Forest Genetic Resources

Conservation and Management

Proceedings of the Asia Pacific Forest Genetic Resources Programme (APFORGEN) National Coordinators Meeting and International Tropical Timber Organization (ITTO) Project PD 199/03 Rev.3 (F) Update, Dehradun, India, 15–16 April 2006

L.T. Hong and H. C. Sim *editors*

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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 in establishing 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 was subsequently revised. This was discussed, modified and adopted during the meeting of Heads of Forestry Research Organizations in the Asia-Pacific in Bogor on 21 February 1995, and resulted in the establishment of APAFRI.

The International Union of Forestry Research Organizations (IUFRO) has endorsed 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 has been appointed as the Asia Pacific Regional Coordinator for IUFROAPDC.

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Bioversity International is an independent international scientific organization that seeks to improve the well-being of present and future generations of people by enhancing conservation and the development of agricultural biodiversity on farms and in the forests. It is one of the 15 centres supported by the Consultative Group on International Agricultural Research (CGIAR), an associate of public and private members who support efforts to mobilize cutting-edge science to reduce hunger and poverty, improve human nutrition and health, and protect the environment. Bioversity has its headquarters in Maccarese, near Rome, Italy, with offices in more than 20 other countries worldwide. The institute operates through four programmes: Diversity for Livelihood, Understanding and Managing Biodiversity, Global Partnerships and Commodities for Livelihood.

The international status of Bioversity is conferred under an Establishment Agreement which, by January 2006, 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, Mali, Mauritania, Morocco, Norway, Pakistan, Panama, Peru, Poland, Portugal, Romania, Russia, Senegal, Slovakia, Sudan, Switzerland, Syria, Tunisia, Turkey, Uganda and Ukraine.

Financial support for Bioversity research is provided by more than 150 donors including the Governments, private foundations and international organizations. For details of donors and research activities please see Bioversity annual reports, which are available in printed form on request from bioversity-publications@cgiar.org or from Bioversity website (www.bioversityinternational.org)

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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 research focus and efforts through nearly a century of existence means 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 tropical forests conducted at FRIM had produced publications before and just after the 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 continually upgraded, have placed FRIM among the top forestry and forest products research institutions.

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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 199/03Rev. 3(F) which has duration of three years (2006–2009).

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Contents

Preface

This was the second full APFORGEN National Coordinators meeting, which was held as a side event of the Asia Pacific Forestry Commission 21st Session in Dehradun, India in April 2006 since the Inception Workshop that was held in 2003 in Kuala Lumpur, Malaysia to initiate APFORGEN. It was timely that this second meeting was held as changes have been evolving in the region in managing and conserving forest resources particularly pertaining to forest genetic resources (FGR). Noting the increasing awareness of countries on its importance as an essential component of sustainable forest management principles, FGR has yet to gain the recognition desired in many countries in the region. The APFORGEN initiative is a step in the right direction to constantly nurture and guide national forestry managers by promoting a network for a more coordinated approach to FGR conservation and management, both nationally and regionally.

The meeting has provided a means for participating countries to present an updated status of FGR conservation and management in addition to refining the draft APFORGEN action plan, which was derived after the inception meeting of 2003. The meeting was also convened as a forum for discussion and setting the scope for executing activities of the ITTO project PD199/03Rev. 3(F). The National Focal Points from the seven participating countries for this ITTO project, who attended the meeting, were briefed on their roles and the activities of the project.

The country status papers of FGR conservation and management in this publication will serve as a valuable source of information for the region's forest managers and policy makers to draw upon in refining forest management practices to suit their national needs.

Organizing this meeting would not have been possible without the support and assistance of various individuals and organizations. We thank them all. FAO RAP, Bangkok provided the opportunity and time-slot for the meeting, Indian Council of Forestry Research and Education (ICFRE), Dehradun, India, provided the organizational support and the facilities for the meeting. The International Tropical Timber Organization (ITTO), Yokohama, Japan provided the financial support via the ITTO project PD199/03Rev. 3 (F).

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March 2008

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- FAO RAP, Bangkok for the opportunity to hold it as a pre-event during the 21st Session of the Asia Pacific Forestry Commission.

- Indian Council of Forestry Research and Education (ICFRE), Dehradun, India for organizational assistance, facilities provided and its hospitality.

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

- Asia Pacific Association of Forest Research Institutions (APAFRI), for logistical and organizational support.

- Bioversity International and Forest Research Institute Malaysia (FRIM) for providing technical support.

Summary of National Coordinators Meeting 2006 and Update on ITTO Project PD 199/03 Rev.3 (F)

APFORGEN National Coordinators Meeting 2006

The meeting was held as a side event of the Asia Pacific Forestry Commission (APFC) 21st Session held at the campus of Indian Council of Forestry Research and Education (ICFRE), Dehradun, India.

The objectives of the **APFORGEN** meeting were to discuss recent updates of national forest genetic resources conservation and management (FGR C&M) in the region, to receive updates on the development of national FGR programmes in the participating countries, to revisit the draft **APFORGEN** Action Plan, to explore more effective means for information dissemination between the participating organizations and countries in the region, to explore resource generation strategy or ideas, to identify other areas of common interest for collaboration and to update on the progress of the ITTO-Project, *Strengthening National Capacity and Regional Collaboration for Sustainable Use of Forest Genetic Resources in Tropical Asia (PD 199/03Rev.3[[F]).*

Representatives from 12 of the 14 countries participating in APFORGEN who attended the meeting were from Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, and Viet Nam. Bangladesh and Pakistan were unable to attend. Several Indian scientists and individual researchers from Malaysia, Thailand and Vanuatu also attended as observers. The meeting, which was held as a side event of the Asia Pacific Forestry Commission (APFC) 21st Session was organized by Asia Pacific Association of Forest Research Institutions (APAFRI) and Bioversity International (Bioversity) in collaboration with the Indian Council of Forestry Research and Education (ICFRE).

The meeting started with a presentation on update of **APFORGEN** activities. The major achievements of the programme during the past three years included the publication of the Inception Workshop proceedings (2003), information sheets of nine priority tree species, **APFORGEN** brochures, establishment and updating of the **APFORGEN** Web site (**www.apforgen.org**) and organizing two sub regional national coordinators meetings. An important activity initiated recently was the project funded by the International Tropical Timber Organization (ITTO) entitled *Strengthening national capacity and regional collaboration for sustainable use of forest genetic resources in tropical Asia* that started in February 2006, which directly involved 7 of the 14 **APFORGEN** countries (Cambodia, India, Indonesia, Malaysia, Myanmar, Philippines and Thailand).

