trees for extraction and inadequate retention of mother trees in the forest.

In order to remediate pressure on teak, utilization, market development programmes and projects for lesser used species (LUS) were conducted. It was noted that LUS were hard to be available for sustainable production oncommercial scale from the mixed forests. Their limited populations in the composition of the mixed forests are likely to be prone to species loss in the onset of market demand.

Permanent forest estate (PFE) comprises RF, PPF and PAS. All these conservation units are regarded *in situ* conservation measures. RFs mainly support economy of the State and both RFs and PPFs provide basic needs for the local people. Due to the immense pressures for production of various forest resources, its protection functions become weaken. Almost all 42 PAS already established are mainly for protection. Cultural practices of gap planting, enrichment planting, natural regeneration, forest plantation in the PFE are *in situ* conservation activities

Securing quality seeds (planting material) supply to thousands of hectares of forest plantation has been a critical issue for the FD. Increasing private forest plantations with policy changes to private ownership, may intensify this problem. Therefore establishment of seed production area (SPA) are urgently needed. Phenotypically good stand selected from existing plantations have been established as SPAs in cost-effective way.

With regard to *ex situ* conservation, in Myanmar, teak seed orchards were established in Bago and Mandalay Divisions in 1981. A clonal seed orchard (CSO) of 34 ha was established in Toungoo District of Bago Division and one of 6 ha at a research station in the Yemathin District of Mandalay Division. The Forest Research Institute (FRI) of the FD has been conducting germination tests on seeds collected from these orchards. Establishment of Hedge Gardens for teak and other priority species is an option for conservation of FGR. Both clonal and seedling Hedge Gardens can be applied in order to ensure the sustained production of planting stock for plantations. It is simple, flexible, cost efficient and widely applicable in large scale plantation forestry because conventional vegetation propagation methods, such as grafting, budding, layering and cutting could easily be applied for clonal propagation and establishment of Hedge Gardens, germplasm. Research on shoot-cutting was successfully experimented by FRI, Yezin in 1995-96. On-site planting of rooted cuttings of teak from Teak Hedge Garden have been introduced in some forest districts in 2002. The establishment and development of Hedge Gardens for teak and priority species are much more needed to provide future large scale programme. Research on tissue culture of teak has started in late 1990s and the first batch of teak plants have been field planted. These plants are being observed growing with good health and performance. However, this achievement is still at the experimental stage and it need to be developed with momentum not only for the technical aspects but also for the mass production with reasonable costs per hectare. (Thaung Naing Oo, 2004)

Identification of the priority plant species

Identification of the priority plant species has been carried out based on the following criteria (IPGRI 1998), which are suitable for the current conditions of the country. (Thaung Naing Oo, 2004) and the proposed species are given as Annex 1.

- Ecological value
- Financial value (Nguyen Xuan Lieu, 2000)
  - Fit into the objectives of the planting programme
  - Bring high benefits
  - Have large and stable market
  - Availability of seed sources and propagation methods
  - Availability of planting and tending techniques
- (Potential) socio economic value
- Distribution pattern of the species and its population
- Distribution pattern of its genetic variation
- Threats imposed on the species
- Conservation status
- Reproductive biology
- Associated species

Conclusion

The traditional concept of forest conservation is in need of shift to a new concept of forest genetic resource conservation and the customary practices are also in need of modification with advanced technologies as well. As the forest genetic resource conservation becomes a multidisciplinary subject, relevant stakeholders are called for tocollaborate.

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Annex 1

Proposed national priority species for conservation

No.	Local name	Scientific name	Commercial value
1	Teak	*Tectona grandis*	Very high
2	Pyinkado	*Xylia xylocarpa*	Very high
3	Padauk	*Pterocarpus macrocarpus*	Very high
4	Thingan	*Hopea odorata*	Very high
5	Thitya	*Shorea obtusa*	High
6	Ingyin	*Shorea siamensis*	High
7	Tamalan	*Dalbergia oliveri*	Very high
8	Kanyin	*Dipterocarpus turbinatus*	High
9	Karaway	*Cinnamomum obtusifolium*	High
10	Kashit	*Pentace burmanica*	High
11	Kokko	*Albizzia lebbek*	High
12	Kya-na	*Xylocarpus molluccensis*	High
13	Sakawa	*Michelia champaca*	High
14	Sit	*Albizzia procera*	High
15	Taung-tama	*Cedrela multijuga*	High
16	Tinyu	*Pinus khasya & Pinus merkusii*	High
17	Hnaw	*Adina wordifolia*	High
18	Pin-le-Kanaso	*Baccurea sapida*	High
19	Binga	*Mitragyna rotundifolia*	High
20	Magyi-pway	*Diospyros martabanica*	High
21	Hman-thin	*Cinnamomum iners*	High
22	Yinma	*Chukrasia velutina*	High
23	Yemane	*Gmelina arborea*	High
24	Yindaik	*Dalbergia cultrata*	High
25	Thadi	*Protium serratum*	High
26	Tinwun	*Milletia pendula*	High
27	Thitkado	*Toona ciliata*	High
28	Thit-hka-ya	*Diospyros oblonga*	High
29	Thitsi	*Melanorrhoea usitata*	High
30	Thitmagyi	*Albizia odoratissima*	High
31	Thitsho	*Pentace griffithii*	High
32	Anan	*Fagraea fragrans*	High
33	In	*Dipterocarpus tuberculatus*	High

Appendix 4

Rationale for Germplasm Conservation of Medicinal Plants and Wild Relatives of Cultivated Species

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Introduction

Nature has generated, over the millions of years of evolution, diversity in biological organisms. This diversity has enabled various organisms to adapt, survive and reproduce under diverse and changing environments. The human beings, since the initiation of the ancient civilizations, discovered, used and altered bio resources as per their needs; and have, thereby, contributed, over the course of time, to the evolution of diversity in bio resources. The challenge of ecologically sustainable development is the single most pressing issue that confronts the humankind today; and diversity of bio resources provides the foundation blocks for that. The ecosystems rich in diversity possess greater resilience and are, therefore, able to recover and adapt more readily from natural calamities and stresses or human induced habitat degradations. If biodiversity is drastically diminished, the functioning of ecosystems is put at risk.

What is biodiversity?

Biodiversity is the total variability within all the living organisms and the ecological complexes they inhabit. Biodiversity has three levels – ecosystem, species and genetic diversity – reflected in the number of different species, the different combination of species and the different combinations of genes within each species. The variability among living organisms from all sources and the ecological complexes of which they are part; this includes: Ecosystem diversity: the variety and frequency of different ecosystems. Species diversity: the frequency and diversity of different species. Genetic diversity: the frequency and diversity of different genes and/or genomes. It includes the variation within a population and between populations.

Beginning of the agricultural revolution, the human species has incredibly multiplied its own numbers at the expense of the rest of the world's biota. Threats to destruction of biodiversity in general stem from the very high rate of growth of human population, especially during the latter half of last century.

Ecosystem

Ecosystems make up big natural systems such as grasslands, mangroves, coral reefs and tropical forests, also agro-ecosystems, which are highly dependent on human activities for their existence and maintenance.

Genetic diversity

A species or a population has the ability to adapt with ever changing environments. It is the foundation upon which plant breeding depends for the creation of new varieties and is, therefore, a critical public value for global food security. Genetic diversity occurs at gene level (the molecular level), the individual level, the population level, the species level, and the ecosystem level.

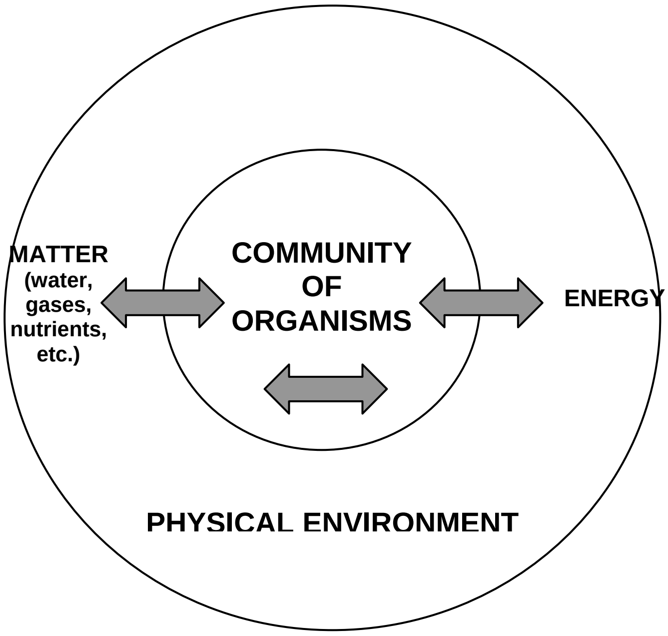


Figure 1. An Ecological System

Plant Genetic Resources (PGR)

Genetic resources are the heritable characteristics of a plant or animal of real or potential benefit to people. The term includes modern cultivars and breeds; traditional cultivars and breeds; special genetic stocks (breeding lines, mutants, etc); wild relatives of domesticated species; and genetic variants of wild resource species. A wild genetic resource is the wild relative of a plant or animal that is already known to be of economic importance. The reasons for conserving such a resource include the provision of direct and indirect economic benefits. However, the conserved genetic material must be made available to the people who require it to improve the productivity, quality, or pest resistance of utilized plants or animals. Biological assets to ensure sustainable agro-ecosystem (production and improve livelihood options). Genetic resources are the genes, stored as germplasm (seeds, tubers or other reproductive parts of plants), that can be used to develop new crops and crop varieties or to protect existing crops from pests, diseases or environmental stresses.

What are the Forest genetic resources?

Forest genetic resources are invaluable to humankind: not only as a provider of products, services and in aiding economic development but also for their unexplored potential in areas such as medical research. In spite of the high number of species already in use, less than 500 species have been systematically studied for their present-day utility and potential.

Forests provide a wide array of goods and services. Forest trees and shrubs play a vital role in the daily life of rural communities in many areas, as sources of timber, fuel wood, food, fodder, essential oils, gums, resins and latex, pharmaceuticals, shade, as contributors to soil and water conservation, and as repositories of aesthetic, ethical, cultural and religious values.

Forest animals are a vital source of nutrition and income to many people, are used for medicinal purposes, have important cultural roles, and have vital roles in forest ecology, such as pollination, seed predation and dispersal, seed germination, herbivory, and predation on potential pest species. Forests are among the most important repositories of terrestrial biological diversity. Together, tropical, temperate and boreal forests offer diverse sets of habitats for plants, animals and micro-organisms.

Conserving forest genetic resources is vital because genetic variation is the basis of evolution and the catalyst for species to adapt to ever changing environment. The forest genetic resources contained in the populations and genes of thousands of tree species globally are unique and irreplaceable. When genetic variation is lost through habitat destruction or intensive breeding, successive generations are less adapted at responding to adverse conditions such as atmospheric pollution, climate change, pests and disease.
Forest biological diversity is needed to allow species to continuously adapt to dynamically evolving environmental conditions, to maintain the potential for improvement to meet human needs and changing end-use requirements, and to support ecosystem functions.

In the same way that the term *forest resources* refers to the usefulness of the forests for the production of timber or other products for human benefit, the term *genetic resources* implies that elements of the genetic variability of the trees and other plants and animals will be used to meet human needs and objectives. The other important aspect of the *genetic resources* of natural forests, especially the tropical forests, is their great diversity, and this range of variation provides the basis for selection and improvement of the products and other benefits to meet future needs, so far as they can be foreseen.

What are the Germplasms?

The sum total of the genetic material in a plant: crop plants plus primitive cultivars, landraces, and wild and weedy relatives; also referred to as the wild species, genes from the wild, the world's gene pool of the plants, the genetic largess, the common heritage of mankind, plant genetic resources. Living substance of the cell nucleus that determines the hereditary properties of organisms and that transmits these properties from makeup of organism. Any plant genetic material used for plant propagation and breeding, with emphasis on its genetic contents. It is the genetic material, especially its specific molecular and chemical constitution that comprises the physical basis of the inherited qualities of an organism. Often synonymous with "genetic material", when applied to plants it is the name given to seed or other material from which plants are propagated.

Medicinal plants resources

Interest in the exploitation of medicinal and aromatic plants as pharmaceuticals, herbal remedies, flavorings, perfumes and cosmetics, and other natural products has greatly increased in the recent years (Anon 1994; Ayensu 1996; Salleh *et al*. 1997; Kumar *et al*. 2000). As with many other economic plants that are still being collected from the wild and exploited by humans unsustainably, threats to genetic diversity and species survival have also increased in the case of medicinal plants as a result of habitat destruction, over-exploitation, land use changes and other pressures (Arora and Engels 1993).

The medicinal plants have been used by humans from the pre-historical times. Studies have pointed out that many drugs that are used in commerce have come from folk-use and use of plants by indigenous cultures (Anon 1994). About 50 drugs have been discovered from ethno botanical leads by translating folk knowledge into new pharmaceuticals (Attachment Table 1; Cox 1994). Medicinal plants of Myanmar which are found in natural habitats, for instances are *Rauvolfia, Cassia, Dioscorea, Swertia, Atropa, Podophyllum, Psoralea, Catharanthus.* However, relatively few medicinal and aromatic plant species have been brought into cultivation worldwide and most of these species continue to be harvested from their native habitats (Gupta and Chadha 1995; Salleh *et al*. 1997; Gautam *et al*. 1998).

Very little work has been undertaken on their selection and improvement, for developing suitable varieties. Much of the existing work on *ex situ* conservation of medicinal plants has been undertaken by botanic gardens, focusing more on interspecific diversity and less on intra-specific diversity. Little genetic material for research and conservation is held in gene banks, except for a handful of species that have entered into commercial products. Most of the collections are with the private sector, and the genetic diversity status of such collections is largely unknown. Although in recent years the attention given to development of propagation methods for threatened species has increased, most of such efforts proceed with little understanding of how these methods and collections can support conservation objectives overall (Natesh 2000; Tandon *et al.* 2001; Rajasekharan and Ganeshan 2002).

Traditional practices and importance of medicinal plants are as follow; refinement of practices lead to the well established Asian systems of medicines including Ayurveda and Siddha of India, Unani system of middle and Far East Asia, Ying and Yan principles of Chinese herbal medicines, Jamu of Indonesia and others (Sharma *et al.* 1998; Natesh 2000). About 400 plant species are used in regular production of Ayurvedic, Unani, Sidhha and tribal medicine (Rajasekharanand Ganeshan 2002).

Medicinal resources occur in nature in various ways. Though much information exists on the species diversity in medicinal plants in the Asia-Pacific region, relatively very little is known about the distribution, abundance, ecology and genetic diversity of the great majority of medicinal and aromatic plants, although some efforts have started in recent years (Chadha and Gupta 1995; Chandel *et al.* 1996; Kumar *et al.* 2000; Paisooksantivatana *et al.* 2001), including the use of molecular markers (Sharma *et al.* 2000; Natesh 2000). Out of the 350,000 plant species identified so far, about 35,000 (some estimate up to 70 000) are used worldwide for medicinal purposes and less than about 0.5% of these have been chemically investigated.

Medicinal plant resource conservation *ex situ* has been observing in somewhat limited. There have been a few efforts to collect and conserve medicinal plant species. Botanic gardens are one of the main repositories of medicinal plants and good examples are set by the world renowned gardens.

Provisional grounds for conservation of medicinal plant genetic resource are exploration, collecting, assessing diversity and conservation collectively focus on the rationale for conservation of medicinal plants regarding management of these genetic resources for their utilization. Following criteria are supposed to comprehend for medicinal plants germplasm conservation;

- Understanding the diversity of medicinal plants.
- Understanding taxonomy and refine classification.
- Understanding of growth and other phonological requirement.

Wild relatives of cultivated species

The domesticated and related wild components of bioresources are the primary sources, from where the humankind derives most of its food and many products of industrial and pharmaceutical importance. In fact, only 30 plant species provide 95% of human nutrition and only three (rice, wheat, maize) contribute 56% of total food requirement globally There are approximately 400,000 plant species of which 300,000 have been documented. Among these 30,000 species are edible but, over the course of human civilization, only about 7,000 of them have been used for food. A further eight important crops or commodities with respect to energy intake are sorghum, millets, potatoes, sweet potatoes, soybean, sugar (cane/beet), beans and bananas/plantains; and groundnut, pigeonpea, lentils, cowpea and yams are the dietary staples of million of the world's poorer people. In addition to the abundance of diversity in organisms associated with agriculture, there are a large number of edible 'wild' plants, as stated above, that are used by people in different parts of the world particularly in developing countries. There have been many factors which have led to an increased realization of the importance of our indigenous PGR. The scientists have the unenviable task of continuously enhancing the crop production to meet the ever-increasing demands for food, feed, fodder, fibre, fuel etc., and at the same time to ensure sustainable development of agriculture as well as protection of environment. The plant breeders, in their search for desirable genes, depend upon PGR, to develop new and better varieties and hybrids.

Himalayan, Sino-Himalayan, Indo-Chinese-Indonesian regions are centre of diversity of several crop species; These crops are foxtail millet (*Setaria italica*), proso millet, (*Panicum miliaceum*), barnyard millet (*Echinochloa* spp.), sugarcane (*Saccharum* spp.), bamboos (*Bambusa* spp., *Dendrocalamus* spp., *Sinocalamus* spp.), buckwheat (*Fagopyrum esculentum*), mungbean (*Vigna mbella*), chickpea (*Cicer arietinum*), ricebean (*Vigna mbellate*), clusterbean (*Cyamopsis tetragonoloba*), *Brassica* spp., cucumber (*Cucumis sativus*), bitter gourd (*Momordica charantia*), bottle gourd (*Lagenaria siceraria*), snake gourd (*Trichosanthes anguina*), citrus (*C. aurantifolia* and related species of lime and lemon), taro (*Colocasia esculenta*), yams (*Dioscorea* spp.), ginger (*Zingiber* spp.), turmeric (*Curcuma longa*), and small cardamom (*Elettaria cardamomum*).

Systematics

Taxonomy: The science of discovering, describing, and classifying species or groups of species (together termed taxa).

Phylogenetic analysis: The discovery of the evolutionary relationships among a group of species.

Classification: The grouping of species, ultimately on the basis of evolutionary relationships.