At the meeting the APFORGEN National Coordinators presented updates on policies, organizations, scientific projects, conservation strategies and international collaboration in FGR in their respective countries. There were numerous newly introduced policies and research initiatives relevant to FGR C&M. In addition, the 12 national coordinators explained why forest genetic diversity matters and what kind of new initiatives would be needed from their perspectives. The activities suggested for APFORGEN included: establishment of national forest genetic resource conservation networks, training of scientists, joint research/conservation projects

among member countries, development of standards, integrated conservation and tree improvement programmes and facilitation of exchange of genetic materials.

The APFORGEN draft action plan proposed during previous meetings were reviewed. A number of the proposed actions have already been initiated by participating countries. It was decided that the activities in the action plan needed updating as changes had taken place in the participating countries during the past years. It was agreed that National Coordinators would review and provide updates and submit the revised versions to the **APFORGEN** secretariat.

The meeting decided that the **APFORGEN** web site would play a key role in information dissemination between member countries and the region. To accomplish this, regular efforts should be made to update the Web site and also a suggestion was made to post success stories in FGR C&M on it for dissemination.

A discussion was held on genetic diversity in forest rehabilitation following a presentation on this topic. This discussion revealed that several **APFORGEN** countries have important reforestation and rehabilitation activities and that these efforts would likely be strengthened in the future. The understanding of the importance of genetic diversity in forest rehabilitation varies between the countries. However, the level of scientific knowledge on genetic diversity in rehabilitation was still low throughout the countries. There was a strong need for a project to assist countries to increase genetic diversity of planted trees through scientific and research related activities.

The meeting was informed that the Indonesian national coordinator Dr. Nur Masripatin, with some support from the Indonesian government had established a national **APFORGEN** secretariat shortly after the Inception Workshop of 2003. This successful Indonesian effort could be replicated and Indonesia has volunteered to assist other countries in this task. In addition, Indonesia has volunteered to host the next **APFORGEN** national coordinators meeting scheduled for 2007 or 2008.

Update on ITTO Project PD 199/03 Rev.3 (F)

The activities of the project, Strengthening National Capacity and Regional Collaboration for Sustainable Use of Forest Genetic Resources in Tropical Asia, PD 199/03 Rev.3 (F), were presented and discussed. It was emphasised that this three-year project was officially initiated in February 2006, when the agreement was formalized between the Executing Agency, the Forest Research Institute Malaysia (FRIM) and the International Tropical Timber Organization (ITTO). Collaborating with FRIM to execute the project are the Asia Pacific Association of Forest Research Institutions (APAFRI) and Bioversity International (Bioversity). The project comprised the participation of seven APFORGEN country organizations out of the fourteen, which are members of APFORGEN. Owing to the limitation of the approved budget for the project only seven countries, which are also members of ITTO are participating in this project. The National Focal Points for each of the seven participating countries have been nominated by their respective national organizations and were represented in this meeting.

The ITTO-Project National Focal Points or their representatives of the seven country organizations attending the meeting namely, Cambodia, India, Indonesia,

Malaysia, Myanmar, Philippines and Thailand some of whom were also APFORGEN National Coordinators have been informed that one of the immediate tasks was to hold a national consultative workshop for stakeholders on the status of forest genetic resources conservation and management. The deliberations and outcomes of these workshops would be compiled into reports for reference and also in fulfilment of the project's activities.

The National Focal Points present were urged to cooperate to provide updated information on the FGR conservation status for compilation into a database, which would be made available in the APFORGEN webpage for access. The framework for the database, which has been formulated by Bioversity, was shown to the participants of the meeting. More FGR information would be needed from each of the participating countries to be uploaded to make this a useful source of FGR information.

In addition it was pointed out that there was a delay in the implementation of some of the project's activities. This was due mainly to the changes in personnel of some of the participating country organizations, which necessitated the renomination of National Focal Points. The meeting was informed that the process to appoint the Project Coordinator was being undertaken. With the appointment it would speed up the execution of activities of the project and hopefully would bring it back on schedule.

Forest genetic resources conservation and management in Cambodia – An update on activities, challenges and needs since APFORGEN inception in 2003

Sok Srun
Forest Administration, Cambodia

Policies

Forestry sector contributions towards national development goals are guided by the Cambodia Millennium Development Goals (Anon. 2003c), the Statement of the Royal Government on National Forest Sector Policy, the Forestry Law, and Forestry Action Plans (2006a). In combination with the National Biodiversity Strategy and Action Plan (Anon. 2002c), these call for the development and implementation of programmes for all endangered plant species (both *in situ* and *ex situ*).

The Statement on National Forest Sector Policy (Anon. 2002b) recognises international issues, processes and commitments, such as the Convention on Biodiversity and United Nations Forum on Forests, and is being detailed in accordance with the development of the National Forest Programme. The Forestry Law (2002a) makes provision for forest gene conservation within protected forests and within special management areas in forest concessions.

Since 2003, forest gene conservation (Anon. 2005a) has been addressed in a number of strategies and plans, as outlined below. Implementation of forest gene conservation has been supported by the Danish International Development Agency (DANIDA) funded Cambodia Tree Seed Project since 2001 (Anon. 2003d), and currently, alternate sources of support are being sought. Other strategies and plans include:

- National Forest Gene Conservation Strategy and Action Plan (Anon. 2003a) which provides a systematic approach and recommends participatory approaches wherever appropriate;
- Gene Ecological Zonation (Anon. 2003b) that provides an extremely useful tool for planning gene conservation and a digitized software model for tree planting.
- Forestry Action Plan 2004–08 (Anon. 2006a) that includes the implementation of the National Forest Gene Conservation Programme to ensure the conservation of endangered, economically valuable and indigenous tree species populations, and secure the availability of quality planting materials that are fundamental to the success of future tree planting and improvement;
- National Forest Gene Conservation Programme (Anon. 2005a) forms one part of the National Forest Programme. It provides the framework for the conservation and sustainable use of tree species, based on the achievements of the DANIDA (now called Forest and Landscape Denmark) supported Cambodia Tree Seed Project (CTSP);
- Ministerial declarations for protection of 25 forest gene conservation areas.

Reforms within the Forestry Administration (FA) have established a new organisational structure, within which forest gene conservation is integrated into forest management planning processes and guidelines at decentralised levels (Anon. 2003e).

Organizations

The Forestry Administration, of the Ministry of Agriculture, Forestry and Fisheries (MAFF) is the lead institution for forest gene conservation and management (C&M) within Cambodia. The Department of Nature Conservation and Protection, of the Ministry of Environment (MoE) has responsibility for forest gene C&M falling within protected areas under its jurisdiction. Organisations active in forest gene conservation are listed below:

- Forestry Administration – responsible for the management of forests and forest resources in accordance with the National Forest Sector Policy and Forestry Law, recently undergone institutional re-organisation as noted above;
- Department of Nature Conservation and Protection – is responsible for forest gene conservation and management that falls within protected areas under its jurisdiction;
- Technical Working Group for Forestry and Environment (TWG-F&E) provides a mechanism for government and donor coordination in supporting and strengthening development activities within forestry and environment. This acts as a forum for discussion of forest gene conservation management and planning at the national level and a channel for resource distribution to activities within the Forestry Action Plan;
- Cambodia Tree Seed Project (2001–2006) supports the Forestry Administration through capacity building for forest gene conservation;
- Forests, Landscape and Planning (Denmark) formed partnership with the Forest Administration in developing an institutional framework for the implementation of the Forest Gene Conservation Strategy (Anon. 2003a);
- International and non-governmental organizations involved in forest gene conservation partner FA/CTSP within community forest areas, and include Food and Agriculture Organization of the United Nations (FAO) and American Friends Service Committee (AFSC);
- The Community Based Natural Resource Management Learning Institute (http://www.cbnrmli.org/english.html) works with partners to analyze and improve its approach as an integral component of poverty alleviation, sustainable livelihoods and resource management, conservation, and decentralization policies and strategies of the Royal Government of Cambodia; and
- New projects/programmes/initiatives (proposed and/or approved) are documented in National Forest Gene Conservation Programme (Anon. 2005) and include:
    - a proposal for forest gene conservation through community based approaches, submitted to DANIDA

- partnership agreement for the institutionalization of forest gene conservation (with Forest and Landscape Denmark)
- capacity strengthening and regional collaboration of forest gene conservation (with International Tropical Timber Organization [ITTO]/ Asia-Pacific Association of Forestry Research Institutions [APAFRI]/Bioversity International (formerly known as International Plant Genetic Resources Institute [IPGRI] and Forest Research Institute Malaysia [FRIM])
- assessment of biodiversity richness and potential for forest gene conservation (with Asian Development Bank)
- forest restoration for biodiversity recovery (with Darwin Initiative).

Scientific projects

Ongoing trials of FA/CTSP include:

- management of a ten hectare seed orchard containing seven species;
- provenance trials for four species; and
- species-elimination trials for 21 species.

The individual plots are regularly measured and the data recorded within a computerized database. Detailed analysis of the data will be done when sufficient data sets have been recorded. However, preliminary results from the trials already illustrate that native species can grow quickly and healthily in open areas. A number of laboratory tests have been conducted for seed collection, handling and storage techniques.

Conservation strategies

The National Forest Gene Conservation Strategy and Action Plan were launched in December 2003 and included the 34 priority species referred to in the 2003 Country Report (Anon. 2003a). Its development and implementation were fully documented in a recently published Case Study on Conservation of Valuable and Endangered Tree Species in Cambodia 2001–2006 (Anon. 2006b).

Even though the strategy is not binding, a number of conservation areas are protected by ministerial declarations or community forestry agreements. There are already some activities ongoing within the National Forest Gene Conservation Programme. However, its broader implementation requires additional funding and has been allocated a high priority within the Forestry Administration. Achievements to date include:

a) *In situ* seed source establishment and management:
   - thirty-five forest gene conservation areas in 16 sites have been established amounting to a total area of 691 ha, including 20 species
   - five ministerial declarations made to protect 18 conservation stands
   - promising initial results from piloting of community participation in forest gene conservation

b) *Ex situ* conservation plots (Anon. 2005b):
   - management of a 10 ha seed orchard containing seven species
   - establishment of provenance trials for four species
   - species elimination trials for 21 species

c) Networking with other countries active in gene conservation for information and experience exchange; and

d) Capacity building on:
   - forest gene C&M
   - the use of GIS based Gene-Ecological Zonation Model.

The Forest Gene Conservation Strategy is supported by a GIS based Gene-Ecological Zonation Model that was developed as an extremely useful tool in planning conservation activities and for species-site matching. Together with the Centre for Forest Landscape and Planning of Denmark an agreement is under implementation including pilot activities to propose an appropriate institutional framework for the implementation of the National Forest Gene Conservation Strategy.

Why genetic diversity matters?

Even though natural forests account for almost 60% of total land in Cambodia many species are still being exploited to the extent that they are now listed as vulnerable or endangered with a distinct number of populations threatened with extinction. Whilst this situation is not unique in Cambodia, the Royal Government of Cambodia has recognized the fundamental importance of conserving genetic diversity. Conservation is essential for sustainable forest management and the promising potential of forestry to contribute to national development objectives such as poverty alleviation and socio-economic development has been realized.

Forest gene conservation is crucial in ensuring that the rural population and the national economy benefit from the continuous use of indigenous tree species, whether in meeting commercial (timber), livelihood (agro-forestry, living fences, home gardens, fuel wood, etc) or environmental (watershed protection, erosion control) objectives. The use of quality germplasm is fundamental for successful tree breeding and planting and is directly linked to the production of high quality trees and tree products, which attract higher market prices. Non income/monetary generating values of forest gene conservation are equally important in meeting the long term interests of Cambodian society and its future generations. These include environmental protection and the conservation of biodiversity and natural heritage. Therefore, implementation of the National Forest Gene Conservation Strategy ensures that seed and planting materials of different populations of desired tree species will be available when a planting need arises in the country.

The main challenges of forest gene conservation and management are related to ongoing forest degradation and encroachment. This is a national scale problem that requires multi-sectoral solutions towards land use planning and improved livelihoods. Forest management is limited by capacity and budgetary constraints. It is best to allow local people to manage local resources. Participatory approaches to natural resource management have potential to contribute to poverty reduction

through sustainable livelihoods and improved management of local forest resources. However, a set of enabling conditions are needed to overcome some constraints such as rights of access and forest use, devolved responsibilities, and the removal of barriers to market entry.

The National Forest Gene Conservation Strategy identifies participatory approaches as essential for *in situ* activities through the integration of conservation and local development efforts. Such approaches to forest gene conservation are being explored in several locations to assess its potential and to secure access to resources contained for respective local people. Details of these initiatives are published in the recent Case Study.

Participatory approaches to forest gene conservation can only be sustained if the participants themselves perceive clear benefits for their efforts. Forest gene conservation in itself is unlikely to provide a large monetary benefit to communities. Therefore, it needs to be integrated into wider forestry related activities such as the establishment of forest gene conservation areas within community forests. This will provide a wider buffer for the protection of the forest gene resource while securing access to a wide range of non-timber forest products (NTFP) for communities.

International collaboration and future initiatives

The National Forest Gene Conservation Programme forms a part of the National Forest Programme and is guided by its principles. It allows flexibility and dynamism, enabling components to be added and implemented without affecting other implementations.