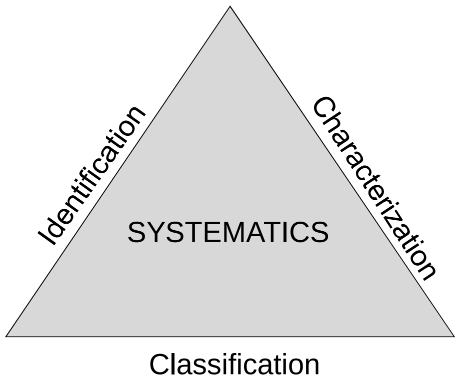
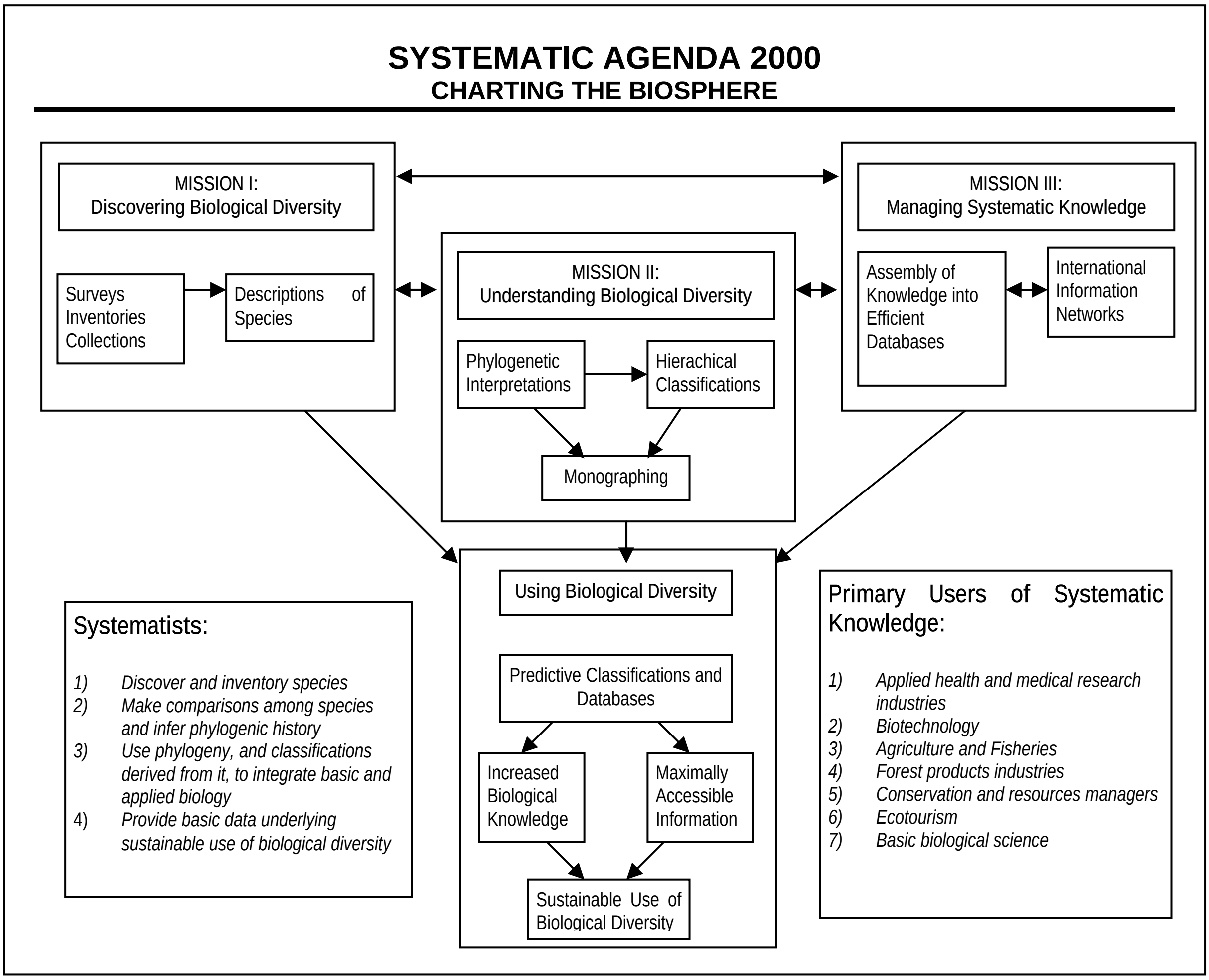
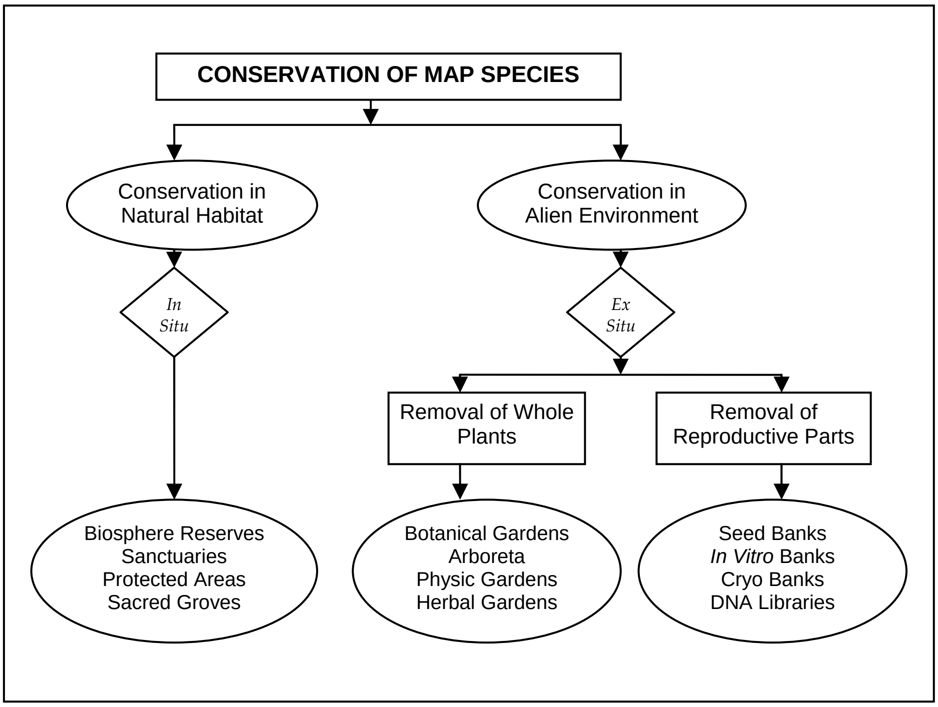


Figure 2. SYSTEMATICS



Source: American Society of Taxonomists (2000)

Figure 3. Systematic Agenda 2000



Source: Natesh (1997, 2000)

Figure 4. Conservation of MAP species

Table 1. Assessing Genetic Uniformity

Method of assessing stability		
Phenotypic	Morphology	quantitative, e.g. height
		qualitative, e.g. flower colour
	Protein electrophoresis	denaturing
		non-denaturing
		isoelectric focusing
		non-specific stain
		enzyme activity
		immunological staining
	Secondary products	alkaloid production
		gaseous evolution
Genetic	Chromosomes	general staining – ancuploidy
		giemsa/ C-banding – inversions deletions
	Restriction fragment analysis	alterations in DNA sequence

Source: Potter, R. H. and M.G.K. Jones (1991)

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Appendix 5

Present Management of the Existing Teak Resources in Myanmar

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Introduction

The forest flora in Myanmar is diverse varying from sub-alpine in the north through dry and moist mixed deciduous to tropical rain forest species in the south. Teak, economically the most important forest resource of the country, is recognized as one of the most valued and sought after tropical timbers in the world and it is asserted that at present extensive and beautiful natural teak stands can be seen only in Myanmar. It has mainly been due to Myanmar's culture and affection attached towards the trees and the wildlife, the systematic management of which has already been exercised almost one and a half centuries now.

In Myanmar, like in many other tropical countries, the forest resources are of paramount importance for national economic development and environmental conservation. The forests provide timber for both domestic use and export. They are also a vital source of food, shelter, fuel and income for the rural poor who constitute about 76% of the country's total population of over 55 million.

Notwithstanding ever increasing pressures on the forest resources for both domestic and export requirements, the forest management in Myanmar has always adhered to the principles of sustainable forest management (SFM). It is manifested by the wealth of the forest resources Myanmar is still endowed with. Myanmar Selection System or MSS in short, has been the principle forest management system applied in managing the natural forests in Myanmar since 1856. It involves adoption of a felling cycle of 30 years, prescription of exploitable sizes of trees, girdling of teak, selection making of other hardwoods, felling of less valuable trees interfering with the growth of teak, thinning of congested teak stands, enumeration of future yield trees down to fixed sizes, and fixing annual allowable cuts (AACs) for teak and other hardwoods. Simple coppice or coppice with standards systems are also applied in the local supply forest reserves.

Under MSS, only mature trees are selected and harvested. Harvesting of trees is regulated based on annual growth and controlled by girth limits prescribed species–wise. Felling of exploitable trees is within the bounds of carefully calculated Annual Allowable Cut (AAC). Fixing AACs, therefore, accords the increment of individual tree species, which has taken place over the course of 30-year felling cycle. AAC is thus a tool that ensures the harvest of timber yield on a sustained basis. AACs for teak and for non-teak other hardwoods are periodically revised and fixed based on the updated information. Current AACs are given in the following table.

Table 1. Current AACs for Teak and Other Hardwoods

Species	AAC	
	No. of trees	Cubic meter
Teak	118,548	460,528
Non-teak Hardwoods	1,131,461	2,533,608

Source: Planning and Statistics Division, Forest Department, 2006

Current Status of Teak Genetic Conservation and Improvement in Myanmar

Status of Myanmar Forests

The Forest Resource Assessment (FRA 2005) conducted by the Food and Agriculture Organization of the United Nations (FAO) in cooperation with the Myanmar Forest Department has indicated that Myanmar is still endowed with a forest covered area of 52% of the country's land total area of 676 553 km^2, one of the highest in the Asia-Pacific region. The status of forest cover is shown in Table 2.

Table 2. Forest Cover Status

Category	Area (ha)	% of total land
Closed Forest	25,516,600	37.71
Degraded Forest	9,970,500	14.74
Other Wooded Land	10,545,000	15.59
Other Land Use	21,623,200	31.96
Total	67,655,300	100.00

Source: 1998 appraisal (FRA 2005), Forest Department, Myanmar

Forests are owned by the State and are categorized legally as reserved forests (30%) and public forests or unclassified forests (70%). 13 million ha (37.8% of the total forest area and 19% of the country's land area) are categorized as Permanent Forest Estate (PFE), of which 3.3 million ha are in designated conservation reserves. It is claimed that 62.2% of the boundary of the PFE has been demarcated. Within the PFE, 9.7 million ha are designated as production forest, comprising 8.3 million ha of mixed deciduous forests and 1.4 million ha of evergreen forests.

Institutional Arrangements

Policies, Laws and Legislations

The forest policy focuses on the **Protection** of soils, water, vegetation and wildlife, **Sustainability** of forest resources, satisfying the **Basis needs** of the people, **Efficiency** in harnessing the full economic potential of the forests, **People's participation** in forest management and biodiversity conservation and raising the **Awareness** of the people and the decision makers in forestry.

The Burma Forest Act 1902 and subsequent amendments were in use until the Government promulgated new forest legislation in November 1992. The important instruments for implementation of forest resource management and biodiversity conservation are:

Forest Policy (1995);

1. Forest Law (1992);
2. Forest Rules (1995);
3. Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law (1994);
4. Myanmar Agenda 21 together with Environmental Policy
5. Departmental Instructions for Forest Officers in Myanmar 1955
6. Working Plan Manual, Myanmar 1938
7. Standing Orders for Subordinates, Forest Department 1959
8. Community Forestry Instructions 1995

Organizations for Policy Implementation

The Ministry of Forestry has the primary responsibility for the administration and management of the forestry sector. The organizational structure comprises a combination of government agencies such as the Planning and Statistics Department, the Forest Department, Myanmar Timber Enterprise, the Dry zone Greening Department, Non Governmental Organization such as the Forest Resource, Environment, Development and Conservation Association, and private bodies such as the Timber Merchants Association.

Among above mentioned organizations, the Forest Department (FD) is mainly responsible for research and development of forest management and conservation of biodiversity. Under the organizational structure of FD, the Forest Research Institute (FRI) and Central Forestry Development Training Centre (CFDTC) have been conducting some research works on genetic conservation and tree breeding and improvement by use of *in vitro* and *in vivo* propagation techniques.

Forest Research Institute (FRI)

FRI is one of the divisions under the Forest Department which has established in 1978 and it is situated in Yezin. The main research activities concerned with biodiversity conservation and tree improvement are:

- Development of natural forests
- Development of forest plantations
- Establishment of provenance trials of some valuable tree species
- Establishment of Clonal Seed Orchards (CSOs) and Seed Production Areas (SPAs)
- Vegetative propagation on teak, padauk, thitsein and other species
- Utilization of lesser-used-species
- Introducing some tropical exotic tree species as trial basis.
- Seed Improvement Activities
    - Comparison of the general characteristics of Teak fruit and seed from different provenances
    - Study on the relation seediness and emptiness of Teak, and its potential germination capacity by cutting test
    - Phenology and controlled hand-pollination of Teak in Clonal Seed Orchard
- Plus Tree Selection as a tool in Tree Improvement and *In situ* and *Ex situ* Conservation of Genetic Resources
    - Plus tree selection in any tree species population is simply "The Selection of Phenotypically Superior Trees" that would give better quality of regeneration and materials for breeding.
- Selection
    - in natural stands
    - in even-aged stands

  as many desirable traits as possible such as good stem form, good height and dbh, crown position and form, good bole height and quality, resistance to pests and diseases
- Independent Culling Levels Approach
    - Candidate tree will be compared to a number of neighboring trees for various characters.
- An Index Approach
    - Genotype and Phenotype
- Base Line Selection Approach
    - Candidate tree will be selected and compared to a regional average (or base line) calculated from a composite of measurements taken on a number of trees within a region.

Central Forestry Development Training Centre (CFDTC)

The Central Forestry Development Training Centre (CFDTC) with financial and technical aid from the Government of Japan and under the responsibility of the Forest Department was founded in 1990 as an Institute for the provision of systematic forestry training and educational opportunities to in-service personnel and to local people with the advanced technologies. The main objective is to conduct the training courses to support the major task of the Forest Department, which has to conserve the natural forests through sustainable forest management by people participation intend to provide socio-economic and environmental values to the people. At CFDTC, there is a tissue culture lab for propagation and conservation of teak and some endangered indigenous wild orchids.

Teak Improvement Programme

As many other forest tree improvement programmes, the main elements in the teak improvement programme are: strategies, tree populations, operation and management, research and development.

Strategies

Tree improvement strategies involve planning and execution for achieving general objectives, especially of long term breeding, propagation and conservation in the improvement programme. The formulation and development of an improvement strategy requires biological and technological knowledge including: genetic variation and gain, flowering biology, mating system, seed production, clonal propagation, planting techniques etc.

Populations

Tree populations in an improvement programme consist of genetic resources, breeding, propagation and wood production. The genetic structures of these four populations are the core elements in the breeding programme. Due to the differences in their objectives, genetic structures, variabilities and long-term utilization, these four populations are usually established and maintained separately.

Operation/Management

Operations and management in an improvement programme are mostly concerned with the availability of human resources, financial resources, infrastructure and organization, knowledge of the genetic parameters and reproductive biology of the species, information, technologies, etc.

Research and Development

Research and development in an improvement programme is essential to solve certain key problems. Moreover, the development of appropriate technologies will assist and facilitate the breeding activities (e.g. pollen extraction and storage, flowering induction, etc.) and propagation operations (e.g. seed production, cuttings, tissue culture, etc.).

The Objectives

The objectives in the teak improvement programmes are divided into short- and long-term objectives as follows:

Short-term objectives include increased volume production per unit area of the plantation through the improvement of growth rate (e.g. diameter and height growth). Improved stem quality of trees in terms of stem straightness, stem, clear bole, or pruning capability; persistence of stem axis other desirable characters. Improved wood qualities e.g. wood color and density. Production of genetically improved seed (e.g. through the establishment of seed production areas and seed orchards) and vegetative propagates (e.g. through the establishment of clone banks) sufficient for planting programmes.

Long-term objectives include establishment of long-term breeding populations for greater cumulative genetic gains of improved characters. Manipulation and maintenance of genetic variabilities of the breeding populations through as many generations as possible. Securing the supply of improved seed and/or planting materials of greater cumulative gain for planting programmes.

The Importance of High Quality Seed

Seeds used for plantation establishment should be of high quality because seed quality has a direct impact on the successful establishment, tree growth and quality. The quality of seed consists of three components:

- **Genetic Quality** – inherent characteristics of the tree from which seeds are collected.
- **Physical Quality** – it is related to physical characteristics such as size, color, age, occurrence of cracks, pest and diseases etc.
- **Physiological Quality** – it is related to physiological characteristics such as maturity, moisture content, and germination ability. Physiological quality is influenced by the handling, processing and storing of seed. It is dependent on the internal progress of the biological process of the seed and is not always easy to detect from visual inspection of the seed, but physiological quality can be revealed by germination test.

It is very important that seeds used for plantation establishment meet all of three qualities described above. It is worth noting that the cost of seed is proportionally very low (1–5 %) compared with the total cost of plantation establishment. The most practical option in an improvement programme for the immediate supply of quality seed is in Seed Production Areas (SPA), formed by the conversion of existing older plantations and/or natural stands.

In order to be able to maintain the reputation of Myanmar teak, it is vital that the seed used for these plantations should come from good mother trees that are of good genetic quality. The use of improved seed is most essential in the improvement of growth, stem quality and other characters of the plantation (Kaosa-ard 1995). According to a report submitted in June 2001, there was problem in getting sufficient supply of teak seed in most Forest Division except Magway Division (Anon. 2005). Consequently, most Forest Officers have no choice for selection of quality seed. Thus, each Forest Division that is planting teak should have a facility for the availability of sufficient good quality seed for their plantation.

The idea of establishment of plantation with good quality seed was conceived in the mind of foresters in Myanmar since the beginning of scientific forestry. This can be seen in the old "girdling instruction" where trees of good form, whether under- or over- the prescribed girth limit were instructed to be left as *mother trees* in the natural forests for seed collection. At the same time, a number of Seed Production Areas (SPAs) were also established by the EPP in Kabaung Reserved Forest, Taungoo Forest Division and by the Seed and Seedling Centre (SSC) and the East Pegu Yoma Project (EPP) in the Compartment 1 of Than-taung Reserved Forest Taungoo Forest Division. The interest in the programme again subsided with the completion of the EPP (Gyi and Myint 2008).

Establishment of Seed Production Areas (SPAs)

Seed Production Areas (SPA) are plantations or natural stands where phenotypically superior trees are chosen and turned into seed collection areas, after removing inferior trees. SPAs can be classified into temporary and semi permanent types; the type used will be dependent upon the need for seed and the extent of good stands. A temporary area is established and managed so that a heavy seed crop is obtained, the seed trees are felled for timber and at the same time seeds are collected. This method can be used where stands acceptable as seed production areas are numerous, so that new seed production areas can be established to replace the older ones when they are harvested.

The semi-permanent seed production area is operated on the principle that several crops will be harvested following the response to initial thinning before the seed production area trees are felled. (Note: SPAs are only interim in nature, so the trees can be harvested for timber.)

In 1996, the Forest Department has issued a detailed instruction on the establishment of SPA to the State and Division Forest Department. This was followed up the Forest Department by allotting quotas for the establishment of SPA to the States and Divisions. The area of SPA established by each State and Division up till the year 2006 are as given in Table 3 below.

Table 3. Established SPA by Forest Department up till 2006

State/Division	Area of established SPA (Acres)						Total
	Teak	Pyinkado	Padauk	Pine	Yemane	Mangrove spp	
Kachin	440	300	-	-	-	-	40.00
Kayah	100	-	-	-	-	-	00.00
Kayin	213.83	21.21	-	-	-	-	35.04
Chin	90	-	-	5.00	-	-	5.00
Sagaing	1315.00	325.00	25.00	-	-	-	665.00
Taninthayi	85.00	915.00	-	-	-	-	000.00
Bago (East)	1162.90	-	-	-	-	-	162.90
Bago (West)	1060.00	-	-	-	-	-	060.00
Magway	983.59	-	-	-	-	-	83.59
Mandalay	1299.00	25.00	-	-	-	-	324.00
Mon	28.45	1.50	-	-	-	-	9.95
Yakhaing	125.00	70.00	-	-	-	-	95.00
Yangon	-	40.00	-	-	-	-	0.00
Shan (South)				264.15			264.15
Shan (Nort	400.00	-	-	-	-	-	0.00
Shan (East)	20.00	-	-	-	-		20.00
Ayeyawady	600.00	150.00	-	-	50.00	120.00	920.00
Grand Total	7922.77	1847.71	25.00	269.15	50.00	120.00	10234.63

The idea behind this is to initiate a tree improvement programme and at the same time, have a mean of getting good quality seed quickly for the plantations that are being established. Establishment of CSOs can follow, however, intensive selection of plus trees is vital as, the logging is always faster than our selection. Moreover, selection for commercial purpose will be mostly good and big trees, leaving behind mostly smaller and inferior trees.

Establishment Method of Seed Production Area

The following steps are usually taken in the establishment of seed production area:

1. Choose good natural stands with high composition of the desired species or a good plantation with near full stocking and minimum deformed trees.
2. The stand must be old enough to produce seeds. There is no specific age limitation in natural stand but very old plantations are not easy to manage and the response to thinning is minimal.
3. Choose phenotypically superior trees. Mark the chosen trees with yellow paint and number the trees. Record must be kept in triplicate for the selected trees.
4. The size of area should be at least 5 ha.
5. It is best to retain 50 best trees of superior phenotype per acre (0.4 ha) but 20 to 30 trees per acre (50–75/ha) after thinning is acceptable. However, this will also depend upon the site quality and number of deformed trees in the plantation.
6. Thin out the inferior trees. (Note: When thinning out the inferior trees it is very important to be careful not to damage the "trees left" so as to avoid leaving degenerated trees as seed producers). Careless thinning is a most common mistake in the establishment of seed production areas.
7. Establish a buffer zone or an isolation zone or pollen dilution zone around the SPA. The zone should be about 300–450 feet (100–150m) wide.