International collaboration and future initiatives should therefore be integrated into the programme to harmonize government, donor and partnership objectives and activities. Opportunities for collaboration include:

- Capacity building in natural resource management for communities, focusing on the wise use of NTFP; and
- Regional cooperation and support for research into *ex situ* conservation: seed orchards, provenance trials and species elimination trials.

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Forest genetic resources conservation and management in China – An update on activities, challenges and needs since APFORGEN inception in 2003

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Policies

The Chinese government recognizes the importance of conservation of plant genetic resources (including forest genetic resources). In recent years, increasing attention has been given by the government to forest genetic resources (FGR) conservation and management (C&M) (Gu 2002a and 2002b). The current emphasis of FGR C&M in China is on the development of a national mechanism and information-network based platform for better access to FGR and sharing of related information (Wang 2004). Studies on intellectual property (IP) rights related to FGR are also given a lot of attention. *In situ* conservation of FGR in the form of nature reserves has made significant progress in recent years. More specifically, several policy initiatives that have been started in recent years are as follows:

- National plan for conservation and utilization of biological resources: (State Environment Protection Administration, 2005. Completed for approval);
- Strategic studies on intellectual property right protection of biological resources (State Environment Protection Administration, 2006.
- Draft regulation for management of forest genetic resources (State Forestry Administration, 2006. Completed for approval);
- Call for strengthening protection and management of biological resources (State Council, 2003); and
- Biosecurity law (being drafted since 2005).

Access to genetic resources and benefit sharing (ABS) of the Convention on Biological Diversity (CBD) is a major international process affecting FGR C&M in China. Government agencies such as the State Environment Protection Administration (SEPA), State Forestry Administration (SFA) and other agencies are actively participating in this process. Studies on development of national policies and institutional framework on ABS have been conducted with leadership of SEPA. A national strategic study on protection of intellectual property rights of FGR is ongoing with support from the State Intellectual Property Bureau. This study will enable a national plan of protection of FGR to be developed as a component of a national strategy for protection of IP of biological resources.

Organizations

The Inter-ministry Joint Meeting on Protection of Biological Resources of the State Council is the highest government body supervising development of policies on biological resources, including FGR. The SFA is the national authority of the

government for activities related to FGR activities, including activities of conservation and utilization, research and development, and breeding and improvement. Other central government agencies involved with FGR activities include the SEPA, the Ministry of Science and Technology (MOST) and the Ministry of Agriculture (for fruit trees). Similar responsibilities apply to provincial and lower level government authorities.

NGOs involved in FGR activities include the Chinese Society of Forestry and provincial society of forestry of every province in China. Chinese Association of Science and Technology (CAST) is a large and high profile NGO in China, which covers many areas of science and technology including forestry. These organizations mainly provide policy consultations, organize academic workshops/conferences and coordinate training programmes and international academic exchanges. World Wildlife Fund for Nature (WWF) is an example of an NGO that is actively involved in FGR and biodiversity conservation activities in China.

A number of organizations and NGOs have been conducting activities in FGR C&M since the APFORGEN inception workshop in 2003. The names of these organizations and NGOs are listed below:

- Inter-ministry Joint Meeting on Protection of Biological Resources (Involving 18 ministries and agencies of the central government);
- State Environment Protection Administration (SEPA);
- State Forestry Administration (SFA);
- Ministry of Agriculture (Fruit trees, economic forests);
- Ministry of Science and Technology (MOST);
- Science and Technology Development Centre of the SFA;
- Chinese Academy of Forestry(CAF);
- Forestry Universities in Beijing, Nanjing, Harbin, etc.;
- Chinese Academy of Sciences;
- Botanic Gardens/Arboretums;
- National/provincial/county nature reserves;
- Chinese Academy of Agricultural Sciences;
- Provincial forestry academies;
- Municipal/prefecture level forestry institutes;
- Chinese Association of Science and Technology (CAST);
- Chinese Society of Forestry; and
- World Wildlife Fund for Nature (WWF)

The SFA established a Leading Group Protection as the national coordination body for FGR C&M activities. This clearly indicates increasing attention on FGR C&M from the government. An Expert Panel of Biological Resources was formed as an advisory body to the Leading Group Protection to provide technical consultations and advice for decision making. The Young Scientist Forum of the CAST and the Chinese Forestry Science and Technology Forum of the CAF were held to discuss issues related to FGR C&M in the last couple of years. The main programmes involving FGR C&M include:

- Natural forest protection programme (started in 2000, funded by SFA);
- Land conversion programme (started in 2002, funded by SFA);
- Wildlife protection and nature reserve development programme (started in

2001, funded by SFA);
- Fast growing plantations for timber production in key regions (in 2002, funded by SFA); and
- National network platform for sharing biological resources and related information (Started in 2004, MOST).

Scientific projects

Research projects involving FGR C&M include:
- Documentation and information system of FGR, funded by MOST;
- Conservation and utilization of FGR of major tree species, funded by MOST;
- Standards for FGR conservation and data management, funded by MOST;
- National network platform for FGR information sharing, funded by MOST;
- Protection and sustainable utilization of wildlife animals and plants, funded by MOST;
- Documentation and information sharing of wildlife plant genetic resources, funded by MOST;
- Platform development for information sharing of nature reserves, funded by MOST;
- Forest germplasm resources conservation banks, funded by SFA;
- Research projects on FGR C&M, funded by Ministry of Education;
- Projects supported by provincial governments; and
- Projects supported by industries;

Conservation strategies

The current FGR conservation strategy was developed by scientists from the CAF through consultations with relevant departments of the SFA. It clarifies responsibilities and obligations of various organizations of the central and local government for FGR conservation. Main features of the conservation strategy include:
- FGR conservation based on geographic distribution of tree species;
- Species characterization and ecological survey of natural distribution as a starting point for FGR conservation;
- Combination of short-term rescue protection and long-term conservation (both *in situ* and *ex situ)*;
- Integrated approach to FGR conservation;
- Assessment of genetic diversity and patterns of genetic variation;
- Appropriate FGR management for sustainable utilization;
- Establishment of major conservation centres according to climate zones and species richness;
- Prioritized, phased and sequenced conservation activities;
- Objectives were set for immediate goals (1991–2000), short-term goals (2001–2020) and long-term goals (2021–2050).

However, this FGR conservation strategy has not been officially set as the national policy but is still used as a guideline for research activities. Changes and adjustments to the strategy are needed for further improvement. Conservation strategies are being developed for specific species in recent years, some of which were developed by tree breeding programmes. Much of this work remains to be taken in the near future.

Why genetic diversity matters?

Genetic diversity has strong linkage with the livelihood of local communities because:

- Genetic diversity allows trees to adapt to different climate and soil conditions. Therefore people can get the same products and services from the trees in different regions. An example is the Poplar tree species that are widely grown in China (Zhu 1991);
- It provides trees with stronger resistance to possible pests and diseases. Poplars and pines are typical species that resist pest/disease damages through its diversity;
- It provides opportunities to produce different types of products to meet different needs by different people. Eucalypt trees are a good example of a producer of diverse products i.e. timber, essential oil, firewood etc.;
- It provides possibilities to breed new types of products to meet future needs. This applies to all tree species;
- It allows trees to evolve to adapt to the changing environment. This applies to all tree species.

Negative impacts are the high management costs. Genetically diverse trees may have different growth rates and produce timber with different wood properties which increases the cost of processing.

International collaboration and future initiatives

Examples of international collaboration in FGR related activities include:

- The Central America and Mexico Coniferous Resources Cooperative (CAMCORE) 2004 annual meeting in China;
- China-Australia collaboration on utilizing Australian tree genetic resources;
- China-UK collaboration on tropical pine genetic resources; and
- International Network of Bamboo and Rattan.

The following activities are suggested for future initiatives:

- Annual APFORGEN workshop held in each of the participating countries;
- Regional/national training workshops/courses on FGR C&M;
- Joint research/conservation project among APFORGEN member countries;
- Development of standards for documentation, assessment, conservation and utilization for the participating countries.

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Forest genetic resources conservation and management in India – An update on activities, challenges and needs since APFORGEN inception in 2003

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Introduction

Conservation of forest genetic resources (FGR) is essential for sustaining the productive values of forests, for maintaining the health and vitality of forest ecosystems and, for maintaining their protective and environmental roles. Thus, appropriate strategies and protocols need to be developed for continued monitoring of the genetic resources for their conservation and management (C&M). India is one of the 12 mega-diversity countries of the world, which together possess 60 to 70% of the world's biodiversity (MoEF 2005). India with its extensive and varied forests is a key country globally for conservation of FGR. The country has shown appropriate concern for the purpose by establishment of strong organizational set up, legal-constitutional framework and research and development institutions. An account of Indian initiative for C&M is briefly presented here.

National policies and legislations

FGR conservation in India has been integrated within broad frameworks, such as national forest policy and other legislations. Forest Policy and Planning in India are concurrent responsibilities of the Central Government and state governments. Policy and Planning are linked to authorizations contained in basic national legislation, including forestry legislations. In turn, policy shapes legislations in as much as legislations provide the structure and grounds for implementation of policies, strategies and priorities.

The rich traditions of modern scientific forest management began in 1864 under the British administration with the establishment of the Indian Forest Department. Since then, new forest policies have been issued in 1894, 1952, and 1988. The recent forest policy embodies the principles of sustainable forest management and India's forests are treated primarily as environmental and social resources and only secondarily as a revenue or commercial resource.

The National Forest Policy 1988 has provisions for maintenance, conservation and enhancement of biodiversity of forest ecosystems; maintenance and enhancement of forest resource productivity and optimization of forest resource utilization. The Government also issued the guidelines helping to weave environmental considerations into the fabric of national life and development process in the form of National Conservation Strategy and Policy Statement on Environment and Development 1992.

In India, the protection and improvement of the environment and the safeguarding of forest and wildlife is ensured under the directive of state policy

Articles 48A and 51A (g), Part IV of the Constitution. The Constitution directs citizens to protect nature and also provides for forests and wildlife as concurrent subjects under Schedule 8, List III, and Entry 17-A and 17-B.

The 73rd amendment to the Indian Constitution 1992 makes it mandatory for all states to decentralize governance through a three-tier structure viz. the States, Districts and Local Bodies (called Panchayati Raj Institutions or PRI in brief). Among the 29 functions recommended for decentralization, three relate to forestry, i.e. Social Forestry, Fuel Wood Plantations, and Non-Timber Forest Products (NTFP). Thus, the legal basis for effective participation of people in forest protection and forest management is available.

Apart from these, there are also other important regulations for forest resource conservation and protection such as The Indian Forest Act 1927, The Forest (Conservation) Act 1980, amended in 1988, The Forest (Conservation) Rules 1981, The Environment (Protection) Act 1986, and a Notification on Coastal Regulation Zone 1991.

The **Indian Forest Act 1927** is the main Act which regulates the management of forests by the States. The Forest Conservation Act 1980 that is among the most stringent of regulatory statues in the country is intended to control deforestation. The Forest Conservation Act 1980 is a special regulatory Act that overrides all other Acts in cases related to diversion of forest land for non-forestry purposes. It has placed strict controls on the diversion of forestland for non-forestry purposes. These Acts are the basis for the protection of the flora and fauna of the country. Aiming at weaving environmental considerations into the fabric of national life and development, process guidelines have also been issued as National Conservation Strategy and Policy Statement on Environment and Development 1992.

Recent legislations and policy changes

Biological Diversity Act, 2002/Biological Diversity Rules 2004

Taking cognizance of the provisions of the Convention of Biological Diversity (CBD), India has enacted an umbrella legislation called the Biological Diversity Act 2002, and also notified the Biological Diversity Rules 2004 (National Biodiversity Authority, 2004). The Act and Rules are for guidance of and compliance by various stakeholders, including the Union and State Governments, non-state sectors and individuals. Biological Diversity Rules 2004 aim at regulating access to biological resources of the country with the purpose of securing equitable sharing in benefits arising out of the use of biological resources; and associated knowledge relating to biological resources. The Rules proposed declaring and developing areas of importance from the standpoint of biological diversity as biological diversity heritage sites. The Act also envisages constitution of National Biodiversity Authority, State Biodiversity Boards, Biodiversity Management Committees and Local Biodiversity Funds. Salient features of the Biological Diversity Rules 2004 are as follows:

- To regulate access to biological resources of the country with the purpose of securing equitable share in benefits arising out of the use of biological resources and associated knowledge relating to biological resources;
- To conserve and sustainably use biological diversity;
- To respect and protect knowledge of local communities related to biodiversity;

- To secure sharing of benefits with local people as conservers of biological resources and holders of knowledge and information relating to the use of biological resources;
- Conservation and development of areas of importance from the standpoint of biological diversity by declaring them as biological diversity heritage sites;
- Protection and rehabilitation of threatened species.

Forest (Conservation) Rules 2003

The procedure for forestry clearance has been simplified by Forest (Conservation) Rules 2003. Under the rules, Central Government has fixed a time limit of 60 days to take decisions on proposals seeking forestry clearance. Good practices have been adopted to ensure transparency in the system of forestry clearance.

Indian Forest (Punjab Amendment) Act 2004

The comments/concurrence of the Ministry of Environment and Forests were given on the Indian Forest (Punjab Amendment) Act 2004.