Complete elimination of contaminating pollen is virtually impossible. The isolation zone reduces contamination to negligible amount. The zone can be left unplanted or planted with low annual or perennial species or planted with species that does not generally hybridize with those in the seed production area.

Management of Seed Production Area

1. If the SPA is to be operated efficiently, vegetative materials under the seed trees must be controlled. After thinning, clean up the residue and the forest floor of weeds. This is to prevent fire, disease outbreak and to allow easy management.
2. Fertilizer will be used in conjunction with thinning to induce heavy flowering. (Note: Younger trees respond to fertilization more than older trees).
3. Pesticides sprays to control seed insects can be applied both aerially and from the ground which is sometime not successful.
4. Record of SPAs must be kept in triplicate.

Advantage of Seed Production Area

1. Seed collected from SPAs will have better quality than seed tree method or better than that collected haphazardly.
2. When seed production areas are established in natural stands, the geographic origin of the parent trees are known, thus yielding seed from a suitable (*known*) source. A land race will be developed when the best individuals are selected from plantations.
3. Quality seeds which are well adapted can be collected at a modest cost.

Teak Clonal Seed Orchards (CSOs)

Although the SPA has many advantages, the establishment of CSOs is still essential, as the core component in a teak improvement programme. In breeding populations, the CSOs create successive new breeding and propagation populations with greater cumulative genetic gains. In propagation populations, successive CSO produce larger quantities of seed with greater genetic gains compared with the SPA. Although Teak CSOs have long been established throughout the region in Asia, little is known about seed production capacity in the seed orchards. In Myanmar, the need for proper tree improvement programme was greatly debated at the initiation of the early 1980's. Consequently, the first Clonal Seed Orchards (CSOs) were established at Moswe, Pyinmana Forest Division by the FRI in 1981, and the second CSO at Let-pan-khon, Toungoo Forest Division, by the EPP in consultation with FRI in 1983. In 1998, the FRI has established a new teak CSO with 25 clones which are collected from the selected plus trees.

Reproductive Biology of Teak

Knowledge of specific reproductive biology is very important in the formulation of improvement strategies. This knowledge includes maturity and flowering, type of flower, flower initiation, development and structure, pollination mechanism, fruit setting, development and ripening, etc.

Flowering

Teak starts flowering at 6–8 years after planting. However, the first flowering may be as early as 3–4 years and as late as 20–25 years. The first flower panicle usually initiates and develops from the terminal shoot of a stem axis (Gram and Larsen 1958; Boonkird 1964). This first flowering habit causes a development of the forked stem of this species (Boonkird 1964). That is, early flowering trees usually have shorter stem boles than late flowering trees. Teak flowering starts soon after the growth flushing stage, i.e. in the middle of rainy season. The flowering time of this species, however, varies depending on the arrival of the rainy season. In Myanmar, flowering time usually starts in June–July and lasts until September. The flowers occur in a large panicle and each panicle contains 1,200 – 3,700 flowers (Bryndum and Hedegart 1969) and may be up to 8,000 flowers (White 1991). The flower is white and small (6–8 mm in diameter) and perfect type, consisting of six sepals, six white petals, six stamens and a pistil (Bryndum and Hedegart 1969). The flower opens for only one day; if no pollination occurs it will drop in that evening or in the next morning (Bryndum and Hedegart. 1969.

Pollination time

Although the flower buds start opening in the early morning, the pollination period begins in late morning and reaches a peak during midday, 11.30–13.00, and then declines thereafter (Bryndum and Hedegart 1969; Hedegart 1973). This is due to the light requirement for pollen ripening and receptivity. During this pollination period, the pollen is fully developed and is easily transferred by the pollinators. At the same time, a large quantity of fluid exudes on the stigma for trapping pollen (Hedegart 1973; Siripatanadilok 1974). The flower usually opens for one day; pollen receptivity also lasts within that day; where as the pollen viability may be up to 3 days after flowering (Egenti 1981b). Using the vacuum desiccators' storage technique pollen viability can be maintained for as long as 24 months and used successfully in the controlled pollination (Egenti 1981b)

Pollination vectors

Teak is a mainly insect-pollinated species but some wind pollination also occurs (Bryndum and Hedegart 1969; Hedegart 1973). A series of studies in Thailand and Nigeria showed that the percentage of fruit setting per flower panicle increases significantly with an increase in number of visits of pollinators (Hedegart 1973; Egenti 1981a). Bees, flies, butterflies and ants appear to be major pollinators as identified in Thailand and Nigeria are shown below:

List of species of teak insect pollinators

Species	Family
Apis florea	Apidae
Acraea bonasia	Nymphalidae
Belenois calypso	Apidae
Belanogaster juviceus	Formicidae
Ceratina hieroglyphica	Anthophoridae
Euphaedra janatta	Nymphalidae
Heriades parvula	Megcichilidae
Heriades bingham	Megcihilidae
Megachile cincta	Megachilida
Nomia tridinta	Halictidae
Sarcophaga spp.	Sacophagidae
Tabanus spp.	Tabanidae

Source: Choldumrongkul and Hutacharern (1986)

Crossing or selfing species

Teak is a cross-pollinating species (Bryndum and Hedegart 1969; Hedegart 1973). Under controlled pollination, the highest percentage of self-compatibility is only 5.5 % as compared with crossing which is as high as 60 % (Bryndum and Hedegart 1969; Hedegart 1973). Moreover, the selfed seeds are smaller in size and lower in viability and germination percentages than the crossed seeds (Bryndum and Hedegart 1969; Hedegart 1973). However, when germination percentage of routine or open pollinated seed is taken into account, the proportion of self-pollinated seed to cross pollinated seed in each seed lot may be as high as 30% (Bryndum and Hedegart 1969). This is due to the lack of insects for cross pollination activity. In Papua New Guinea, Cameron (1966) reported similarly that the proportion of selfed seed from open pollinated seed orchards is expected to be very high, based on assumptions that cross pollinated seeds will occur only through insect activity and observations that an early flowering isolated seed orchard tree can produce a quantity of viable seed. Early results in isozyme studies in Thailand also indicated that there is a high possibility of selfing in teak seed orchards (Kaosa-ard 1977, 1981)

Fruit Setting

Although a massive number of small flowers occur throughout the flowering period of 4–5 months, only a small quantity of seed can be collected from each tree. This is especially with trees in plantations, SPA and CSO where the stem density is relatively high. A series of studies in Thailand and Nigeria showed similar results with only 1–2 % (with a range of 0–5 %) of flowers in each panicle successfully developing into fruits (Bryndum and Hedegart 1969; Hedegart 1973; Egenti 1981a). This low fruit percentage is due primarily to: a) the low proportion of pollinators to flowers; and b) the short flowering and pollination periods of individual flowers. Based on this assumption, the production capacity and germination of teak seed can be improved through the increase of populations of insect pollinators in the seed sources.

Genetic Variation

Provenance variation

Teak occurs naturally in India, Myanmar, Thailand and Lao (along the northern Thai-Lao border) (Kaosa-ard 1977, 1981). In Indonesia (in central and eastern Java and its neighboring islands), the species was long time (>700 years) introduced and through many generations of succession and distribution, it has been accepted as one of the natural sources (Kaosa-ard 1981, 1986). Due to its wide range of distribution, three main natural populations, i.e. the Indian, the Myanmar-Thai-Lao and the insular (Indonesian) populations, have been grouped according to their geographical differences (Hedegart 1976). Within each population, a number of sub-populations are also divided such as the "dry interior", the "moist west coast" and the "semi-moist east coast" subpopulations of the Indian population (Keiding *et al*. 1986). Apart from natural populations, the species has been introduced since the 1800s and is well acclimatized in many countries in the tropics (FAO 1957).

A series of international provenance trials (75 provenances and 48 field trials) established in the early 1970s clearly demonstrated effects of provenances or seed source on growth, stem quality and health of this species (Keiding *et al*. 1986). Reports on provenance trials from India, Thailand and Indonesia indicated that national provenances performed best. Myanmar provenances were not included in those series of international provenance trials implemented by DANIDA, and Myanmar trials have been examined in one country trial (Kyaw 2003).

Heritability values of certain characters at provenance level have been estimated to understand teak genetic parameters. Among the observed characters, diameter growth (dbh) and stem straightness and clear bole, persistence of stem axis and flowering habit (early and/or late flowering) are strongly inherited (i.e. h^2 (0.70) in this species (Harahap and Soerinegara 1977; Keiding *et al. 19*86; Kaosa-ard 1993). Based on this information, it is clearly indicated that gains of these characters can be largely improved through provenance selection.

Research activities

ITTO project titled "*Ex situ* and *In situ* Conservation of Teak (*Tectona grandis* Linn. F) To Support Sustainable Forest Management" was formulated with the objective of initiating a Tree Improvement Programme effectively in Myanmar. Thus, the project is concentrated on the simple establishment of SPA with the community participation and development of that area together with preparatory work for more sophisticated tree improvement programme. The preparatory work consists of strengthening of tissue culture laboratory, plus tree selection, and establishment of provenance trials, clonal seed orchard, and hedge gardens.

The major constraints in teak improvement strategies are low seed production, low plant percentage in nursery production and difficulty in controlled pollination. Supportive research and development in these areas are really required.

Research on seed production

Priority research on seed production should be as follows:

1. Effects of environmental factors, e.g. climate prior to and during flowering period, soil fertility and fertilizer application, stand age and density, etc., on flowering and fruit setting.
2. Flowering biology in relation to seed production, e.g. flower initiation and development, pollination ecology, fruit growth and development, etc.
3. Effects of leaf defoliators, e.g. *Hyblaea puera,* on flowering and seed productivity.
4. Effects of insects feeding on flowers and young fruits on seed production.
5. Effects of hormones and other related substances on flowering induction and seed production.
6. Effects of pollination insects on seed production.

Research on nursery techniques

Research and development priorities on nursery techniques:

1. Physiological dormancy of teak seed.
2. All existing seed pre-sowing treatment techniques are revised and/or retested. Promising techniques be further developed for large scale operation programme.
3. Nursery techniques, as transplanting and hardening techniques, i.e. to reduce growth competition and to improve uniformity of nursery seedlings.

Research on vegetative propagation

The strong current interest in vegetative propagation is justified by the outlined difficulties with seed production. An effective application of tissue culture and/or sprout-cutting of seedlings will support testing and selection in the breeding populations and may be an option for mass clonal propagation for the clonal planting programme. The possibility of mass production of tested individual clones will generally lift the possible performance level of material reaching plantation forestry in the form of clone mixtures in sets of; say 25 clones (Kaosa-ard 1979).

Other research urgently needed in association with the teak improvement programme is of wood quality studies. Environmental as well as genetic investigations into variation in those wood properties which are of economic interest should be initiated. Based on these findings it will then be possible to judge if specific wood properties should be included among the breeding objectives.

Conclusion

Teak has been artificially regenerated by: direct sowing of seed, seed broadcasting, seedling transplant and stumps (derived from seed). Traditionally, seed was collected from natural stands that are identified as seed bearers, but unfortunately these trees have become rare due to heavy felling practices in the past. Though clonal seed orchards have been promoted recently, the amount of seed produced is still below demand. Consequently, seed has been collected from genetically inferior parent trees, and this guides the increase of poor quality teak in plantations.

Clone planting was not common up to the recent past because clonal cultivation materials were very difficult to obtain. Budding, grafting and cutting techniques have been successfully developed but applied only to a limited extent. These methods have been employed to multiply plus trees for clonal seed orchards. The successful development of tissue culturing of teak in Myanmar in the past 3–4 years has opened up new horizons for clonal plantations of teak in near future.

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Philippines National Consultative Workshop to Identify Stakeholders and Capacity Building Needs in Forest Genetic Resources Conservation and Management

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Background

A National Consultative Workshop on Forest Genetic Resources Conservation and Management was organized on 6 February 2007 with the major objective of reviewing and developing the forest genetic resources conservation strategy for the Philippines. Specifically, the workshop, (a) Assessed the status of FGR conservation in the Philippines, (b) Identified research and development gaps in FGR conservation, (c) Proposed capacity-building programmes in support of FGR conservation; and (d) Solicited commitments for a National/Regional Coordinating Committee for FGR. It was attended by thirty-five (35) participants from the government, research and academic sectors.

It was highlighted by three paper presentations: (i) The Framework for Philippine Plant Conservation Action and Action Plan by E.S. Fernando, A. C. Manila and T. M.S. Lim; (ii) Research and Development Initiatives on Forest Genetic Resources Conservation in the Philippines by M.T. Pollisco and (iii) Harnessing Forest Genetic Resources for Sustainable Forest Management by M.U. Garcia.

Highlights

In the first paper Dr. Fernando stirred the interests of the audience by his presentation of the rich biodiversity treasures of the country (Appendix 1). He, however, hastened to add the perilous conditions of these plant resources as threatened by overexploitation for commercial purposes (collection of wild orchids for export), land conversion (logging and shifting cultivation), and habitat fragmentation. The Philippine National List of Threatened Species of Plants prepared by the Philippine Plant Conservation Committee contained 696 species. The paper further discussed the implementation of the Global Strategy for Plant Conservation (GSPC) in the Philippines which was partly addressed by the following initiatives: National Integrated Protected Area System (1992), National Biodiversity Strategy and Action Plan (1997), Wildlife Conservation Act (2001) and Philippine Biodiversity Conservation Priorities (2002).

The Philippine Plant Conservation Committee was created in 2003 by the Department of Environment and Natural Resources (DENR) with the major task of developing the national framework for plant conservation and serving as the National Red List Authority of the Philippines on plants. The Committee completed by the end of 2003, the *Framework for Philippine Plant Conservation Strategy and Action Plan,* which would address the targets in the GSPC. The paper concluded by saying that further work would required to develop, review and improve the Philippine Plant Conservation Strategy and Action Plant in the context of GSPC and promote its implementation.

Dr. Pollisco in the second paper reviewed relevant research on FGR in the Philippines conducted by the DENR and other research institutions including academic institutions (Appendix 2). These included tree improvement programmes, seed technology and propagation techniques and tree production for indigenous tree species particularly dipterocarps. The paper provided a conceptual framework for DENR on the aspect of FGR conservation and management. It integrated the *in situ* and *ex situ* conservation strategies and the supporting technologies for the production of planting materials. The framework showed how the bureaus under DENR would take part in the FGR conservation and management. The paper also identified important R & D concerns, which included research on the effects of forest fragmentation on genetic diversity, since fragmentation would affect abundance, composition and behaviour of many pollinating species, R & D on the propagation of beach forest species which could be on the verge of extinction, ultra-dry seed storage for orthodox species and storage behaviour of many indigenous tree species. She also raised concerns about the critical habitats of Mindoro pine, Philippine teak, narek and apitong in Bohol and Palawan, and other local endangered tree species that needed to be protected.

The third and final paper by Dr. Garcia highlighted the importance of FGR in terms of ethical, aesthetic, ecological and economic aspects. She further explained the conservation strategies as *in situ* and *ex situ* and cited examples or programmes used in the country. Finally, she described thirteen measures to increase usefulness of FGR in the country. It touched on the following issues: enhanced information gathering and exchange for floristic surveys and forest inventory; role of indigenous knowledge systems; revitalized breeding programme using broad genetic base; provenance testing; promotion of indigenous tree species; dysgenic nature of the present selective logging system; employing multiple use in upland communities; mass propagation of non-timber forest products; mixed plantings; integration of production and protection objectives in industrial tree plantations; and harnessing biotechnology for increased growth/development of trees and pest/disease resistance.

In the afternoon the three workshop groups addressed the following issues, (a) *in situ* and *ex situ* conservation for Forest Genetic Resources, (b) Research and Development agenda for Forest Genetic Resources Conservation and (c) capacity building for Forest Genetic Resources Conservation.

All groups discussed priority species for conservation. All the groups cited the criteria that should be used to select priority species in terms of its economic and ecological importance. They agreed to prioritize the species listed in the National List of Threatened Species (as per DENR Administrative Order No. 2007-01). Group 1 discussed additional criteria for selecting sites for conservation which included, (a) the site or vegetation type that is species-rich even though the total number of species present therein may not be accurately known, (b) the site or vegetation type known to harbour a large number of endemic species, (c) the site that harbours a diverse range of habitat or ecosystem types and (e) the site that has a significant number of species adapted to special edaphic conditions, such as ultrabasic or limestone formation. The group also listed success stories on conservation for *in situ* and *ex situ* strategies, e.g. publications on *Building Lessons in the Field* and *Regional Conference on Protected Areas* as well as indigenous practices and local upland projects. For the management strategies for the conservation sites, they recommended the following:

- Assess existing experimental and research centres (Dipterocarps, conifers, mangrove) and recommend these for establishment as Field Gene Bank
- Develop data base for priority species and priority areas including success stories
- Creation of a network of Regional Botanical Gardens (both for *in situ* and *ex situ)*
- Evaluate existing Botanical Gardens
- Establishment of new Botanical Gardens
- Identification/Listing of Philippine National. Heritage Trees
- LGU resolutions/ordinances
- Develop a list of economically important species (for specific sites)

- Public awareness
- Refer to strategies identified under the Framework for Philippine Plant Conservation.

The group on R & D enumerated the following critical research gaps that needed to be addressed to promote FGR conservation:

- Continur assessment of conservation status of all FGRs (e.g. inventory, taxonomy, database of FGRs *in situ* conservation sites), conservation biology (reproductive biology)
- Ecological studies of FGRs (carbon sink, watershed/environmental services, ecotourism, genetic diversity)
- Policy assessment and formulation in support of FGRs (e.g. bioprospecting, rescue centers)
- Guidebook development for identifying FGRs
- Valuation studies of FGRs (for bio-prospecting purposes, ecological services, etc.)
- Assessment of socio-economic and cultural practices and their impacts to FGR conservation (e.g., ethno-botany)
- Production technologies/silvicultural requirements for FGRs

The group, which tackled the Capability Building/Enhancement needs to promote FGR conservation listed the following recommendations:

i) Capability-building needed by institutions to enhance FGR Conservation
   - Education and Training
   - Public Awareness (IEC)
   - Resource mobilization to support FGRC activities
   - MIS
   - Inclusion of FGRC in academic curriculum
   - Other extension programmes – demo farms, cross site visits

ii) Training courses
   - Strategies on FGRC *(in situ, ex situ)*/ results of R & D technology development
   - Stakeholders' participation in FGRC
   - FGRC advocacy – policy makers, implementers of FGRC like forest managers, community, academe
   - Product utilization, processing and marketing
   - Policy issues on FGRC – Bioprospecting, biosafety

All groups were enthusiastic in being part of the national/regional task force on FGR. A short plenary session ensued after the workshop to discuss issues arising from the previous reports. The participants also agreed to form an e-group that would sustain and enhance the information exchange between forestry practitioners, scientists, researchers and policy makers.

Appendix 1

Framework for the Philippine Plant Conservation Strategy and Action Plan

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Introduction

Species conservation efforts at the national level in the Philippines have, until recently, been more focused on wild fauna – the Philippine eagle (*Pithecophaga jefferyi),* Philippine tamaraw (*Bubalus mindorensis),* Philippine cockatoo (*Cacatua haematuropygia)* and Philippine tarsier (*Tarsius syrichta),* among several others. No national conservation programme or species recovery programme has ever been focused on wild plants even though they are rarer and more endangered than their animal counterparts.

But appreciation of plants as part of Philippine natural heritage has grown considerably. Plants are, indeed, an important component of our biodiversity and an essential resource: food, clothing, shelter, medicine, cultural artifacts. They are the primary producers; they provide the habitat infrastructure for many ecosystems, and play a key role in maintaining the environmental balance and ecosystem integrity. Plants make up vegetation such as forests and also contribute to providing many ecosystem services such as clean air, watershed protection, freshwater, climate regulation. Plants are, indeed, fundamental to human life.