Guidelines for Felling and Transit Regulations for Tree Species Grown on Non-Forest Private Lands

The National Forest Policy 1988 lays down that one third of the geographical area of the country should be under forest/tree cover. The Tenth Five-Year Plan mandate is to increase the forest and tree cover in the country to 33% of the geographical area by 2012. This target requires additional 9.97% of the geographical area of the country, i.e. 33.60 million hectare to be brought under forest and tree cover. Since almost 85% of the potential lands for additional tree planting would fall outside the notified forestlands, the involvement of non-government sector, including private individuals, is most crucial for achieving the objective. A balance is also needed between regulation and promotion of forestry in the private sector. In view of the necessity and importance of achieving the targets, the matter has been considered by the Central Government and accordingly the guidelines for the simplification of felling and transit regulations of trees grown on Non-Forest private lands have been framed. The State/UT governments have been requested to consider the guidelines for augmenting the pace of the tree plantation on private lands.

State/UT MFP (Ownership of Forest Dependent Community) Act 2004

Minor Forest Produce (MFP) is a subject with Panchayats. The Panchayats (Extension of Scheduled Areas) Act endows ownership of MFP with Gram Sabha in scheduled areas. Provision for benefit sharing mechanism with forest dwelling communities through Joint Forest Management Committees (JFMCs) exists and the States of Madya Pradesh, Chhatisgarh, Gujarat, Jharkhand and Maharashtra already have legislation to share benefits of MFP with Panchayats or through Co-operative societies. There are conflicts between JFMCs and Panchayats with regards to sharing of benefits and ownership of MFP. The Common Minimum Programme of the Union Government also envisages that the State Governments will be urged to make legislation for conferring ownership rights in respect of MFP on all those people from the weaker sections who work in forests. Accordingly, the Ministry of Environment and Forests has prepared model State/UT Minor Forest Produce (Ownership of

Forest Dependent Community) Act 2004 and the States/UTs have been requested to enact similar law conforming to their local conditions.

National Forest Commission

National Forest Commission has been set up vide resolution dated 7 February 2003 to look into re-structuring, reform and strengthening the entire forest set up and affiliated institutions in the country under the chairmanship of Honourable Justice Mr. B. N. Kirpal, Former Chief Justice of India. Keeping in mind the desire of the Central Government that there should be an increase in the forest and tree cover to 25% by 2007 and 33% by 2012, the following five terms of reference have been made to the commission:

- Review and assess the existing policy and legal framework and their impact in a holistic manner from the ecological, economic, social and cultural viewpoint;
- Examine the current status of forest administration and the forestry institutions both at all India and State level to meet the emerging needs of the civil society;
- Make recommendations indicating specific policy options for achieving sustainable forest and wildlife management and ecological security;
- Suggest ways and means to make forest administration more effective with a view to help to achieve the above policy options; and
- Establish meaningful partnership and interface between forestry management and local communities (including tribal communities).

The National Forest Commission is expected to submit the report to the Government shortly.

Organizations in the arena of FGR conservation

India has a strong set up of government (Union and States), non-governmental organizations (NGOs), academic and research institutions to carry out various activities in the field of FGR.

Government organizations

Ministry of Environment and Forests is the nodal agency for planning, promotion, coordination and overseeing the implementation of various forestry programmes in India. It also provides financial support to various Government and Non-government institutions for conduction research in the area. The Ministry also acts as nodal agency for United Nations Environment Programme (UNEP), South Asia Cooperation Environment Programme (SACEP), World Conservation Union/International Union for Conservation of Nature and Natural Resources (IUCN) and various other international agencies. The ministry also participates in International Agreement related to environment such as the Convention on Wetlands of International Importance, Conventions on Biological Diversity and Climate Change, Convention to Combat Desertification.

In addition to the Ministry of Environment and Forests, other government institutions, which directly or indirectly focus on FGR management and research, include Department of Science and Technology, Department of Biotechnology and Departments of Environment and Forests at the state and union territory level. A brief description of the nature and activities of some important players in the arena of FGR in India has been provided below:

The Indian Council of Forestry Research and Education

The Indian Council of Forestry Research and Education (ICFRE) is the apex body in the national forestry research system to develop a holistic forestry research through planning, promoting, conducting and coordinating research, education and extension of all aspects of forestry. ICFRE is an autonomous body under the Ministry of Environment and Forests, Government of India, with the following eight research institutes and three advanced centres in various parts of the country:

1. Forest Research Institute, Dehradun;
2. Tropical Forest Research Institute, Jabalpur;
3. Institute of Forest Genetics and Tree Breeding, Coimbatore;
4. Institute of Wood Science and Technology, Bangalore;
5. Arid Forest Research Institute, Jodhpur;
6. Himalayan Forest Research Institute, Shimla;
7. Rain Forest Research Institute, Jorhat;
8. Institute of Forest Productivity, Ranchi;
9. Centre for Social Forestry and Eco-rehabilitation, Allahabad;
10. Centre for Forestry Research and Human Resource Development, Chhindwara;
11. Forest Research Centre, Hyderabad.

ICFRE caters to the needs of different biogeographical regions of the nation to increase the productivity through genetic and silvicultural improvement, treatment of wasteland and conservation of forest ecosystems. ICFRE has expertise and research collaboration with various international organizations, such as Food and Agriculture Organization of the United Nations (FAO), Danish International Development Agency (DANIDA), United Nations Development Programme (UNDP), UNDP/FAO Regional Forest Tree Improvement Project (FORTIP), and World Bank on economically important species. ICFRE's priority areas for research include among others (NFRP 2001):

- Research on conservation, protection and sustainable development of existing forests to conserve biodiversity;
- Increasing productivity of existing forests and future plantations through high quality seed production; production and multiplication of site matched planting stock, improvement of species and varieties using traditional breeding methods and biotechnology; and
- Research on non-wood forest products, which provide sustenance to people and supply raw materials to forest-based industries; and socioeconomic research for motivating farmers/land owners to adopt tree farming.

The Forest Survey of India (FSI)

The Forest Survey of India (FSI), an organization under the Ministry of Environment and Forests, Government of India, has been carrying out assessment of forest resources in the country since its inception in 1965. Initially, FSI assessed the forest resources in different parts of the country through ground inventory and interpretation of aerial photographs. However, since the early 1980s, it started using satellite data to assess the forest cover of the country. Under its revised mandate of 1986, FSI assesses the forest cover on two-year cycles and publishes the information in the form of a State of Forest Report (SFR). The first report on the forest cover of the country was published in 1987, using Landsat data of US satellites through visual interpretation technique on a 1:1 million scale. The latest assessment is based on the scale of interpretation of 1:50,000. The periodic assessment of forest cover provides a quantitative measure of the extent of land area under forest/tree cover, along with the density and helps in monitoring changes in the same. Forest cover information forms the basis of national and state policy planning. Comprehensive assessment of the forest resource involves measurement of numerous parameters such as forest cover, growing stock, annual increment, species composition, biodiversity, NTFP, etc.