Plant diversity and endangerment

The Philippines is the world's second largest archipelagic country after Indonesia. Its complex geological history and archipelagic setting, its mountainous character with diversified topography and great altitudinal range, varying exposure to shifting trade winds and typhoons, and peculiar distribution of the rainfall has resulted in a great range and diversity of habitats. These habitats are home to a wide variety of plant species; many species are restricted only to a particular habitat, mountain, or island.

A complete inventory of the plants of the Philippines has not yet been assembled, but it is estimated that the total number of vascular plant species (seed plants and ferns) alone may be of the order of about 10,000 (Table **1).** Twenty-six genera of flowering plants and ferns are endemic to the Philippines (van Steenis 1987; Madulid 1991; Johns 1995). The ferns and fern allies, gymnosperms and angiosperms constitute 22.5% of the Malesian, and 3.8% of the world's vascular flora. Taxonomic revisions and new species discoveries, as well as, geographical range extensions would undoubtedly change the estimates for the species counts.

Many of the species, especially endemic ones that are restricted in their natural distribution are seriously threatened by over-exploitation for commercial purposes (e.g. collection of wild orchids for export) and by habitat loss resulting from conversion of natural vegetation such as forests into other uses (e.g. logging operations, shifting cultivation). Logging can often lead to lost of forest structure, productivity and native species plant diversity. Habitat fragmentation also leads to major structural changes in soil, stream hydrology, microclimate, and biodiversity (e.g. Johns 1988, 1997, Douglas *et al.* 1992, 1999, Counsell 1999). In certain cases, logging and habitat fragmentation have been found to contribute to (i) a decrease in outcrossing rate in dipterocarp trees by about half the average value, and (b) a recruitment failure (i.e., reduction in the extent and intensity of reproductive episodes for dipterocarp species (Curran *et al.* 1999). Logging and habitat fragmentation can also promote the establishment of non-native or alien invasive plant species, potentially affecting forest structure and diversity even long after the perturbation has ceased (e.g. Brown and Gurevitch 2004).

Table 1. Estimated number of species of plants (including algae and fungi) currently known from the Philippines (data from Gruezo 1979; DENR-UNEP1997; Villareal and Fernando 2000; Barcelona 2002).

Plant Group	Estimated No. of Species	Endemic Species
Angiosperms	8,120	c. 5,800
Gymnosperms	33	6
Pteridophytes	1,100	285
Bryophytes	1,271	195
Algae	1,355	?
Fungi, slime molds, water molds	3,555	?
Lichens	789	?

The Philippines has been identified as one of the world's biologically richest countries and also one of the most endangered areas – indeed, one of the world's biodiversity hottest hotspots (Myers *et al.* 2000). Its lowland dipterocarp forests have been regarded, at least in the early part of this century, 'the richest of their kind in the world, especially those on the islands of Negros and Mindanao' (Wyatt-Smith 1954). Those in Surigao in Mindanao, in particular, have been considered 'amongst the grandest in the world' (Cox 1990). Whitford (1909) has shown that the relative density of dipterocarps, among trees exceeding 40 cm in diameter, varied from 3% on Mindoro Island to 89% on Negros Island.

Historically, the Philippine forests have been logged for timber products. Forest cover has continuously declined from about 68% in 1876 to a mere 18% in 2001 (Table 2). Forest destruction and degradation and conversion of unique habitats have threatened many plant species.

The 2000 IUCN Red List included 227 species of plants from the Philippines (IUCN 2000). The proposed new Philippine National List of Threatened Species of Plants prepared in 2005 by the Philippine Plant Conservation Committee includes 696 species: 480 angiosperms, 11 gymnosperms, 203 ferns and fern allies, and 2 bryophytes (Table 3). About 94 species are considered in the Critically Endangered category and 188 species are in the Endangered category.

The continuing disappearance of such vital habitats for many plant species sets one of the greatest challenges for all Filipinos: to halt the destruction of Philippine plant diversity that is so essential to meet their own present and future needs.

Table 2. Estimates of forest cover in the Philippines, 1876–2002. (after Fernando 2005. Sources: 1876–1987 from Garrity *et al*. (1993); 1990 from FAO (2001); 1999 from ESSC (1999); 1991, 1996, 2001, 2000 and 2002 from DENR-FMB 2005).

Year	Forest Cover (%)	Year	Forest Cover (%)
1876	68	1948	59
1890	65	1948	59
1900	70	1950	55
1903	70	1950	49.1
1908–1910	50	1957	44.3
1910	66	1969	34.9
1911	64	1976	30.0
1918	68	1980	25.9
1919	67	1987	23.7
1923	50	1987	22.2
1929	57	1990	22.3
1934	58	1991	20.0
1937	57	1996	18.3
1937	58	1999	18.3
1939	60	2000	17.9
1943	60	2001	17.9
1944	60	2002	17.9
1945	66		

Table 3. Threatened plants of the Philippines (2005 assessment by the Philippine Plant Conservation Committee).

Taxonomic group	Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)	Other Threatened Species (OTS) [1]	Other Wildlife Species (OWS)[2]	Possibly Extinct	All Threat Categories
Angiosperms	85	142	124	56	71	2	480
Gymnosperms	-	9	2	-	-	-	11
Pteridophytes	9	35	51	8	99	1	203
Bryophytes	-	2	-	-	-	-	2
All Taxonomic Groups	94	188	177	64	170	3	696

[1]Other Threatened Species (OTS) – refers to a species or subspecies that is not critically endangered, endangered nor vulnerable but is under threat from adverse factors, such as over collection, throughout its range and is likely to move to the vulnerable category in the near future. This shall include varieties, formae or other infraspecific categories; [2]Other Wildlife Species (OTS) – refers to non-threatened species that have the tendency to become threatened due to predation and destruction of habitat or other similar causes as may be listed by the Secretary upon the recommendation of the National Wildlife Management Committee. This shall include varieties, formae or other infraspecific categories.

Implementing the Global Strategy for Plant Conservation (GSPC) in the Philippines

As many as two-thirds of the world's plant species are threatened by deforestation and habitat loss, over consumption of resources, and the spread of alien invasive species. Loss of plant diversity also occurs in crop plants and wild relatives by genetic erosion and narrowing of the genetic resource base of many economically important species.

The Conference of the Parties (including the Philippines) to the Convention on Biological Diversity (CBD), at its 6th meeting in The Hague in April 2002, adopted Decision VI/9 on the Global Strategy for Plant Conservation (GSPC) (SCBD 2002). The Global Strategy includes outcome-oriented targets for year 2010 to reduce significantly the rate of biodiversity loss agreed at the World Summit for Sustainable Development in Johannesburg in September 2002. National governments are being invited to adopt their own targets within the framework of the Strategy.

Many of the actions required under the Global Strategy are already being undertaken in the Philippines, even well before the adoption of the Strategy in 2003. Some platforms that already address some of the actions for the GSPC include the National Integrated Protected Area System Act (1992), the National Biodiversity Strategy and Action Plan (1997), the Wildlife Resources Conservation Act (2001), and the Philippine Biodiversity Conservation Priorities (2002).

The formal creation of the Philippine Plant Conservation Committee by the DENR thru Special Order No. 2003-32 on 20 January 2003 was, in part, a direct response to the GSPC and in pursuit of the country's commitment to the Convention on Biological diversity (CBD). The Philippine Plant Conservation Committee is chaired by the Director of the Protected Areas and Wildlife Bureau (DENR-PAWB) and is composed of botanists from the academe, government agencies (including DENR), and NGOs, who provide free and voluntarily service. The committee was tasked to develop a national framework for plant conservation and to serve as the National Red List Authority of the Philippines on plants. By the end of 2003, the draft Framework for the Philippine Plant Conservation Strategy and Action Plan was completed addressing the targets in the GSPC (see Annex 1).

Implementing the Strategy will necessarily rely on a partnership approach with many different agencies, institutions and organizations, indigenous and local communities, and individuals providing diverse aspects of the required actions. Some agencies and organizations may lead others in the work on specific targets. Implementation should mainly occur thru existing work programmes and projects. We encourage all Philippine government agencies and institutions, non-government organizations, and the private sector in the plant and forest industry to review their work programmes and priorities in the light of actions identified in the Philippine Plant Conservation Strategy.

As with the GSPC, the Philippine Plant Conservation Strategy and Action Plan is not meant to be a programme of work, and therefore does not contain detailed activities or expected outputs. Rather, the Strategy provides a framework by means of setting outcome-orientated targets. Activities necessary to reach those targets can be developed within this framework. In many cases, activities aimed at plant conservation are already under way, or envisaged in existing initiatives.

Botanic Gardens

Botanic gardens around the world – currently more than 1840 in 148 countries (Wyse Jackson and Sutherland 2000) – have continued to play a significant role in the ex situ conservation of plants. Their combined living collections alone represent nearly one-third of the world's vascular flora (Wyse Jackson 1999). Botanic gardens also contribute to increasing public awareness and education on the importance of plants and in the generation of research information on the taxonomy and conservation biology of plants. Botanic gardens (including arboreta and gene banks) are *ex situ* conservation strategies designed to complement *in situ* conservation.

About 58% of the world's botanic gardens are, however, situated in temperate regions, in

North America, Europe and former states of the Soviet Union (Wyse Jackson and Sutherland 2000). Ironically, only 2.2% of the existing botanic gardens are in South East Asia where there are far exceptional concentrations of plant species, higher levels of endemism, and equally exceptional rapid loss of plant habitats.

In the Philippines, only about 10 botanic gardens (Table 4) are registered in the BGCI database. Many of these are small collections of plants for public display, while others are living collections for plant genetic resource conservation research and education. Most, if not all, remain poorly-funded and under-staffed; in the greater majority there are no scientific activities and no documentation or inventory of collections.

Table 4. Botanic gardens in the Philippines (after BGCI 2004; Catibog-Sinha and Heaney 2006)

Botanic Garden	Administrator	Location
Arboretum of the University of the Philippines	University of the Philippines - Diliman	Quezon, City
La Union Botanical Garden	Department of Environment and Natural Resources	La Union Province
Makiling Botanic Gardens	University of the Philippines - Los Baños	Laguna Province
Manila Zoo and Botanical Garden	Public Recreation Bureau, City of Manila	Manila
Patio Botanico Garden	Philippine National Museum	Manila
Philippine Bambusetum	Department of Environment and Natural Resources	Baguio City
Philippine National Botanic Garden	University of the Philippines - Diliman	Quezon Province
The Hortorium	University of the Philippines - Los Baños	Laguna Province
University of Santo Tomas Botanical Garden	University of Santo Tomas	Manila
Siit Arboretum and Botanic Garden	Eric Hanquinet	Negros Oriental Province

The Makiling Botanic Gardens (MBG) in Los Baños has approximately 5-ha of recreational area and arboretum and about 200 ha of natural forest. It was formally established in 1963 "for the purpose of supporting professional instruction and research relating to forestry and plant sciences generally and for serving the needs of tourists as well as the educational and recreational needs of the general public". On the average it receives up to 103,000 visitors each year, more than 60% of which are primary and secondary school students and nearly 50% come from the Metro Manila area. The Makiling Botanic Gardens maintains an arboretum of Dipterocarpaceae representing more than half of all the species known from the Philippines. It also has plantations of *Swietenia macrophylla* representing probably the earliest seed lot of this species first introduced in the Philippines in June 1913 from the Royal Botanic Gardens in Calcutta, India (Ponce 1933). MBG's collections of commercial timber trees also include, among others, *Vitex parviflora, Pterocarpusindicus, Afzelia rhomboidea, Intsia bijuga, Sindora supa, Madhuca betis*, *Petersianthus quadrialatus, Agathis philippinensis, Tectona grandis*, *Tectona philippinensis*, *Cedrela odorata*, and *Endospermum peltatum* (Fernando 2001).

Protected Areas

The focal response of the Philippine government to conserving its plant biodiversity is the establishment of a network of protected areas – the National Integrated Protected Areas System or NIPAS which was formally established in 1992. This network of protected areas includes national parks, watershed forest reserves, wilderness areas, game refuges and bird sanctuaries, and mangrove swamp forest reserves, including many established prior to 1992 (Tables 5 and 6). The NIPAS is the major legal instrument for *in situ* conservation of plant biodiversity in general (Catibog-Sinha 1994) and forms a significant component of the Philippine National Biodiversity Strategy and Action Plan (PAWB-DENR 1997).

The Philippines has one of the oldest national park systems in South East Asia established in the early 1900s. The 4 244 ha Makiling Forest Reserve on Luzon Island (see Table 7) is one of the earliest having been established in 1910. This and other national parks established before 1992 became the initial components of NIPAS (Table 5). Currently, there are 302 of these in the NIPAS with a total area of more than 5.5 million ha, including natural parks, protected landscapes and seascapes, natural monuments or landmarks, resource reserves, wildlife sanctuaries, natural biotic areas, and marine parks and mangrove swamps (Tables 5 and 6). Only about 93 have, thus far, been given Presidential Proclamation or Congressional actions covering some 2.95 million ha or just 9.8% of the total land area of Philippines (Table 6).

Table 5. Summary of initial components of protected areas in the Philippines (in ha) (DENR-PAWB 2003).

Region	Initial Components											
	Total		National Parks / National Marine Parks / National Marine Reserves		Game Refuge and Bird Sanctuary		Wilderness Area		Watershed Forest Reserve		Mangrove Swamp	
	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area
TOTAL	209	2,599,628	71	524,117	8	918,585	16	3,297	87	1,153,629	27	Undetermined
CAR	9	137,545	4	18,457					5	119,088		
R-I	16	25,702	7	20,994					9	4,707		
R-II	10	112,195	2	4,955	2	4,554	2	1,095	4	101,591		
R-III	15	242,823	7	31,425	1	12			7	211,385		
NCR	1	24	1	24								
R-IVA	33	107,253	11	57,379			1	430	19	49,443	2	-
R-IVB	16	1,051,869	4	134,201	3	906,799			5	10,869	4	-
R-V	23	75,759	7	42,473			4	465	5	32,821	7	-
R-VI	12	158,332	3	26,555					9	131,777		
R-VII	18	54,391	4	21,670	1	920	4	1,307	4	30,494	5	-
R-VIII	9	19,732	5	2,118					3	17,614	1	-
R-IX	7	14,390	3	3,110					3	11,280	1	-
R-X	8	146,324	3	84,616					3	61,708	2	-
R-XI	7	75,434	2	74,195			1	-	3	1,239	1	
R-XII	5	161,564	1	94.00	1	6,300			3	155,170		
R-XIII	10	32,089					4	-	3	32,089	3	-

Table 6. Summary of proclaimed protected areas in the Philippines (DENR-PAWB 2003).

Region	No.	Protected Area (ha)	Buffer Zone Area (ha)
TOTAL	93	2,954,196	217,303
Cordillera Autonomous Region	1	77,561	-
Region I	6	13,830	563
Region II	7	798,187	-
Region III	2	8,354	-
National Capital Region			-
Region IVA	11	90,802	-
Region IVB	6	360,525	11,677
Region V	10	31,109	-
Region VI	4	73,909	169
Region VII	9	70,824	-
Region VIII	10	437,220	125,400
Region IX	12	293,966	16,593
Region X	6	88,839	49,061
Region XI	5	83,769	9,479
Region XII	2	231,550	-
Region XIII	2	293,750	4,361
Autonomous Region of Muslim Mindanao			

For the large majority of the protected areas in the Philippines, there are no complete inventories of their plant biodiversity or detailed information on which rare and threatened species occur in which protected area. Efforts are being pursued by the Philippine Plant Conservation Committee to address this issue.

Table 7. Centers of Plant Diversity in the Philippines (after Cox 1988; DENR-UNEP 1997).

Centers of Plant Diversity	Island Group	Biogeographic Zone
1. Mt Iraya + Sabtang Island	Batanes	Batanes
2. Sierra Madre Mountains (Isabela)	Luzon	Sierra Madre
3. Mt Pulog (Benguet)	Luzon	Cordillera
4. Mt Arayat (Pampanga)	Luzon	Northern-Southern
5. Mt Makiling (Laguna)	Luzon	Northern-Southern
6. Lobo (Batangas)	Luzon	Northern-Southern
7. Mt Isarog (Camarines Sur)	Luzon	Northern-Southern
8. Mt Halcon (Mindoro)	Mindoro	Mindoro
9. Coron Island (Calamianes Group)	Palawan	Calamian
10. Palawan Mainland	Palawan	Palawan
11. Southern Samar	Visayas	East Visayas
12. Sibuyan Island (Romblon Group)	Visayas	West Visayas
13. Mt Canlaon (Negros Oriental)	Visayas	West Visayas
14. Mt Talinis + Lake Balinsasayao	Visayas	West Visayas
15. Mt Baloy (Central Panay)	Visayas	West Visayas
16. Mt Kitanglad (Bukidnon)	Mindanao	Mindanao
17. Agusan Marsh (Agusan del Sur)	Mindanao	Mindanao
18. Mt Apo (Davao City, Davao del Sur + Northern Cotabato	Mindanao	Mindanao

In 1988, 18 centers of plant diversity in the Philippines were identified by Threatened Plants Unit at Kew (Cox 1988; Table 7). During the conduct of the Philippine Biodiversity

Conservation Priority Setting Programme in 2002 (DENR-PAWB *et al*. 2002), about 88 conservation priority areas have been listed for the Philippines. These are usually sites that include unique threatened habitats, exceptional botanical richness, high in species endemism, or include rare and endangered species.

These are also are referable as Important Plant Areas (IPAs) (Plantlife International 2004). Of the 88 conservation priority sites for plants or IPAs, only 39 sites are currently within established protected areas.

Although many protected areas in the Philippines, especially the initial components of the NIPAS, were not determined on plant biodiversity considerations, these, nonetheless, serve as de facto plant genetic resource areas or genetic reserves for many commercial timber trees and other economically important species.

Plant conservation in production areas

Despite the expansion of the network of protected areas in the Philippines, these remain still limited in their coverage, especially for the biodiversity of the lowland dipterocarp forests (Fernando 2001). The great bulk of dipterocarp species diversity is not found in currently declared forest reserves or protected areas, but in increasingly shrinking forest fragments and residual forests within logging concessions or areas previously and currently under Timber License Agreements (TLAs). A consensus has been growing that protected areas alone will not be sufficient to effectively conserve plant biodiversity in the Philippines. The challenge, therefore, has been to include plant biodiversity conservation measures, even as timber is harvested from natural forests. Many around the world have begun to develop measures to maintain biodiversity within the practice of forestry (see for example Aplet *et al.* 1993). This sustainable forest management plan and the guidelines that integrate biodiversity and genetic resource conservation measures with timber production have been developed for a timber company in Surigao (Umali *et al*. 1998; Fernando *et al.* 1999). The plan includes, among others, very specific management strategies for the timber production zone within the logging concession. There are proposed strict standards in pre-logging inventory and tree marking (of trees to be cut) and felling (see for example Fernando *et al.* 1999, Fernando 2001).

This concept of sustainable forest management plan that integrate plant biodiversity and genetic resource conservation measures with timber production is similar to that being developed for the Berau Forest Management Project in East Kalimantan, Indonesia (Tyrie and Natadiwirya 2000). The Kalimantan sustainable forest management plan allows forestry to continue and at the same time maintaining environmental quality.

Summary and Conclusions

Further work is required to develop, review and improve the Philippine Plant Conservation Strategy and Action Plan in the context of the GSPC and promote its implementation. The Protected Areas and Wildlife Bureau (DENR-PAWB) as lead agency has been collaborating with other government agencies (e.g. the Bureau of Plant Industry of the Department of Agriculture), the academe, NGOs, horticultural groups (e.g. Philippine Orchid Society, Philippine Horticultural Society), and the private sector (e.g. ornamental plant exporters) to ensure full participation and get all sectors on the same path towards plant conservation.

Botanic gardens in the Philippines, although small and few, can contribute to attaining the targets of the GSPC, as well as, in increasing public awareness and education on the value and importance of plants.

Despite the Philippines' rapid decline of its habitats, *in situ* conservation through the protected areas system remains its best hope for conserving plant biodiversity and genetic resources. The protected areas, however, are still limited in their scope, often excluding lowland dipterocarp forests that harbor the majority of the commercial timber trees. The recently identified Conservation Priority Areas for Plants or Important Plant Areas not yet covered under the NIPAS must be integrated into the protected area system. Sustainable forest management systems involving integrated and careful planning of timber harvesting operations that incorporate plant genetic resource conservation measures are a promising strategy. Although there is a high diversity of plant species and habitats in the Philippines, the financial resources for plant conservation are often limited.

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Annex 1

Framework For The Philippine Plant Conservation Strategy and Action Plan

Mission

Halt the current loss of Philippine plant diversity to ensure its perpetual existence essential to meet the present and future needs of the Filipino people and the global community.

Aims

1. Provide a framework to enhance existing initiatives aimed at plant conservation, identify gaps where new initiatives are required, and promote mobilization of the necessary resources;
2. Provide mechanisms to enhance species and ecosystem approaches to the conservation and sustainable use of plant diversity and focus on the vital role of plants in the structure and functioning of ecological systems and assure their provision of goods and services;

Objective 1: Conserve important plant areas in the Philippines and plant species of direct importance to human societies.

GSPC Target 4: At least 10% of each of the world's ecological regions effectively conserved.
GSPC Target 5: Protection of 50% of the most important areas for plant diversity assured.

Actions:

1.1 Formulate criteria for identification of Important Plant Sites (IPS) or Important Plant Areas (IPA);
1.2 Identify and designate Important Plant Sites (IPS) or Important Plant Areas (IPA) or *In Situ* Plant Conservation Centers;
1.3 Develop and implement conservation and management plan for each of the designated IPS. Such plan must include mechanism that will ensure active participation of concerned local government units and other stakeholders;
1.4 Identify key plant species that will serve as emblem of plant conservation in each region of the country;

Objective 2: Document Philippine plant diversity, including its uses and its distribution in the wild, *in situ* within and outside protected areas, and in *ex situ* collections.

GSPC Target 1: A widely accessible working list of known plant species, as a step towards a complete world flora.
GSPC Target 7: 60% of the world's threatened species conserved *in situ*.
GSPC Target 8: 60% of threatened plant species in accessible *ex situ* collections, preferably in the country of origin, and 10% of them included in recovery and restoration programmes.

Actions:

2.1 Conduct specimen-based plant inventory throughout the country;
2.2 Develop a checklist of Philippine plants (per protected area, mountain, province, and region);

2.3 Publish a book on the "Flora of the Philippines";
2.4 Establish and maintain *ex situ* conservation centers of wild plants;
2.5 Establish a "National Botanic Garden" that showcases the Philippine native plants;

Objective 3: Promote and support research on the genetic diversity, systematics, taxonomy, ecology and conservation biology of plants and plant communities, and associated habitats and ecosystems

GSPC Target 3: Development of models with protocols for plant conservation and sustainable use, based on research and practical experience.

Actions:

3.1 Conduct studies on threatened endemic plants
   a. conservation biology
   b. demography / population studies
3.2 Pursue / support / encourage taxonomic studies;
3.3 Develop research proposals for funding support solicitation.

Objective 4: Promote and support research on social, cultural and economic factors that have impact on biodiversity

GSPC Target 9: 70% of the genetic diversity of crops and other major socio-economically valuable plant species conserved, and associated indigenous and local knowledge maintained

GSPC Target 13: The decline of plant resources, and associated indigenous and local knowledge innovations and practices that support sustainable livelihoods, local food security and health care, halted.

Actions:

4.1 Conduct research on plants uses by the local communities and the impact of these uses on plant species conservation;
4.2 Conduct research on plant resource valuation

Objective 5: Develop an integrated, interactive database information system to manage and make accessible information on plant diversity and alien invasive plant species.

GSPC Target 10: Management plans in place for at least 100 major alien species that threaten plants, plant communities and associated habitats and ecosystems

GSPC Target 16: Networks for plant conservation activities established or strengthened at national, regional and international levels

Actions:

5.1 Enhance capacity of staff to use software or databases;
5.2 Develop / update / enhance digital information on Philippine plants;
5.3 Establish a system, including websites, that will ensure constant exchange of information on Philippine plant genetic resources between and among concerned institutions/organizations and accessible to all interested parties;
5.4 Establish a system that will link the local databases to regional and international information centers

Objective 6: Monitor the conservation status of Philippine plant diversity

GSPC Target 2: A preliminary assessment of the conservation status of all known plant species, at national, regional and international levels

Actions:

6.1 Establish the National List of Threatened Philippine Plants;
6.2 Establish the National List of Economically-Important Species;
6.3 Assess the conservation status of all known Philippine plants periodically;

Objective 7: Promote education and awareness about plant diversity

GSPC Target 14: The importance of plant diversity and the need for its conservation incorporated into communication, education and public awareness programmes.

Actions:

7.1 Develop libraries on Philippine plants;
7.2 Develop and publish popular and technical papers on Philippine plants, including articles on plant conservation-related undertakings regularly;
7.3 Produce plant identification guides;
7.4 Work for the declaration and celebration of Plant Conservation Day / Week or restore the celebration of Arbor Week;
7.5 Conduct lectures / seminars and organize workshops, conferences, fora and other venues to disseminate and articulate issues relating to plants and their conservation;
7.6 Integrate topics on plant conservation in school curricula;

Objective 8: Develop capacity, including physical and technological infrastructure and financial support for plant conservation

GSPC Target 15: The number of trained people working with appropriate facilities in plant conservation increased, according to national needs, to achieve the targets of this Strategy.

Actions:

8.1 Establish the roster of plant experts and agencies, research institutions and organizations involved in plant conservation in the country;
8.2 Provide career opportunities for botanists and plant taxonomists;
8.3 Assess the plant taxonomic needs of the Philippines;
8.4 Develop centers of excellence on plant conservation;
8.5 Implement technical capacity building programmes on plant conservation and management (e.g. trainings on plant identification, preservation, etc. at the national, regional and local level);
8.6 Identify and implement appropriate community training programmes;

Objective 9: Promote sustainable production and utilization of plant resources

GSPC Target 6: At least 30% of production lands managed consistent with the conservation of plant diversity.

GSPC Target 12: 30% of plant-based products derived from sources that are sustainably managed.

Actions:

9.1 Produce 'how-to-manuals' on plant propagation and utilization;

9.2 Promote establishment of nurseries and propagation centers for commercial plant production purposes;

9.3 Promote sustainable utilization of plant (including timber) resources in production areas;

Objective 10: Develop and enforce policies on plant conservation

GSPC Target 11: No species of wild flora is endangered by international trade.
GSPC Target 12: 30% of plant-based products are derived from sources that are sustainably managed.

Actions:

11.1 Develop guidelines on the accreditation and registration of plant nurseries /establishments/breeders;

11.2 Develop guidelines on the exchange of plant specimens between and among researchers/taxonomists, locally and internationally;

11.3 Review and harmonize existing policies on the conservation and export, import and transport of plant genetic resources.

The *Framework for the Philippine Plant Conservation Strategy and Action Plan* is the work of active members of the Philippine Plant Conservation Committee – E.S. Fernando, D.A. Lagunzad, L.L. Co, D.A. Madulid, A.B. Lapis, J.L. de Leon, I.C. Pangga, L.M. Liao, C.C. Custodio, M. Mendoza, A. Meniado, N.M. Molinyawe, P.M. Zamora, G.I. Texon, W.S. Pollisco, A.C. Manila, and T.M.S. Lim – many of whom participated in the several workshops and contributed to putting together the document.

A similar paper was also earlier presented by ESF at the *Global Partnership for Plant Conservation Conference,* 23–25 October 2005 held at the National Botanic Gardens of Ireland in Dublin, Ireland, and by ESF, ACM, and TMSL as a Philippine Country Report at the *ASEAN-China Workshop on Botanical Gardens Management and Plant Conservation,* 15–19 May 2006, Bogor, Indonesia.

Appendix 2

Research and development initiatives on Forest Genetic Resources Conservation in the Philippines

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Introduction

Forest genetic resources are vital to human existence and survival. They are the essential foundation for sustainable development. Koshy *et al.* (2002) defined forest genetic resources as a concept that refers to environmental, social, economic, cultural and scientific values of the heritable materials contained within and among species. Conservation of forest genetic resources is regarded as constituting the actions and policies that assure the continued existence, evolution and availability of these resources in the future.

Unlike its counterpart in agriculture and food, forest genetic resources are not stored in sophisticated gene banks, like the rice germplasm kept at the International Rice Research Institute with a duplicate copy at the National Seed Storage Laboratory at Fort Collins, Colorado stored in a building that can withstand earthquakes and other major disasters. Nor are these kept *in vitro* as an alternative or complementary method for conserving cassava, potato, sweet potato, yam, grasses, *etc.* in about 63 genebanks mostly at the International Agricultural Research Centers.

Forest genetic resources in the Philippines are stored either ex situ in field gene banks as hedge gardens, clonal multiplication gardens, botanical gardens, bambusetum, palmetum, arboretum, mangrove species genebank, seed production areas, seed orchards, plantations, etc., or *in situ* as protected areas, forest reserves, biosphere reserves, national parks, etc. all over the country.

Unlike PGRs, FGRs are not classified as base or active collection, but may belong to either of these two classifications. *In situ*, both may be active and base collections. If only the good materials are retained, it is considered an active collection. If all materials are conserved regardless of quality, it is a base collection. Most *ex situ* collections are active collections, especially those that are being used for tree improvement wherein accessions are immediately available for multiplication and distribution for use. Bambusetum, mangrove genebank and palmetum are considered base and active collections because they serve both purposes of being conserved and preserved for future use and at the same time serve as immediate sources of planting materials for distribution.

The tree breeding activities of private companies and research agencies are not as controversial as PGRs. The high-yielding and fast-growing gmelina of PTFI, the hybrid eucalypts of PICOP Resources Inc. are affordable planting materials developed by the companies on their own, hence no question of ownership. The thing that has similarity with PGRs is the issue on conserving or abandoning landraces and folk varieties of economic plants and embracing the high-yielding varieties instead which are susceptible to pest and disease. In FGRs, the issue is the use of exotics in reforestation and other purposes versus indigenous tree species, despite the alleged disadvantages of exotics such as reduction in soil productivity, allelopathic effects and competition for soil nutrients and water.

Some Research and Development Initiatives Implemented Outside of DENR

Fernando (2001) reported that PTFI has an active tree improvement programme that includes species provenance trials, progeny testing and parent tree selection. The noted improved gmelina clones and high quality acacia are some of their major outputs. PICOP used to be another major player in tree improvement, however, with the changes in management and company ownership, even the parental species of the *E. deglupta* x *E. pellita* hybrid were cut down.

Academic institutions aside from the University of the Philippines Los Banos College of Forestry and Natural Resources conduct researches on seed technology, vegetative propagation and other aspects of forest production especially on indigenous trees like the dipterocarps. The Leyte State University (LSU) developed the technology on Rainforestation, a strategy of forest restoration that uses indigenous tree species in combination with agricultural crops. Nueva Vizcaya State University (NVISIT), in collaboration with the local Ecosystems Research and Development Sector (ERDS) in Bayombong, Nueva Vizcaya also conducts establishment of arboretum and dipterocarp plantation. Gascon (2005) reported that the Southern Luzon Polytechnic College (SLPC) is establishing the database for the Mt. Banahaw protected area, a nursery of indigenous tree species, conducts species trials using indigenous species, and are active members of the Protected AreaManagement Board (PAMB) of Quezon. The Misamis Oriental State College of Agriculture and Forestry (MOSCAT), the Central Visayas State College of Agriculture, Forestry and Technology (CVSCAFT), The Mindanao State University (MSU), Central Mindanao University (CMU) and even the Camarines Sur State College of Agriculture and Forestry (CSSAC), Isabela State University (ISU), DMMSU and a lot of other state universities and colleges are very active in doing different aspects of research in FGRs. De La Salle system is also doing work on ex situ conservation and even *in situ* conservation of Philippine teak, in collaboration with the Mindoro Biodiversity Conservation Foundation.

In 2002, a newly discovered species of a parasitic flowering plant belonging to the genus Rafflesia from Sibalom National Park (SNP), Antique, Panay Is., was jointly described by Barcelona and Fernando. *Rafflesia speciosa* Barcelona and Fernando (Kew Bull. 57:647-651) is now recognized to have the largest flower in the Philippines. This discovery marks a milestone in the history of Philippine botany. The specimens that were collected served as very important acquisitions of the Philippine National Herbarium (MNP 2002).

The discovery of additional new plant species: 1) *Cycas zambales* Madulid and *Agoo* sp. nov. It is a new Cycas species found in ultramafic soil of Zambales in 2005. 2) *Rafflesia magnifica* Madulid sp. nov. second largest flower in the Philippines found in Compostela Valley, Mindanao, 2005. NBSAP Projects (MNP 2005).

Field survey of endangered plants of the Philippines: It is aimed at conducting field investigations to determine the current conservation status of priority endangered plants of the Philippines. *Tectona philippinensis* in Batangas and Mindoro Is.; *Phoenix loureiri (P. hanceana* var. philippinensis) in Batanes; *Rafflesia* spp. in Panay, Mt. Makiling, Mt. Isarog; *Nepenthes* spp. in more than ten localities around the country (MNP 2004).

A report by Tolentino *et al.* (2006) on the assessment of mother trees of the different species by SPA-designated stands, seed orchards, and other designated seed sources and plantations of government (DENR, SCU), corporate/private companies (timber licensees), and smallholder tree farms (CBFMA, private plantations) revealed the following results: 1) documentation of seed origin is seldom practiced; 2) the number of mother trees from where seeds are collected varies. There are those whose sources have more than 100 trees, but some smallholder tree farmers have limited number of trees (<10trees) from which seeds are collected. Corporate or institutional (GO-based) plantations have access to a wide variety of seed sources, particularly superior ones, while resource-limited farmers do not have access to improved seeds; 3) basic policies (DENR Administrative Order 95-9 and its implementing guidelines DENR Memorandum 95-20) to insure the quality of seeds were laid out before but they have weaknesses and shortcomings that need to be addressed. The efficacy of DAOs and memorandum circulars should also be assessed in contrast to complete tree seed legislation, i.e. a Tree Seed Law for the Philippines.

A study was conducted by Calub (undated) on the domestication of indigenous fodder trees to initiate domestication of lesser-known Philippine indigenous fodder trees and shrubs (IFTS). Project components included (1) determination of appropriate nursery methods for propagation and establishment; (2) documentation of growth, herbage production and persistence of the selected IFTS grown in Cagayan, Isabela, Laguna and Nueva Ecija; and (3) assessment of the feeding value, animal performance, nutrient composition and digestibility. Young male native goats fed napier and anabiong in a 50:50 combination had the highest dry matter intake, liveweight gain, average daily gain and feed efficiency as compared to the other napier+fodder tree combination diets. More conclusive information on liveweight gains and effects of anti-nutritive factors can be obtained from further feeding trials. A simple economic evaluation of the feeding system was made. Two schemes for integrating fodder trees and shrubs in pasture areas were proposed.

Fernando (2001) reported about the *in situ* conservation research project implemented by the Sustainable Ecosystems International Corporation (SUSTEC) and funded by the ITTO. The sustainable forest management plan and the guidelines that integrate biodiversity and genetic resources conservation measures with timber production are currently being developed.

DENR R & D Initiatives

The DENR administration considers Forest Genetic Resources Conservation and Management as a kind of war which needs to be fought both at the frontline and at the rearguard at the same time. In the frontline we need to meet the demand for fuelwood, construction materials for housing, furniture and a lot of other needs, and non-timber resources that serve as food, raw materials for industries and others. At the rearguard, we need to be on the lookout that the remaining forests are protected and conserved.

To meet future needs for wood, the forestry sector must increase production per unit area without destroying the natural resource base. Sustainable forest management is defined in the Helsinki Process as 'the stewardship and use of forests and forest land in such a way, and at a rate, that maintains their biodiversity, productivity and regenerative capacity, vitality and the potential to fulfill, now and in the future, relevant ecological, economic and social functions, at local, national and global levels, and that does not cause damage to other ecosystems'.

In order to alleviate the shortage of wood supply, lighten the pressure from natural forests and conserve the existing forests, fast-growing and high-yielding plantations are established. The concern for species which can produce wood with desired properties requiring stability or strength needs should also be addressed. The production of planting materials for endangered, indigenous and other forest genetic resources shall be a primary priority.

The need of the hour is a holistic strategy for wood production and at the same level prevents the eminent danger of the irreversible loss of forest genetic resources. The fundamental problem to be addressed at this point is the lack of supply of improved planting materials for production purposes, and of planting materials for conservation of endangered indigenous and other forest genetic resources.

Conceptual Framework

The DENR management of forest genetic resources is anchored in its mandate as the primary government agency responsible for the conservation, management, development and proper use of the country's environment and natural resources.

Forest genetic resources management is assumed to be a vehicle by which a forestry project can arrive at the goal set by its management. The management (DENR) steers the vehicle to the direction it deems fit. ERDB, PAWB and FMB have proper places in the driver's seat. Figure 1 shows both *in situ* and *ex situ* conservation on the two wheels of the bicycle, implying equal attention to both strategies. In Figure 2, the spokes of the steering wheel is now composed of both the *ex situ/in situ* conservation areas (botanical gardens, old reforestation projects, plantations, CSOs, SSOs, SPAs, protected areas and other forest reserves) from where we get the materials for production. The spokes of the driving wheel become the planting stock production techniques. The support frame, supporting tree improvement, conservation, production and management, consists of research and development, administration and communication. Funding is necessary to make the vehicle move while management has both feet planted on the pedals. Apart from funding, support and strong frames, a forest genetic resources management programme also needs flexible planning and determination from its staff in order to move towards success. Communities, NGOs, OGAs and other stakeholders are support groups themselves who eventually become recipients of these forest genetic resources.

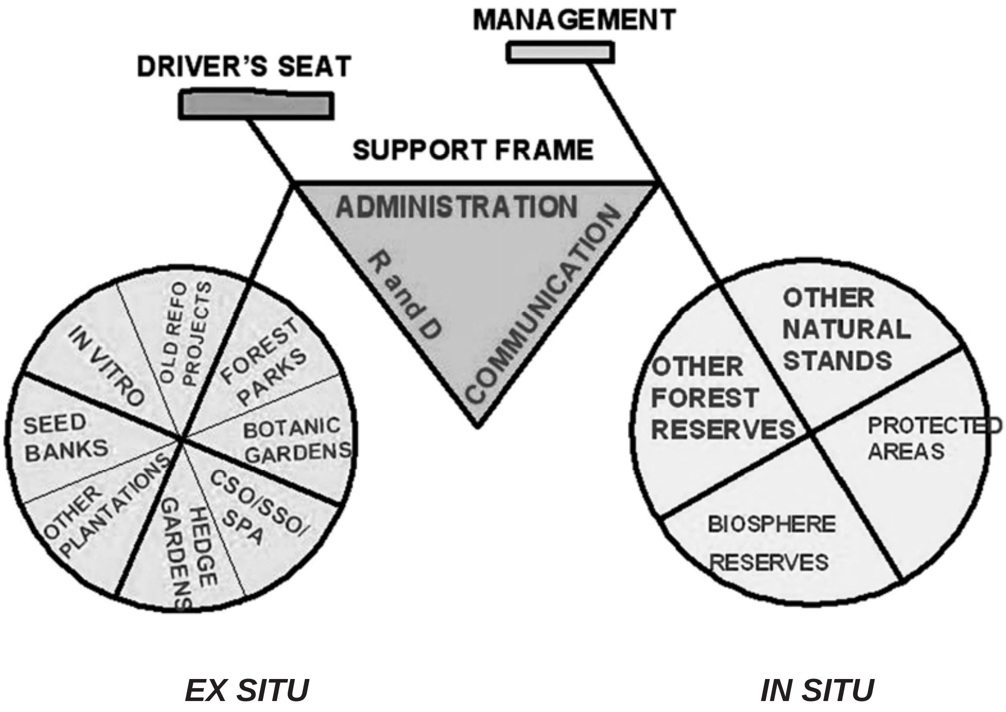

Figure 1. Forest genetic resources conservation and management framework showing both the *in situ* and *ex situ* strategies.