Botanical Survey of India (BSI)

Botanical Survey of India (BSI) established in 1890, is responsible for survey, identification and recording status of the plant resources of the country.

National Bureau of Plant Genetic Resources (NBPGR)

NBPGR is an independent national institute, which has been working to introduce, collect and conserve plant genetic resources of mainly agricultural and horticultural species in India since 1976.

National Bureau of Forest Genetic Resources (NBFGR)

ICFRE has principally agreed to establish a NBFGR under its Genetic Resource Programme, with a wide network of regional institutes situated at various agroecological zones for germplasm collection, *ex situ* and *in situ* conservation as well as introduction and evaluation.

Department of Biotechnology, New Delhi (DBT)

DBT is premier national body dealing with various aspects related to biotechnology in India. In the field of forestry, it has supported a major programme on plant tissue culture with the objective of developing protocols for regeneration of economically important plant species covering forest trees. Studies on genetic manipulation of important forest tree species – neem and poplar and characterization/cataloging of the important clones of forest trees by DNA fingerprinting are underway. The network of three gene banks has been set up by DBT for conservation of seeds, live plants and *in vitro* material of rare, threatened and economically important species.

GB Pant Institute of Himalayan Environment and Development

The GB Pant Institute of Himalayan Environment and Development, Almora (Uttaranchal) established in 1988 is an autonomous organization of the Ministry of

Environment and Forests for developing strategies, technologies and knowledge base for ecologically sound development of the Himalayan region.

Indian Institute of Forest Management

The Indian Institute of Forest Management, Bhopal, is an autonomous organization of the Ministry of Environment and Forests. It undertakes education, training, research and consultancy in forest management.

Tropical Botanic Garden and Research Institute (TBGRI), Thiruvanathpuram

TBGRI has the mandate of conservation and sustainable utilization of tropical plant diversity and is recognized as a National Centre of Excellence in *ex situ* conservation of tropical plants through various research and development programmes.

Centre for Ecological Sciences, IIS, Bangalore

This centre combines basic ecological research, applied environmental problems and extension work with particular reference to the Western Ghats. The Centre has designed the Western Ghat Biodiversity Information System adapting the state-of-art database technology and information.

State Forest Departments (SFDs)

All States have separate departments for environment/forests. Many SFDs have established institutes to conduct research in the field of forestry, for example Kerala Forest Research Institute, Peechi; State Forest Research Institute, Kanpur (UP) and Jabalpur (MP).

In addition, with the aim to improve the productivity and profitability of planted forest species and offering an attractive land use option, many SFDs have established Seed Production Areas, Clonal Seed Orchards, Seedling Seed Orchards, Vegetative Multiplication Gardens and modern nurseries for production of quality planting stock material.

National Biodiversity Authority

A National Biodiversity Authority has been set up at Chennai vide Gazette Notification dated 1 October 2003 under Biological Diversity Act 2002. The Act also provides for establishment of State level Boards and Local level Biodiversity Management Committees to deal with any matter concerning conservation of Biological Diversity, its sustainable use and fair and equitable sharing of benefits arising out of the use of biological resources and associated knowledge. The states of Karnataka, Madhya Pradesh, West Bengal and Goa have already established State Biodiversity Boards. The National Biodiversity Authority is in process of developing norms for Access and Benefit Sharing as related to genetic resources and associated knowledge.

The National Afforestation and Eco-Development Board (NAEB)

NAEB is responsible for promoting afforestation, tree planting, ecological restoration and eco-development activities in the country, with special attention to the degraded forest areas and lands adjoining the forest areas, national parks, sanctuaries and other protected areas as well as the ecologically fragile areas like the Western Himalayas, Aravallis, Western Ghats, etc. The NAEB has seven Regional Centres

located at different universities and national-level institutions in the country. Two major programmes, namely, Coastal Shelterbelt Plantation Programme (CSPP) for afforesting coastal areas in the country with suitable tree species to form shelterbelts; and Bamboo and Medicinal Plantation Projects have been taken up by NAEB as thrust areas identified by the Ministry.

Non-Governmental Organizations (NGOs)

Conservation of FGR would be impossible without active participation of people. NGOs play an important role in mobilizing the people at the grassroots. Some of the NGOs working in the arena of FGR have been listed below:

- Foundation for Revitalization of Local Health Traditions (FRLHT), Bangalore;
- Ashoka Trust for Research in Ecology and the Environment (ATREE), Bangalore;
- Environmental Resources Research Centre (ERRC), Thiruvananthapuram;
- The Energy Research Institute (TERI), New Delhi;
- BAIF Development Research Foundation, Pune;
- Centre for Environment Education (CEE), Ahmedabad;
- Centre for Science and Environment (CSE), New Delhi;
- Indian Association for Environmental Management (IAEM), Nagpur;
- Kalpavriksh, New Delhi;
- Vanarai, Pune;
- Centre for People´s Forestry (CPF), Secunderabad;
- The C.P. Ramaswami Aiyar Foundation, Chennai; and
- Society for Conservation of Forest and Wildlife, Pune.

Scientific projects

Some of the important research projects initiated recently to address the concerns of FGR C&M in India have been listed below.

MoEF sponsored

- Study of conservation biology, propagation and assessment of genetic diversity of some rare and endangered tree species of Eastern Ghats through molecular techniques;
- Studies on the biodiversity of sholas and grasslands and their restoration in the Nilgiris Plateau, Southern India;
- Characterization of plant biodiversity, community structure and population behaviour of some important tree species at the community forests of Nagaland;
- *In vitro* screening and multiplication of tree species of coastal agro ecosystems for abiotic stress tolerance;
- Bioprospecting of potential rare and endangered ethnobotanical important plant species of Jharkhand;

- A study on floral diversity of Bhadra Wildlife Sanctuary, Karnataka; and
- Conservation through micro-propagation and restoration of endemic endangered and economically useful plants of the Kolli Hills in the Eastern Ghats of Tamil Nadu.

ICFRE projects

- Studies on cataloguing the genetic variation in teak species (*Tectona grandis* and *T. hamiltonii*) using molecular markers;
- Estimation of gene diversity and drift pattern in natural stands and plantations of South Indian forest tree species;
- Creation of germplasm resource bank of threatened medicinal plants of Darjeeling Himalayas;
- Studies on plant diversity of Renuka and Simbalwara Wildlife Sanctuaries of Himachal Pradesh;
- Development of ecologically viable and socio-economically accepted integrated model for arresting Willow (*Salix*) mortality in Lahaul Valley of Himachal Pradesh;
- Germplasm collection, conservation and mass multiplication of selected medicinal plants of northeast India; and
- Inventorization and monitoring of biodiversity of threatened wetland sites of Doon valley and surroundings.