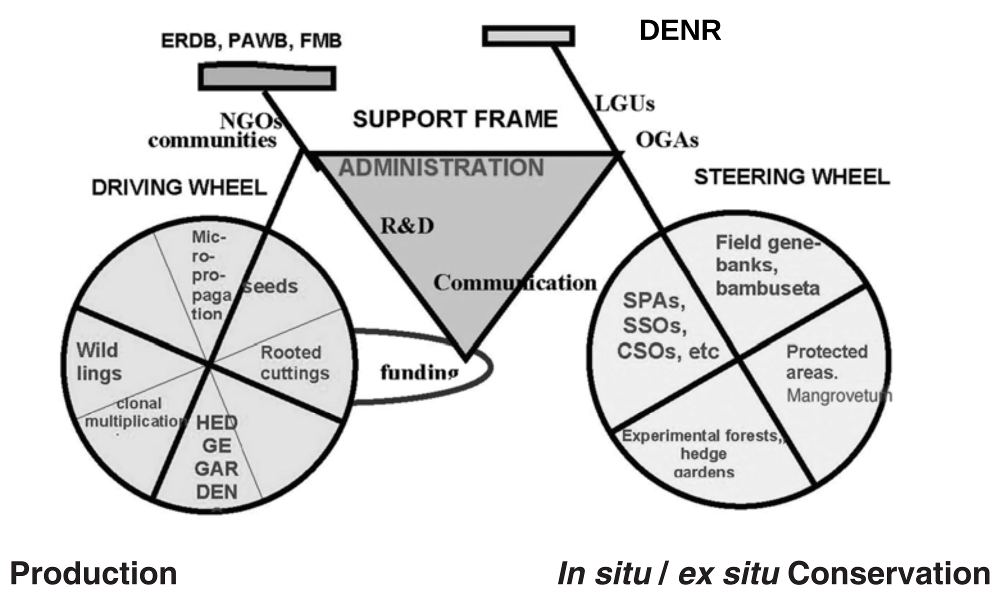

Figure 2. Forest genetic resources conservation and management framework showing production methods and *in situ/ex situ* strategies on each wheel.

The overall objective is to contribute to the sustainable management and conservation of forest genetic resources for the benefit of stakeholders and end-users. Specific objectives include the following: 1) integration of forest genetic resources conservation and management in national forestry management plans and overall development plans; 2) enhanced capabilities of manpower resources to use existing innovative technologies for propagation and conservation; 3) increased production of improved planting materials for production forests; 4) increased planting stocks for biodiversity conservation; and 5) increased planting materials, especially indigenous species for urban and highways greening.

Most of ERDB's past initiatives have been reviewed by Razal *et al* (2003) in their paper presented during the FGR conservation and management workshop in Malaysia. Most of the highlights presented in this paper are those that were not included in that review. Some of the ongoing DENR research activities are listed in Table 1.

Table 1. Species found in the Mangrove Genebank at Pagbilao, Quezon.

1	Nilad	*Scyphiphora hydrophyllacea*
2	Api-api	*Avicennia officinalis*
3	Buta-buta	*Excoecaria agallocha*
4	Tangal	*Ceriops tagal*
5	Bakauan-lalaki	*Rhizopora apiculata*
6	Bakauan-babae	*Rhizopora mucronata*
7	Pagatpat	*Sonneratia alba*
8	Piapi	*Avicennia marina var. rumphiana*
9	Nipa	*Nypa fructicans*
10	Malatangal	*Ceriops decandra*
11	Bungalon	*Avicennia marina*
12	Busain	*Bruguiera gymnorrhiza*
13	Bakauan-bangkau	*Rhizopora stylosa*
14	Pototan	*Bruguiera sexangula*
15	Tinduk-tindukan	*Aegiceras floridum*
16	Tabigi	*Xylocarpus granatum*
17	Pedada	*Sonneratia caseolaris*
18	Bagnit	

Procedures for Conservation

Asound strategy for conserving genetic resources should have three consecutive phases: 1) declaration of a genetic resource conservation targets which deserve highest priority for conservation measures have to be identified; 2) conservation in the strict sense, in which carriers of the selected genetic information from the conservation targets are physically conserved and 3) regeneration of viable populations [Ziehe *et al*. (1989) as cited by Finkeldey and Hattemer (undated); Finkeldey (1994)].

The *ex situ* conservation targets of economically important industrial tree plantation species, bamboos, mangrove species, rattans, medicinal plants and other species, and the *in situ* conservation of the lowland tropical rainforests and eventually the critical habitats of endangered FGRs constitute the first step. The second step involves the actual conservation of these species in different areas which are already in place, and third, protocols for the propagation of individual species for eventual re-establishment in the field.

A major player in *ex situ* conservation, DENR-ERDB and ERDS research and development activities are now geared more towards the third phase of conservation. BFI, A subsidiary of NRDC-DENR, still maintains the *ex situ* conservation areas and use the sites as seed sources for the most promising species and provenances.

***Ex Situ* Conservation**

Procedures concerning *ex situ* conservation are quite distinct from *in situ* conservation. Utility has continued to be one of the main criteria for the *ex situ* conservation of forest genetic resources. SPAs, SSOs, CSOs, and clonal multiplication gardens conserve genetic materials purposely for their desirable genotypes.

The number of germplasm from vegetatively-propagated materials such as bamboos and suckers from rattans, are collected in bulk at various habitats.

Mangrove species are maintained in experimental forest reserves, one of which is in Pagbilao with 19 species (Table 1). Bamboos are kept in bambusetum, species of which vary per site. Species maintained at the Baguio Bambusetum are listed in Table 2. DENR maintains a total of 57 ha in 6 different sites with 8–11 ha per site (Fig. 3). Palms are collectively stored in palmetum, and rattan genebank maintained in Mt. Makiling, Los Banos, Laguna. A duplicate rattan genebank is established in Malaybalay, Bukidnon.

To produce improved sources of planting materials, plus trees (PTs) are selected from seed sources (natural stands, unimproved), seed production areas (SPAs) are established (plantations wherein defective, diseased and deformed trees shall be removed to improve future seed production), as well as seed orchards (SOs) (selected trees based on certain criteria of different provenances placed in an isolated area for the purpose of preventing contamination by undesirable pollen) and clonal multiplication gardens to supply improved materials for propagation. SOs consist of more restricted number of genotypes than SPAs, as can be found in the Gmelina CSO in Ternate, Cavite and at the ERDB nursery. However, complete isolation of CSOs, SSOs and SPAs is impossible because there are stands of unimproved genotypes everywhere. It is likely that pollen contamination may still happen, thus there is an expected genetic variation among offspring. For this year, the reproductive phenology synchrony will be observed in these stands, more especially in the Acacia Hybridizing SSO in Ternate Cavite.

Table 2. Bamboo species planted at the Philippine Bambusetum, Loakan, Baguio City (Roxas 1995).

Scientific Name	Origin
1. *Arundinaria amabilis*	China
2. *Bambusa bambos*	India
3. *Bambusa blumeana*	Philippines
4. *Bambusa sp.1 (bayod)*	Philippines
5. *Bambusa sp.2 (laak)*	Philippines
6. *Bambusa sp.3 (variegate)*	Asia
7. *Bambusa glaucescens "elegans"*	China
8. *B. glaucescens "fern leaf"*	China
9. *B. glaucescens "golden goddess"*	China
10. *B. glaucescens "A. Karr."*	Japan
11. *B. oldamii*	China
12. *B. ventricosa*	China
13. *B. vulgaris*	Asia
14. *B. vulgaris var. striata*	Asia
15. *B. dolichomerithalla*	China
16. *B. vulgariz var. maculata*	Phillipines
17. *Chinonobambusa falcata*	U.S.A.
18. *Dendrocalamus asper*	Philippines
19. *D. latiflorus*	Philippines
20. *D. giganeus*	Indonesia
21. *D. strictus*	Australia
22. *Gigantochloa atter*	Philippines
23. *G. levis*	Philippines
24. *G. sp. (atroviolacea)*	Australia
25. *Guadua angustifolia*	Columbia
26. *G. angustifolia var. bicolor*	Columbia
27. *Pleioblastus argenteo striatus*	Japan
28. *P. chino elegantissimus*	Japan
29. *P. chino f. pumilus*	Chile
30. *P. chino f. pygmaeus*	Chile
31. *P. distichus*	Japan
32. *P.fortunei cv. fortunei*	Japan
33. *Phyllostachys aurea*	Philippines
34. *P. bambusoides*	Australia
35. *P. nigra*	Philippines
36. *P. pubescens*	Japan
37. *Sasa kurilensis*	Chile
38. *S. nipponica*	Japan
39. *S. palmate*	Japan
40. *Sasaella ramose*	Chile
41. *Schizostachyum brachycladum (yellow)*	Philippines
42. *S. lima*	Philippines

Scientific Name	Origin
43. *S. lumampao*	Philippines
44. *Thyrsostachys siamensis*	Philippines
45. *Yushiana niitakayamensis*	Philippines
46. *Dinochloa sp.*	Philippines
47. *Dinochloa sp.*	Philippines
48. *D. diffusa*	Philippines
49. *Dinochloa sp.*	Philippines
50. *D. luconiae*	Philippines
51. *D. pubiramae*	Philippines
52. *Dinochloa sp.*	Philippines
53. *Dinochloa sp.*	Philippines
54. *Schizostachyum sp.*	Philippines
55. *Bambusa atra*	Philippines
56. *Shibataea kumasaca*	Japan
57. *Schizostachyum luzonicum*	Philippines
58. *S. fenixii*	Philippines

Figure 3. Bambusetum established in the Philippines by DENR (Roxas 1995).

El Kassaby (2000) stated that when reproductive phenology differences occur, the orchard clones form several temporally isolated breeding subpopulations, thus increasing the rate of inbreeding, reducing panmixis (random mating), and exposing the early and late-flowering clones to increased levels of non-orchard pollen contamination. This temporal isolation will also affect seed yield, rate of pollen contamination and mating pattern (selfing rate, level of correlated matings) (El Kassaby and Davidson 1991), as cited by Kassaby (2000).

A seedling seed orchard of *A. mangium* and *A. auriculiformis* was established by FORTIP in Ternate, Cavite in 1994. Evaluation of seeds needs to be done yet to check which among the three hybridizing designs worked or not: 1) *A. mangium* surrounded by *A. auriculiformis*; 2) *A. auriculiformis* surrounded by *A. mangium*; 3) line plot of *A. auriculiformis* followed by *A. mangium* (Pollisco undated). It may be through morphometric assessment and/or DNA analysis. The CSO of Gmelina also established by FORTIP in Ternate has a total of 29 clones with 161 ramets planted at 8 x 8 m spacing (Lanting undated).

Acacias and eucalypts in Bansud, Or. Mindoro SPA which are already of seed bearing age produced the following seed yield: 1) *A. mangium* had an average of 399.45 g/tree, the highest of which was 765 g/tree; 2) *E. urophylla*, the average yield of 73.07 g/tree, the highest of which is 102 g/tree (Dimayuga and Pader 2006).

Table 3. Summary of dipterocarp species planted in the ERDB hedge garden (Pollisco 2000)

Species	Source	Date Collected	Planting Materials	Date Established	No. Stock plants
1. Almon *(Shorea almon)*	Malaybalay, Bukidnon	1995	Wildlings	June 1997	188
2. Apitong *(D.grandiloforous)*	SBMA Forest Reserve	Oct. 1995	Wildlings	June 1996	10
3. Bagtikan *(Parashorea malaanonan)*	Mt. Makiling	1998	Seeds	June 1997	103
4. Dagang *(Anisoptera aurea)*	Mt. Makiling	1994	Seeds	June 1998	8
5. Dalingdingan *(Hopea foxworthyi)*	Mindoro Oriental	Feb. 1995	Wildlings	May 1996	141
6. Gisok-gisok *(Hopea philippinensis)*	Bislig,Surigao del Sur	Oct. 1994 Jan. 1995	Wildlings	April 1997	222
7. Guijo *(Shorea guiso)*	Peñablanca, Cagayan & SBMA Forest	Feb. 1995	Wildlings	May 1996	203
8. Hagakhak *(Dipterocarpus validus)*	Mt. Makiling	May 1999	Wildlings	Dec. 1999	17
9. Palosapis *(Anisoptera thurifera)*	Ipo Dam, Angat,Bulacan	1955	Seeds	May 1996	522
10. Panau *(Dipterocarpus gracilis)*	SBMAForest Reserve	Oct. 1995	Wildlings	June 1996	180
11. Red lauan *(Shorea egrosensis)*	Peñablanca,Cagayan	Oct. 1995	Wildlings	May 1996	210
12. Tangile *(Shoreapolysperma)*	SBMAForest Reserve	1997	Seeds	August 1998	76
13. White lauan *(Shorea contorta)*	SBMAForest Reserve	1995	Seeds	May 1996	190
14. Yakal-saplungan	Malaybalay	Feb. 1995	Wildlings	May1996	275

Clonal multiplication gardens composed of selected genotypes with desirable characteristics are established near field nurseries. These are ready sources of propagules for macro and *in vitro* propagation, adding efficiency in propagation. It eliminates the need for frequent travels to very far sources just to collect shoots for clonal propagation. Endangered indigenous tree species are collected as wildlings or seeds/seedlings and placed in the vicinity of nurseries as hedge gardens. Regional DENR-ERDS and ERDB have established hedge gardens in their nurseries, mostly of dipterocarps. Table 3 shows the dipterocarp species planted at the ERDB hedge garden. Phil. teak stockplants are also added, as well as molave from Dasol, Pangasinsn and Lobo, Batangas. Selection is not practiced when it comes to conservation that is not for tree improvement. Selection is applied only when endangered/indigenous trees are used for production purposes/tree improvement. It should be noted, however, that rooting ability of different dipterocarp species decrease after 5 years. Furthermore, considering the number of clones produced from these stockplants, these might lead to narrowing of the genetic base if continuously used as the source. Hence the need to infuse new materials, or completely move out of the garden and convert it to a normal plantation and establish another hedge garden using fresh genotypes. Most of the stockplants by then would have crooked stems because of the bending treatment to induce production of orthotropic shoots. Culling them out would be easy by ocular inspection.

Figure 4 shows the dipterocarp pilot plantations all over the country while Figure 5 shows the area established per region. These plantations were established by virtue of DAO 96-21, Establishment of dipterocarp pilot plantations, which started out as KRA targets in 1993. The propagation technologies generated by ERDB on dipterocarp rooted cuttings and the use of the wildling recovery chamber served as Annexes to the DAO.

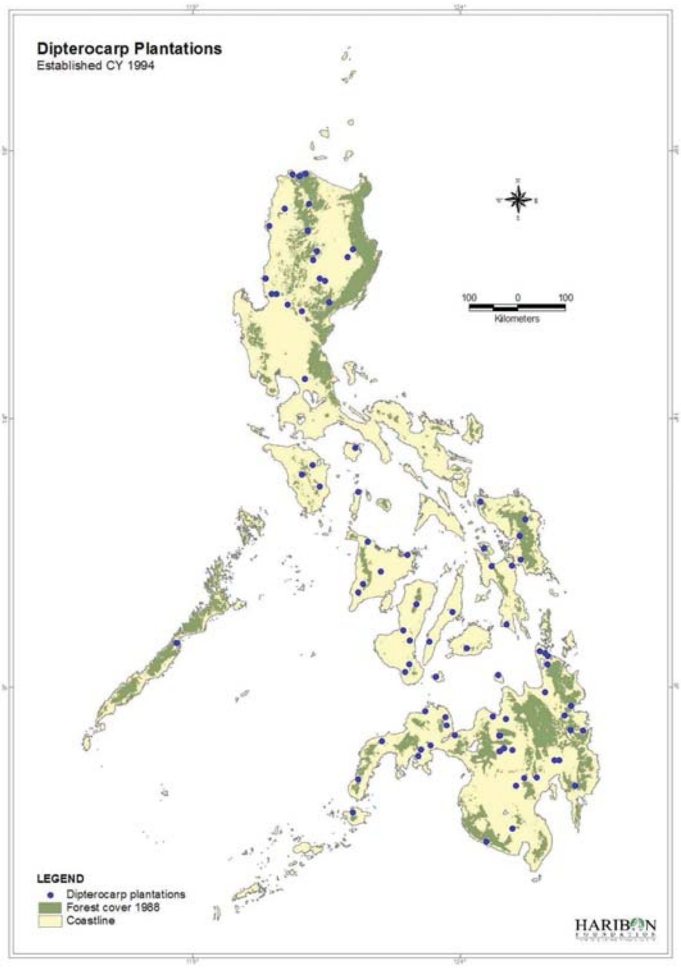

Figure 4. Dipterocarp plantations established by ERDB and ERDS.

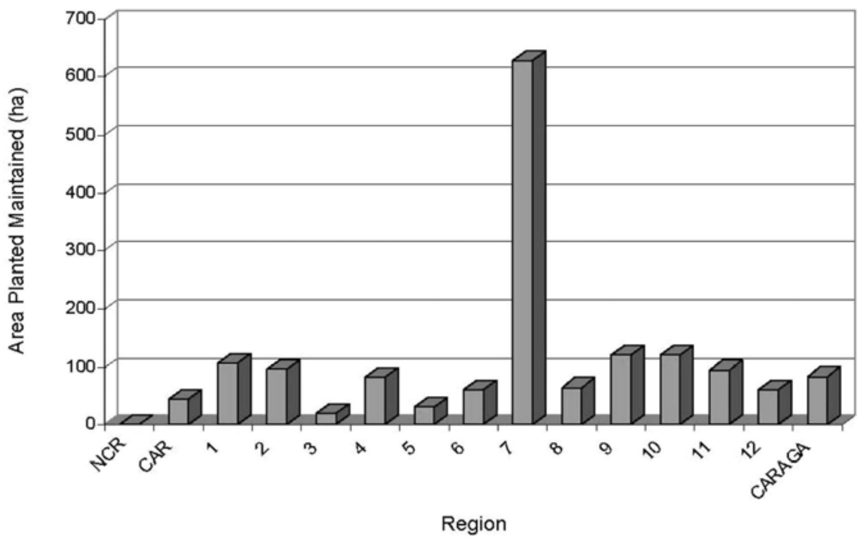

Figure 5. Area planted with dipterocarps by region (in ha).

Seed banking and *in vitro* methods are not mainly used by ERDB as conservation strategies, although there are facilities for short-term storage. Seed and 'tissue' banks are not viable options for the long-term conservation of forest genetic resources. Seed technology problems which are mostly in the aspect of storing of recalcitrant and even identifying intermediate seeds of forest trees like the dipterocarps and other species including non-timber ones are still unsolved, and the investment needed in the laboratory in terms of manpower, equipment and supplies, especially power generators for ensuring the integrity of *in vitro* collections are reasons for their unpopularity.

Propagation methods

Seedlings

Seeds are the most economical sources of planting materials and the easiest to transport. However, most of the indigenous species are found in remote areas and produce seeds after long intervals. Added to this is the fact that most have recalcitrant seeds. Other species show some degree of dormancy or require different pre-treatments. The most recent significant seed research that was developed is the Malapapaya (*Polyscias nodosa*) seed technology by Dayan and Reaviles (2001) and has been used by MP Woods for their plantation in Gumaca, Quezon. It is the raw material for the manufacture of chopsticks, popsicle sticks, bento boxes and veneer. Seed technology of other species are published in DENR Recommends.

Wildlings

Low survival of wildlings was one of the problems encountered by field personnel in the implementation of the DENR KRA on establishment of 10 ha dipterocarp plantations in the regions. Pollisco (1994a; 2006) developed a technology using the wildling recovery chamber considering that taking care of wildlings is more complicated than taking care of seedlings.

Figure 6 shows the comparison between survival using the recovery chamber and without a recovery chamber. Wildlings require a different set of conditions because their lateral roots are left in the soil during collection and their leaves are accustomed to shade. The use of large polyethylene plastic (app. 62 x 25 in.) during collection, with a small amount of water and sealed airtight while collecting prevent desiccation or drying up of the materials. Upon arrival in the nursery, the wildlings are placed in pre-potted plastic bags, depending on size of the wildings, watered and eventually placed in a previously designated area where large polyethylene sheets can be used to cover the wildlings airtight for two months. Watering is done twice or thrice a day, depending on climatic conditions. The plastic should be lifted to make sure that all the wildlings are watered. Hardening is done by gradual exposure to outside conditions. Every two weeks, the opening gets bigger and eventually the plastic cover is removed. Frequency of watering is reduced as part of the hardening process.

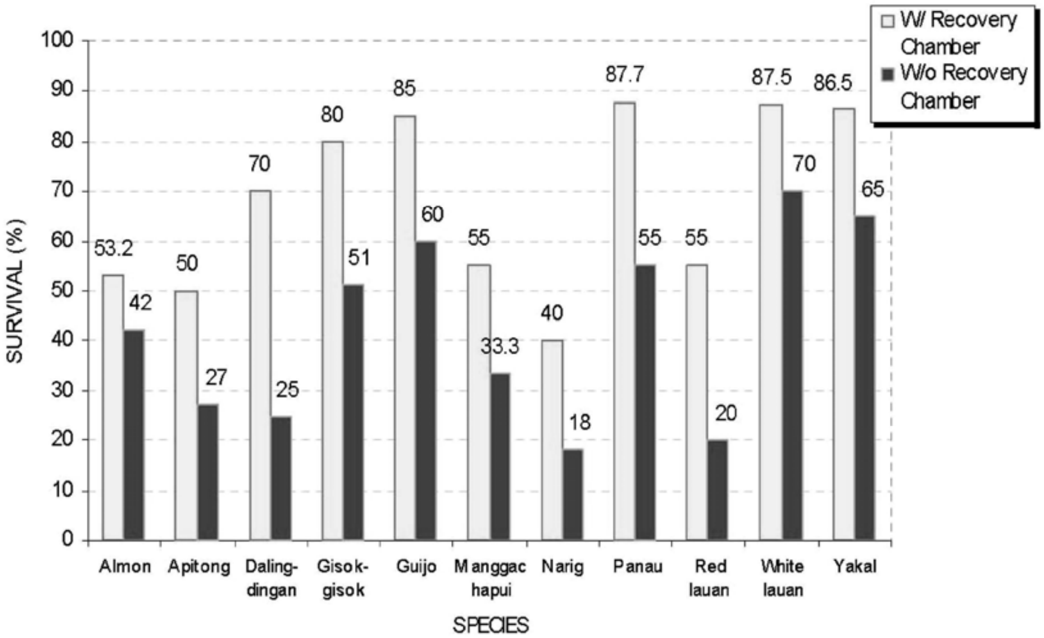

Figure 6. Percent survival of wildlings of dipterocarps with and without recovery chamber after two months in the nursery (Pollisco 2006).

Rooted cuttings

The planting of indigenous species is limited by the availability of seeds. One of the reasons why indigenous species are unpopular is because the only ones available in nurseries are exotics. The problem stems from the fact that exotics flower and fruit yearly while indigenous trees flower and fruit in intervals of 2–10 years. Responsive shoots used in rooted cuttings of the indigenous tree species, especially the dipterocarps, are taken from juvenile materials. Pollisco (1994b; 2006) published results, part of which is shown in Figure 7, a graph of the responses of different dipterocarps to different concentrations of rooting hormone IBA, planted in a non-mist sand-rooting propagation system.

Another non-mist system called the bubble-bath system was also tried using different concentrations of IBA (0–10 ppm) on white lauan, dagang, apitong, palosapis, almon, guijo and bagtikan. However, rooting percentage was verylow (<50%), even after three months. Cuttings taken from the tip portion of the stockplants consistently had higher rate of rooting (Pollisco 2006).

Planting materials of 15 dipterocarp species and other indigenous premiums like Phil. teak, almaciga, molave, and batikuling were eventually produced using cuttings via the misting and non-mist systems with varying degrees of success. These were taken from stockplants less than 5 years old, except for Molave and Phil. Teak which were taken from 30 yr.-old trees (Dimayuga and Pader 2006a). There are a lot of other species that need to be studied, specifically those that are not known to be frequent and prolific seeders.

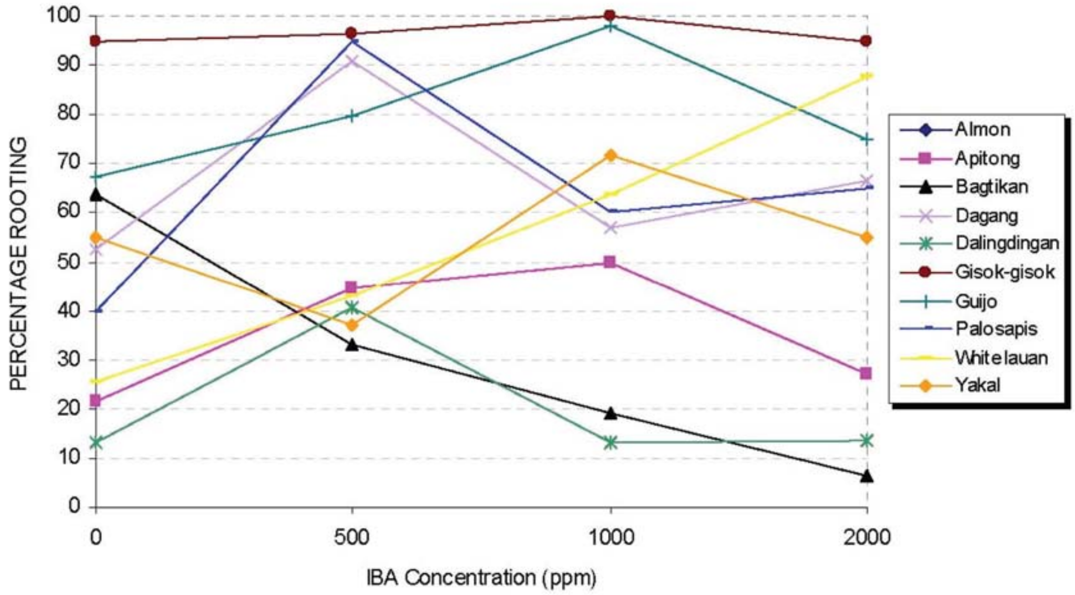

Figure 7. Effects of different Indole Butyric Acid (IBA) concentrations on the rooting performance of dipterocarp cuttings three months aftertreatment (Pollisco 2006)

Tissue culture

The protocol for the micro-propagation and eventual outplanting of bagras (*Eucalyptus deglupta*) plantlets was developed by Capuli and Calinawan (1999) using explants from selected mature genotypes. The *in vitro* cloning technology will be one of the protocols to be highlighted by the 2007 ERDB banner programmes for a demonstration plantation.

Prescriptions regarding conservation of FGRs

The conservation of FGRs needs combined measures of protection and cultural management.

Cultural activities in support to FGR

The cultural management techniques for FGRs differ for smallholders than for large-holders of tree planting companies. Removal of all other vegetation is being practiced in large industrial tree plantations, as in conventional agriculture. Round Up (glyphosate), a herbicide, is used by the Bukidnon Forests Inc. in the control of weeds in plantation. As practiced on the dipterocarps, grasses were allowed to grow up to a certain height such that it helped in soil moisture retention and controlled soil erosion (Pollisco 2000). This was practiced both in the hedge garden as well as in the dipterocarp trial plantations. Only the vines and other climbers were removed since these kill the trees planted.

Traditional forestry use inorganic fertilizers to provide the optimum nutritional requirements to plants. Nowadays, biofertilizers: nitrogen-fixing trees as soil improvers, mycorrhizal associations, and other soil organic matter enhancers like compost and animal dung are used. Castillo (2002) stated that endomycorrhiza, can infect a wide range of vascular plants including agricultural, horticultural, coastal and forest species. This will reduce major expenses in using inorganic fertilizers.

Protection

Fencing is an effective barrier to the entry of large animals and even man. However, without proper community involvement or communication, protection is not assured even with fences. The Caliraya, Laguna, La Salle, Lipa and Bislig, Surigao del Sur dipterocarp trial planting sites have experienced various kinds of human and animal forced entry. The damages they have caused to the planted trees: cutting of 5–10 cm .DBH dipterocarp trees; trampled upon or being eaten by animals; even used as a pasture area; garbage dump.

Periodic visits to the sites especially when these are far from the research stations and even the constant re-painting of signboards are signals that the area is still being maintained and protected.

Major pest or disease infestations were not experienced by ERDB projects. Larvae feeding on leaves of stockplants in the hedge garden are picked up manually.

Highlights of some research results

Field performance of rooted cuttings is a major issue in terms of their susceptibility to wind damage. Pollisco (2000) reported about the destructive sampling done on three year old dipterocarp rooted cuttings and seedlings/wildlings planted at the Mt. Palay-palay National Park, Mataas na Gulod, Ternate, Cavite, to compare their root systems. The species used were white lauan, guijo and palosapis. Results showed that the root system of 3-yr old cuttings had more than one macro-root, each of which is comparable in size to the tap root of seedlings. Observations on the root system of 4-yr. old *Shorea leprosula* from cuttings in Long Nah also showed that the root system of cuttings develop many lateral roots but 1 or 2 roots develop downwards like the tap root of wildlings (Bachtaruddin *et al*., undated). Wildlings were found to have a major advantage of having plenty of lateral roots, presumably because of their having established initial ectomycorrhizal infection upon germination, an advantage over both seedlings and rooted cuttings. Read (1991), as cited by Becker (1983), stated that when seeds germinate, they quickly become infected by mycorrhizal fungi already established in association with the adult trees.

Initially, no major differences were found in terms of height and diameter growth of the cuttings and seedlings derived from juvenile materials. The vegetatively-derived palosapis grew more slowly in the early part than the seedlings, although the sand-rooted cuttings leveled-off with the seedlings after 11 months. Zobel (1992) also observed that rooted cuttings of sycamore (*Planatus occidentalis*) grew in the same pattern as palosapis, while rooted cuttings of *Bambasopsis quinata* grew faster than seedlings.

Dipterocarps are commonly regarded as shade tolerant during early development and light demanders after the seedling or sapling stage (Appanah and Weinland 1993). Many dipterocarp species either failed completely or performed poorly when planted directly on *Imperata cylindrica* grasslands. Poor performance of planted dipterocarps on open grassland was also reported by Zabala (1986). Contrary to these reports, 7-yr. old white lauan planted in the Caliraya, Laguna field trial was found to be growing vigorously in the open (Pollisco 2004), with bushy crown. Those planted under different nurse trees in different areas were observed to be smaller in both height and diameter increments. Dipterocarp trees under narra in Cavite did not perform well, which may be attributed to the closed canopy of the nurse trees during most parts of the year (Pollisco 2004). He said that it is intensive and may have prohibited further development of *Anisoptera marginata* saplings. The same is true with dipterocarps planted under mahogany in Malaybalay, Bukidnon wherein only occasional sunflecks penetrate the lower canopy. Even the dipterocarps planted under canopy gaps in Bislig, Surigao del Sur were smaller than those planted in the open conditions at Caliraya.

Furthermore, narra shed leaves completely during summer, exposing the dipterocarps to full sunlight. Since their leaves are attuned to shade most of the year, intense sunlight during summer is stressful in addition to water deficiency resulting to lower height and smaller diameter. According to ERDS Davao, the Nabunturan, Davao del Norte field trial under eucalypts is also an exceptional trial (pers. com.). Unfortunately, there is no data on hand to support this claim.

Since eucalypts have small, thin leaves, it is a suitable nurse tree for dipterocarps. Appanah and Weinland (1993) noted the same for *Paraserianthes falcataria*, wherein it has a sparse foliage and flat crown high above the ground, allowing sunlight to penetrate fairly uniformly to the forest floor.

Another possible explanation may also be that, as stated by Becker (1983), plants growing under high light intensity have more abundant mycorrhizal roots than those growing in the shade. He found that under natural conditions, the number of mycorrhizal infections was higher in open areas than for seedling growing under closed canopy.

Soil analysis has yet to be conducted to be able to determine the soil status of the sites. Ashton (1988) stated that distribution of dipterocarps is correlated with a number of soil factors, but primarily with magnesium and phosphorus.

Mycorrhizal inoculation trials

Dipterocarps are obligatory ectomycorrhizal, however, results of experiments show they are host-specific. Case 1. Rooted cuttings of white lauan inoculated with vegetative mycelia of Pisolithus and Scleroderma were planted in a logged-over area in Bislig, Surigao del Sur in 1998. Previous to this experiment, Pisolithus was found to promote the growth of *E. urophylla* under nursery and field conditions (Aggangan *et al.* 1997), while Scleroderma promoted the height growth of *E. camaldulensis* and *A. thurifer*. However, in this particular trial, the mycorrhizal-treated cuttings were smaller in diameter compared to the control or untreated cuttings. This result may be due to the host-specific requirements of mycorrhizas for an effective symbiotic relationship to occur. It may also be that the native mycorrhiza may have dominated over the Pisolithus and Scleroderma.

Similarly, results of a trial in the nursery using Mykovam tablets inoculated on palosapis (*A. thurifera*) seedlings had the same results: (Case 2) the untreated seedlings were bigger than the treated ones. Smits (1986) also reported that *P. tinctorius* failed to develop mycorrhizae on *A. marginata* and *S. laevis*. He suspected that the fungus did not behave as a mutualistic symbiont but as a parasite. Indeed, fungi differ in their ability to effect growth on particular dipterocarp species. Smits (1994) found that *A. marginata* form ectomycorrhizae with one fungus but not infected by three other ectomycorrhizal fungi. On the other hand, *V. bancana* did not form ectomycorrhizae with any of the fungi tested. Lee (1997) inoculated different species of dipterocarps with a Pisolithus isolate collected under eucalypts (Pt 441) and compared with a collection from under dipterocarps (Ptmn). Pisolithus 441 successfully colonized the roots of all *H. odorata* seedlings whereas Ptmn gave 100% infection on *H. glauca* seedlings.

The experience of VGL Farms, Inc.

The dipterocarp project of ERDB entered into an agreement with VGL Farms, Inc. for the provision of dipterocarp planting materials and technical assistance on tree domestication technologies needed in the development of the 50-ha. VGL Farms located in Brgy. Songco, Lantapan, Bukidnon. The tree domestication project started in 1998 and the indigenous species planted are the following: kalantas, amugis, supa, almaciga, ipil, red lauan, dalingdingan, dagang, yakal-saplungan, gisok-gisok, palosapis, white lauan, tanguile, pili, narra, Benguet pine and molave. Tanguile collected from Leyte had an outstanding performance having an average height of 183 cm and diameter of 2–2.5 cm two years after outplanting. On the other hand, the Surigao tanguile was stunted with an average height growth of 45.7–61 cm and a diameter of 0.3–0.4 cm. White lauan from Subic, Zambales had an average of 2–2.5 cm after two years (Pollisco 2002). More than a thousand indigenous trees have been planted in the property.

In situ conservation

According to Sinha (1994), although the NIPAS Act does not explicitly or directly mention the term "conservation of genetic resources" (or any of its variants), such conservation is not excluded from the management strategy for a protected area. The many lessons learned on the establishment and management of NIPAP and CPPAP may serve as baseline information and guide to FGR C & M R&D.

Moreover, the protected areas under direct management of DENR belong to a broader context than conservation biology. It is the conservation of genetic resources of target species "on site" within the natural or original ecosystem in which they occur, or on the site previously occupied by that ecosystem; it is with the community of interacting organisms (with pollinators, seed dispersers, microbial symbionts) in its natural location.

Added to this is the fact that there are people inside these protected areas which surely affect FGRs. New research activities in PAs are nil, except on ecotourism and carrying capacity. CEP sites and CBFM areas are also included in the study related to carrying capacity. Carrying capacity is the largest number of any given species that a habitat can support indefinitely. When that maximum population level is surpassed, the resource base begins to decline and sometime thereafter, so does the population (Postel 1994). These researches are still on-going.

Research gaps

A lot of R & D is needed but what comes to mind at this moment are the following: Research on the effects of forest fragmentation on genetic diversity since fragmentation affects abundance, composition and behavior of many pollinating species, etc. R & D on the propagation of beach forest species which are probably on the verge of extinction.

Forest genetic resources research has yet to pursue seed storage using other alternative methods which is called 'ultra dry' seed storing for orthodox seeds. Like the non-mist system of vegetative or clonal propagation as an alternative to the expensive misting system, alternative method of seed storage is also the way to go for forestry seeds. The ultra-dry seed storage technology is based on the principle that desiccating seeds to much lower moisture contents than those generally used in standard procedures will allow us to store them for an extended period at room temperature, thereby avoiding the requirement for refrigeration facilities. The seeds are placed in hermetically sealed containers. This is very important because seeds are the most convenient form for distributing germplasm to farmers and other users.

Most indigenous forest trees have unknown storage behavior. The orthodox and recalcitrant seeds we know in the past as the two kinds of seeds are now updated to include intermediate seeds. This kind of seed is also desiccation-sensitive, but is more tolerant than recalcitrant seeds. It is less tolerant than orthodox and do not conform to orthodox storage behavior. Once dried, they become particularly susceptible to injury caused by low temperature (Ellis *et al* 1990, 1991). The storage life of intermediate seeds can be prolonged by this further drying but it remains impossible to achieve the long-term conservation of orthodox seeds. Included in this category are some economically important species such as coffee, citrus, rubber, oil palm and many tropical forest tree species (Engelmann and Engels 2002).

Concerns

1. Critical habitats of Mindoro pine, Philippine teak, narek, apitong in Bohol and Palawan, and other local endangered tree species need to be protected. (Mindoro pine reaches maturity at approximately 20 years). As stated by Palmberg (1989), it is important to remember that species of local importance generally do not appear on such global lists. However, this does not mean that their importance should be underrated, especially as concerns conservation; and priority in research on species characteristics and possibilities for domestication and improvement.
2. Thailand has trees of Phil. teak in the Teak Improvement Center. Kaosaard (1995) stated that it looks morphologically very similar to *T. hamiltoniana*, which is endemic to the central dry zone of Myanmar. Both are known to possess resistance to defoliators. Let us not wait for the time that all will be lost in Lobo, Batangas, some in San Juan, Batangas, and Ilin Is. in San Jose, Occ. Mindoro where it is endemic. It will be embarrassing if only Thailand will have Phil. teak while we lament because of our own neglect.

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Annex

Some of the DENR research activities for 2007*

1. Development strategies for the production of good quality planting materials:

   (a) for agroforestry and plantations: Operationalization of the innovative production strategies for the different priority species. Proper maintenance of the propagation populations (i.e. Seed Sources, Seed Production Areas, Seedling Seed Orchards, Clonal Seed Orchards) of the different priority species for production of improved planting materials. Identification and testing of land races of exotic species that have already adapted to local conditions and endemic/indigenous species and provenances with fast-growth potential. Nursery generation of improved planting stocks (seeds, rooted cuttings, marcots). Trainings at different levels/technology transfer through meetings, publications, etc.

   (b) for restoration and rehabilitation: Collection of reproductive materials for nursery establishment. Use of seed technology and non-mist systems of propagation by rooted cuttings and the wildling recovery chamber, as applicable or as needed. Establishment of hedge gardens for the priority species. Maintenance of seed sources for abundant seed and other reproductive materials.

   (c) for urban and highways greening: Produce nursery-grown planting materials through seedlings, wildlings and rooted cuttings of shrubs and ornamental trees for distribution. Provide technical assistance to sectors engaged in urban greening. Inventory and protect remnants of urban vegetation in wetlands, lakes, streams and coastal areas. Educate the urban populace on the role of trees and related plants in the urban ecosystem.

2. Rehabilitation and ecological restoration R & D programme for marginal and degraded landscapes and seascapes.

3. Determination of carrying capacities of various areas/sites for resources conservation, ecotourism and sustainable development (Pas, CBFMAs, CEP.

4. Vulnerabililty assessment of priority watersheds in the Philippines

5. National IEC and capacity enhancement

6. Other ongoing research with external funding:
   - Impact assessment of Bt corn on the environment
   - Jatropha planting stock production through tissue culture
   - Molecular level analyses of some tree species
   - Determination of growth, structure and composition of third-growth dipterocarp forest in areas under active Timber License Agreement (TLA) and/or Industrial Forest Management Agreement
   - Development of sustainable tanbark extraction methods for Ceriops tagal
   - Ecology and stand dynamics of Kandelia candel
   - Community-based mangrove plantation establishment for park development and ecological enhancement in Banoyo, San Luis, Batangas.
   - Establishment of mangrove plantation in Tanza, Cavite.

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* Regional research offices also have their own research that is in consonance with the General Plan of Action of the DENR.

Thailand Consultative Workshop on Forest Genetic Resources Conservation

Suwan Tangmitcharoen
Forest and Forest Product Research Office, Royal Forest Department

Introduction

The workshop on *Forest Genetic Resource Management in Thailand* supported by the ITTO project on *Strengthening National Capacity and Regional Collaboration for Sustainable Use of Forest Genetic Resources in Tropical Asia, PD 199/03 Rev. .3 (F)* and assisted by the Asia Pacific Association of Forestry Research Institutions (APAFRI) was held on 12 March 2008 at the Rama Gardens Hotel, Bangkok. The day-long workshop (Appendix 1) was attended by 40 participants from the government, research, and academic sector, including NGOs (Appendix 2).

The main objectives of this workshop were to:

1. To enhance the capacity of forest genetic resource management in Thailand;
2. To consult, exchange knowledge, and share information and experiences among parties involved in forest genetic resource management in Thailand; and
3. To have related parties jointly determine a guiding framework for the development of forest genetic resource management in Thailand.

In order to have an effective one-day workshop a survey form (Appendix 3) was sent out to the participants before the workshop. The participants were asked for opinions and comments on two main topics: i) Capacity enhancement in various activities and ii) Network enhancement on the management and conservation of forest tree agencies. The first topic was further divided into four subtopics: priority species, training and further education, research, and continuity of operations. Eighteen copies of this form were collected by 3 March 2009. The comments were varied depending on their organizations and experiences. For example, 29 species had been selected as priority species for genetic conservation, with teak (*Tectona grandis*) considered as the first priority (Appendix 4).

Opening of the workshop

Dr. Jesada Luengjame, the Director of the Silvicultural Research Division, welcomed the participants, and the workshop was officially opened by Mr. Visoot Somnuek, Director of the Forest Management and Forest Product Research Office, the Royal Forest Department. Dr. Daniel Baskaran Krishnapillay, Executive Secretary of APAFRI, and representative of FRIM, the Executing Agency of the ITTO Project, presented the overview and introduction of ITTO project and APFORGEN.

Presentations

The workshop had four presentations:

1. Introduction: APFORGEN in Thailand by Dr. Suwan Tangmitcharoen;
2. Management and Conservation of Plant Genetic Resources by Dr. Suree Bhumibhamon;

3. Network of Community-base Forest Genetic Resources in Thailand by Dr. Komon Pragtong;
4. Forest Genetic Resource and Management of Royal Forest Department by Mr. Vitoon Luangviriyasaeng.

Dr. Suwan Tangmitcharoen, National Focal Point for ITTO Project and APFORGEN National Coordinator for Thailand, presented a background of the workshop and also briefly described the roles of organizations involved, such as APFORGEN, APAFRI, Biodiversity International, and the Forest Research Institute Malaysia (FRIM). He also elaborated the objectives of the workshop and detailed the expected outputs and follow-up activities of the workshop.

Dr. Suree Bhumibhamon gave an overview of management and conservation of plant genetic resources including status on FGR and biodiversity in Thailand. He also described the Tenth National Economic and Social Development Plan (2007–2011) for Thailand and policy and strategy of national research 2008–2010. Priority species of native and exotic tree species were pointed out. He also provided helpful recommendations on the follow-up R&D on management and conservation on FGR such as to develop on-farm trials for better technology transfer, establish national species network, develop interdisciplinary research among agencies and private sectors, set up long-term research programmes, support tree farmers for better germplasm and silvicultural practices.

Dr. Komon Pragtong stirred the interests of the audience by his presentation of the network of FGR Conservation and Management based on community forestry in Thailand. He focused on the following five items:

1. Academic Network and Alliance
2. How is Forest Genetics applied in Thailand?
3. How does it affect people in forest and agricultural areas?
4. Managerial success in terms of Forest Genetic Resources
5. Example of a successful community forest.

Dr. Pragtong concluded his paper by saying that further work on network and partnership are highly recommended after the workshop.

The fourth and final paper by Mr. Vitoon Luangviriyasaeng, Chief of the Tree Improvement Sub-Division, Forest Management and Forest Product Research Office, RFD, highlighted major tasks of FGR conservation and management conducted by RFD. Conservation strategies in terms of tree domestication for sustainable use were also described. He further explained the major activities on FGR, for example tree improvement programme and conservation project of the core species and fast-growing species such as *Tectona grandis*, *Dipterocarpus* spp., *Pinus* spp., *Eucalyptus* spp. and *Acacia* spp. Finally he described example of *ex situ* gene conservation activities of other indigenous species and tree improvement projects of some economically important species of both indigenous and exotic.

Group Discussions

To brainstorm on strengthening Forest Genetic Resources (FGR) issues, the participants were divided into two groups which addressed different issues: Group 1: Strengthening Forest Genetic Resources Activities in Thailand and Group 2: Strengthening Forest Genetic Resources Network in Thailand.

For Group 1, the overall concerns were focused on FGR activities. The group discussed on the following four topics:

1. Update priority species based on current FGR status and consultancy report made by Forest Genetic Resources Conservation and Management Programme – FORGENMAP (FORGENMAP, 2000)
2. Study and training needs
3. Research and development
4. Follow-up FGR activities.

For Group 2, discussions were focused on:
1. Existing Forestry Network
2. FGR activities that need to be supported
3. Consideration of pilot project on FGR network.

Output Summary

Group 1: Concerns on FGR Activities

This group was facilitated by Associate Prof. Suree Bhumibhamon. Members of Group 1 agreed to prioritize the species in a FORGENMAP consultancy report (FORGENMAP, 2000) in terms of economic and ecological importance. The species were classified into five groups:

a. Economic trees
b. Fuel wood,
c. Trees for rehabilitation
d. Rare/endangered trees, and
e. Minor forest product species.

The updated priority species are listed in Table 1. The members also agreed that training and study on FGR would be required and the FGR should be integrally managed among the stakeholders. As to research needs, members agreed to establish a research committee based on the five groups of priority species. According to their roles and involvement, three committees of three Departments (RFD, DNP, and DMCR) were considered. Dr.Suwan Tangmitcharoen was proposed as the coordinator among the different organizations. For Species Groups a, b and e, Mr. Vitoon Luangviriyasaeng, RFD, would be in charge as coordinator. For Species Groups c (rehabilitation of inland forests) and d, Dr. Suchitra Changtragoon, DNP, was proposed to be coordinator. For Species Group c (rehabilitation of mangrove forest), Mr. Vicharn Meepol, DMCR, was proposed to be the coordinator.

Table 1. Top five priority species summarized from the Thailand conservative workshop on forest genetic resources conservation

Economic Tree Species	Fuel Wood Species	Rehabilitation Species		Rare/Endangered Tree Species	Minor Forest Products Species
		Inland Forest	Mangrove/ Beach Forest		
Tectona grandis	*Eucalyptus* spp.	*Ficus* sp.	*Trichastoma rostratum*	*Dalbergia cochinchinensis*	*Bambusa* spp.
Eucalyptus spp.	*Leucaena leucocephala*	*Peltophorum dasyrachis*	*Avicennia marina*	*Cinnamomum porrectum*	Rattan
Acacia spp.	*Cassia siamea*	*Albizia* spp.	*Melaleuca leucadendron*	*Mansonia gagei Drumm*	*Aquilaria* spp.
Dalbergia cochinchinensis	*Trichastoma rostratum*	*Azadirachta indica*	*Casuarina equisetifalia*	*Gluta usitata*	*Garcinia* spp.
Hopea odorata	*Combretum quadrangulare*	*Duabanga grandiflora*	*Sonneratia caseolaris*	*Cinnamomum camphora*	*Acacia catechu*

Group 2: Strengthening Forest Genetic Resources Network in Thailand

This group was facilitated by Dr. Komon Pragtong. Members of this group discussed and proposed the followings:

- Roles and activities of various organizations from government, state enterprise, private sectors, and non-government organizations involved and taking action on FGR in Thailand.
- Establishing Forest Genetic Resources Networks in Thailand. APFORGEN National Coordinator, Dr. Suwan Tangmitcharoen was proposed to be a coordinator among the organizations and the RFD is the coordinating organization.
  Existing networks that are partly involved with FGR throughout Thailand which could be developed into an FGR network and partnership in the future.

Examples of the relevant networks are:

- The Network of Community Forest Management Bureau, Royal Forest Department.
- The Network of Regional Community Forestry Training Centre for Asia and the Pacific.
- The Network of the Global Environment Facility's Small-Scale Programme in Thailand
- The Network of Green Globe Award
- The Network of Environment Fund of Office of Natural Resources and Environmental Policy and Planning
- Tropical Forest Management Network

The members also proposed FGR activities that would need to be supported, which would include establishing coordinating network team, establishing FGR network database, training and seminars.

Closing of the workshop

In his closing remarks, Dr. Sim Heok-Choh, Executive Director, APAFRI, congratulated the national focal point, Dr Suwan Tangmitcharoen and his team, for organizing such a successful workshop. He also thanked all participants sincerely for sharing their experiences during the workshop, and further expressed the desire in looking forward to closer collaboration and enhanced contributions to the project.

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The workshop participants of the National Consultative Workshop on Forest Genetic Resources Conservation held on 12 March 2008 at Rama Gardens Hotel, Bangkok, THAILAND.

Appendix 1

National Consultancy Workshop on Strengthening Forest Genetic Resources Management in Thailand

12 March 2008
Rama Gardens Hotel, Bangkok

08:00 – 09:00	Registration
09:00 – 09:10	Welcome Address – Director of Silvicultural Research Division, Royal Forest Department
09:10 – 09:25	Opening Remarks – Director General of Forest Management and Forest Product Research Office, Royal Forest Department
09:25 – 09:45	Introduction of ITTO Project and APFORGEN – Dr. Daniel Baskaran Krishnapillay, Executive Secretary of APAFRI, and representing FRIM the Executing Agency of the ITTO Project
09:45 – 10:00	Coffee break
10:00 – 10:15	Introduction APFORGEN in Thailand – Dr. Suwan Tangmitcharoen, Focal Point Person for ITTO Project and APFORGEN National Coordinator
10:15 – 10:25	Introduction of Participants
10:25 – 12:00	Special Presentations: Direction of Forest Genetic Resources Management in Thailand – Dr. Suree Bhumibhamon, Centre for Natural Resources and Environment – NREM, Mae Fah Luang University. Network of Community-base Forest Genetic Resources in Thailand – Dr. Komon Pragtong, Forest Community Specialist Forest Genetic Resource and Management of Royal Forest Department – Mr. Vitoon Luangviriyasaeng, Royal Forest Department
12:00 – 13:00	Lunch
13:00 – 15:15	Group Work Group 1: Strengthening Forest Genetic Resources Activities in Thailand Group 2: Strengthening Forest Genetic Resources Network in Thailand
15:15 – 15:30	Coffee Break
15:30 – 16:30	Group Work Continued; Group Summaries and Workshop Summary
16:30	Closing of Workshop – Dr. Sim Heok-Choh, Executive Director, APAFRI

Appendix 2

Profile of Participants

The workshop was attended by 40 participants from the government, research, academic sectors, including NGOs. The participants' profiles are as summarized below:

Name of the Organization	Management			Administ ration	Utilization
	(*Ex situ* facilities)	*In situ* area	Molecular markers		
Royal Forest Department – RFD	√	√	-	-	-
National Park, Wildlife and Plant Conservation Department - DNP	-	√	√	√	-
Department of Marine and Coastal Resources – DMCR	√	√	-	-	√
Faculty of forestry, Kasetsart University	√	-	√	-	√
Forest Restoration Research Unit, Chiengmai University	-	√	√	-	√
Thai Plywood Co., Ltd.	√	√	-	√	√
Regional Community Forest Training Centre for Asia and the Pacific-RECOFTC	-	√	-	-	√
Non Government Organization – Community leaders in Northeast & South	-	-	-	-	√
Biodiversity Office, Ministry of Natural Resource and Environment	-	-	-	√	-

List of Participants

NAME	OFFICE
Dr. Komon Pragtong	Forest and Plant Conservation Research Office, National Park, Wildlife and Plant Conservation Department
Dr. Suree Bhumibhamon	Green Chiangrai MFU Botanical Garden Centre for Natural Resource and Environmental Management (NREM)
Dr. Jesada Luangjiame	Forest Management and Forest Product Research Office, Royal Forest Department
Mr. Surat Kanjanakunchorn	General Administration Bureau, Royal Forest Department
Mr. Vitoon Luangviriyasaeng	Forest Management and Forest Product Research Office, Royal Forest Department
Dr. Bundit Ponoy	Forest Management and Forest Product Research Office, Royal Forest Department
Mr. Bopit Kietvittinon	Forest Management and Forest Product Research Office, Royal Forest Department
Ms. Benjavon Caruhapattana	Forest Management and Forest Product Research Office, Royal Forest Department
Dr. Surang Thienhirun	Forest Management and Forest Product Research Office, Royal Forest Department

Mrs. Chumnun Pianhanuruk	Forest Management and Forest Product Research Office, Royal Forest Department
Ms. Nutthakorn Semsuntud	Forest Management and Forest Product Research Office, Royal Forest Department
Mrs. Walaiporn Satitviboon	Forest Management and Forest Product Research Office, Royal Forest Department
Dr. Suwan Tangmitcharoen	Forest Management and Forest Product Research Office, Royal Forest Department
Ms. Suthasinee Bhothisuntorn	Forest Management and Forest Product Research Office, Royal Forest Department
Mr. Sirithat Puvadolthatsanai	Forest Management and Forest Product Research Office, Royal Forest Department
Ms. Usarat Tianchai	Forest Management and Forest Product Research Office, Royal Forest Department
Mr. Adulyarat Tangthavee	Reforestation Office, Royal Forest Department
Mr. Pramuk Thichakorn	Reforestation Office, Royal Forest Department
Ms. Renoo Suwanarat	Reforestation Office, Royal Forest Department
Mr. Sumet Sirilak	Reforestation Office, Royal Forest Department
Mr. Chairat Chongkongkiat	Community Forest Office, Royal Forest Department
Mr. Preecha Ungprasert	Community Forest Office, Royal Forest Department
Mr. Pirat Sakulsirachit	Community Forest Office, Royal Forest Department
Mrs. Wanpen Jantachote	Community Forest Office, Royal Forest Department
Mrs. Rabeib Srigongpan	Community Forest Office, Royal Forest Department
Mr. Janesak Wichawutipong	Community Forest Office, Royal Forest Department
Mrs. Narumol Noochplian	Community Forest Office, Royal Forest Department
Mrs. Sirirat Warongkachart	Biodiversity Office, Ministry of Natural Resource and Environment
Mr. Kittikon Manassilpa	Forest Industry Organization
Dr. Suchitra Changtragoon	Forest and Plant Conservation Research office, National Park, Wildlife and Plant Conservation Department
Dr. Kowit Chaisurisri	Forest and Plant Conservation Research office, National Park, Wildlife and Plant Conservation Department
Mr. Prasert Tiyanon	Forest and Plant Conservation Research Office, National Park, Wildlife and Plant Conservation Department
Mr. Wijarn Meepol	Department of Marine and Coastal Resources
Mr. Wichan Eiadthong	Faculty of Forestry, Kasetsart University

Mr. Sutee Duangjai	Faculty of Forestry, Kasetsart University
Mr. Somporn Maelim	Faculty of Forestry, Kasetsart University
Dr. Prasit Wangpakapattanawong	Forest Restoration Research Unit
Mr. Mongkol Srianan	Thai Plywood Co.,Ltd.
Mr. Rawee Thaworn	Regional Community Forest Training Center for Asia and the Pacific
Mr. Peerachai Vonglert	Non-Governmental-Organization

Appendix 3

Comment Form

National Consultative Workshop on
Strengthening Forest Genetic Resource Management in Thailand
12 March 2008

1. **This comment form is made to hear your opinions which will be gathered, summarized, and presented at the workshop in a clear, concise, and effective manner.**
2. **Please see the explanatory notes for further details.**

1.0 Capacity enhancement in various activities

1.1 Priority Forest Tree Species
Comments ………………………………………………………………
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1.2 Training and Further Education
Comments ………………………………………………………………
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1.3 Research
Comments ………………………………………………………………
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………………………………………………………………………………

1.4 Continuity of Operations
Comments ………………………………………………………………
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2.0 Network enhancement on the management and conservation of forest tree genetics

2.1 Partnership network between organizations and communities
Comments ………………………………………………………………
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(If there is not enough space for your answer, continue on a separate sheet of paper)

Thank you for your time!

Explanatory notes for the comment form

	Main Topic	Subtopic	Points to consider	Guidelines for expressing your opinions
1	Capacity enhancement in various activities	1.1 Priority Forest Tree Species	Review of forest tree species	Rank species in order of importance (1-5) by adjusting the ranking items in the table attached.
		1.2 Training and Further Education	The provision of training or scholarship programmes for staff members in your organization. Is it necessary? In what area? And why?	Specify training topics or study programmes you think they are necessary and useful.
		1.3 Research	Research areas in which you organization has potential.	Specify research topics or questions your organization should deal with
		1.4 Continuity of Operations	The operating status, within your organization, for planning ongoing operations on the management and conservation of forest tree genetics.	Propose programme activities that should be continued in your opinion, by focusing on its importance and priority.
2	Network enhancement on the management and conservation of forest tree genetics	Partnership network between organizations and communities	1. Number of existing network partnerships. Working methods within the network. 2. Number of network partnerships engaging in activities on the management of forest genetic resources 3. Types of activities on the management of forest genetic resources for which the support is needed. 4. Forest areas and new networking strategies to form a pioneering network for the conservation of forest tree genetics.	

Notes:

1. Please return the completed form on or before March 3, 2008.
2. Any queries, please contact Khun Suwan Tangmitjaroen, Telephone: 0 2561 4292 Ext. 429, Facsimile: 0 2561 4292-3, Mobile Phone: 081 667 2987 Email:suwantang@hotmail.com, or suwan@forest.go.th

Appendix 4

OFFICE	SPECIES																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
	Tectona grandis	*Acacia mangium*	*Eucalyptus camaldulensis*	*Leucaena leucocephala*	*Acacia auriculiformis*	*Aquilaria crassna*	*Dipterocarpus alatus*	*Pterocarpus macrocarpus*	*Xylia xylocarpa*	*Afzelia xylocarpa*	*Hopea odorata*	*Gmelina arborea*	*Melia azedarach*	*Azadirachta excelsa*	*Cinnamomum porrectum*	*Sonnertia ovata*	*Dalbergia cochinchinensis*	*Acacia & Eucalyptus*	*Mansonza gagei*	*Hopea ferrea*	*Pinus kesiya*	*Pinus merkusii*	*Intsia palembanica*	*Elateriospermum tapos*	*Lithocarpus calathiformis*	*Fagaceae*	*Leguminoceae*	*Shorea roxburghii*	*Shorera henryana*
Forest Management and Forest Product Reseach Office, RFD	1						3	5		2	4																		
Forest Management and Forest Product Reseach Office, RFD	1						2	4		3	5																		
Forest Management and Forest Product Reseach Office, RFD	1					4	2				3						5												
Forest Management and Forest Product Reseach Office, RFD	1							3			4						2	5											
Reforestation Office, RFD	1	2	3	4	5																								
Reforestation Office, RFD	1					2		4									3		5										
Department of Marine and Coastal Resources																	1		3	2	4	5							
Forest Industry Organization	1					2	3	4	5																				
DNP	1						2	4		3	5																		

DNP	1						5	3	4	2																			
DNP						2											1												
Faculty of forestry Kasetsart University	1							2	5	4							3												
Thai Plywood Co.,Ltd.	1						3	2				4	5																
RECOFTC							1				2								3				4	5					
Forest Restoration Research Unit						5				4															1	2	3		
Non Government Organization						2					5			1	3	4													
unidentity	5						1	3	4																			2	
unidentity							1	5			2																	3	4

NOTE: Number represent the degree of priority (1 = highest and 5 = lowest, respectively)

RFD : Royal Forest Department

RECOFTC : Regional Community Forest Training Center for Asia and the Pacific

DNP : Department of National Park, Wildlife and Plant Conservation Department