DST sponsored

- Identification of elite genotypes of *Hippophae rhamnoides* for multiplication and large-scale domestication in the higher Himalayan region of Uttaranchal;
- *In vitro* propagation of Bijasal (*Pterocarpus marsumption*) – A medicinal leguminous tree;
- Analysis of climatic changes in North-East India during the last several thousand years using pollen and tree ring data;
- Assessment and conservation strategies of pteridophytic diversity of Milam;
- Bioelectrical stimulations for enhancement on hairy root biomass and in vitro regeneration of Neem (*Azadirachta indica*).

National Medicinal Plants Board (NMPB) sponsored

- *In situ* conservation and *ex situ* cultivation of selected medicinal plants and endangered species in Madhugiri Taluk, Tumkur District;
- Varietal improvement of *Rauwolfia serpentina* and *Tinospora cordifolia* through germplasm selection evaluation and breeding;
- Inventory, conservation and documentation of medicinal plants of Bundelkhand region of Madhya Pradesh;
- Production of elite planting material of medicinal and aromatic plants suitable for hilly region through macro and micropropagation;

- *Ex situ* and *in situ* conservation and development of medicinal plants in Tripura; and
- Exploration and introduction of some selected medicinal plants of Kumaon Himalaya, Uttaranchal with special emphasis on establishment of Biodiversity Park.

New research findings

Various research institutions of the country have provided significant impetus in the areas of FGR. Salient new research achievements are as follows:

- Genomic DNA isolation techniques has been perfected for different Himalayan Pines [*Pinus roxburghi* (55 population); *P. wallichiana* (11 population) *P. geradiana* (4 population) and *P. kesia* (4 population)] for molecular base genetic analysis;
- Analyzed the genetic variability among 20 provenances of *E. camaldulensis* using Amplified Fragment Length Polymorphism (AFLP) markers and 12 provenances of *Casurina equisetifolia* using Random Amplified Polymorphic DNA (RAPD) markers;
- In the Casuarina hybridization programme, forty outstanding clones of *Casuarina equisetifolia* and *C. jungbubunia* were selected, clonally propagated through cladode cuttings and assembled in a potted seed orchard to facilitate control crosses in different combination and produced seeds;
- Genetic diversity among *Taxus wallichiana* growing in north Himalayan region has been estimated by RAPD analysis;
- Floristic inventory on two threatened wetland sites namely, Kali Ka Dhal (Manu Swamp) and Goalatapper (Tin Paani) was carried out. Impacts on the sites resulting into loss of biodiversity and habitat of species, e.g. *Carallia, Glochiodon, Baliospermum, Firmiana* etc were assessed;
- Species distribution mapped for 21 threatened medicinal plants in Kolli hills;
- Analyzed genetic diversity of teak plus trees assembled in the National Germplasm Bank, Chandrapur, using RAPD and Inter-Simple Sequence Repeat (ISSR) markers;
- Rare, threatened and spectacular plant species namely Hedychium, Ferns, Dedlacanthus, Phlogacanthus, Adenostemma, Mosla, Nelsonia etc. typical of Doon valley were floristically surveyed, taxonomically studied and their germplasm collected for introduction in the Botanic Garden of the FRI, Dehradun;.
- Selection of wild and cultivated populations of *Artocarpus integrifolia* and progeny trial established;
- Established of SPAs of *A. hirsuta*, a threatened endemic species of Western Ghats;
- Studies were conducted to identify elite genotype of Sea buckthorn (*Hippophae rhamnoides*) – a useful medicinal wild plant;
- Documented indigenous knowledge (IK) related to the use of medicinal plants for curing different ailments by the "Vaidyas", methods of vegetable drying

and weather forecast indicators in Uttaranchal and NTFPs in Arunachal Pradesh and Assam;.

- Developed propagation protocols for high value (both economically and ecologically) plants: *Aconitum heterophyllum, Arnebia euchroma, Heracleum candicans, Picrorhiza kurrooa, Saussurea obvallata* and *Swertia chirayita;*
- Cloned *Dendracalamus hamiltonii, Grewia oppositifolia, Rhododendron* spp. and *Taxus baccata;*
- *In vitro* plantlet production and field transfer of *Heracleum candicans, Picrorhiza kurrooa* and *Arnebia benthamii;*
- *In vitro* rooting of *Rhododendron maddeni* was also accomplished;
- Tissue culture protocols for two Eucalyptus hybrids i.e. FRI-5 and FRI-14 through auxiliary buds were standardized;
- Vegetative propagation of *Tinospora cordifolia* standardized and variation in rooting ability of *T. corditolia* germplasm collected from different geographical location tested;
- Callus induced from auxiliary node of *Gymnema sylvestre;* and.
- Mass propagation technique of *Terminalia arjuna* has been developed.

National FGR conservation strategies

The Government of India has adopted several schemes under National Forestry Programmes to achieve Sustainable Forest Management and the national goal of one third of land area to be under forest/tree cover. This also links with livelihood and poverty alleviation issues of forest dependant communities. Such sustained commitments on the part of the State/UT governments have also resulted in significant participation of local people in tree planting and forest management, as well as in the conservation of biodiversity.

National Forestry Action Plan (NFAP)

Recognizing the role of forests in rural livelihoods and in ensuring environmental security for future generations, the Government of India has formulated the National Forestry Action Plan (NFAP) which is a comprehensive work plan for the next 20 years to achieve the goal of sustainable development of forests and also to increase the forest/tree cover in the country to 33% of the land area as mandated in the National Forest Policy 1988. The implementation of NFAP requires huge investment, i.e. US$ 20 billion to achieve sustainability of all types of forests in the country. There is scarcity of financial resources and international attention is needed in key areas such as finance, transfer of environmentally sound technology (EST), legal protection of traditional forest related knowledge (TFRK), etc. The international arrangement on forests is not effective in the fields of finance and transfer of EST. India believes that only after these have been addressed, and consensus solutions found to these issues, meaningful discussions on future international arrangements or mechanisms can be initiated on the basis of a firm consensual foundation.

National Biodiversity Strategy and Action Plan (NBSAP)

A comprehensive project has been launched for preparation of planning documents relating ecological security and livelihood of people depending on natural resources. The ultimate aim is to develop a National Action Plan for conservation of biodiversity and its sustainable use. A consultative and participatory approach was adopted by all the executing agencies. A draft National Action Plan (NAP) has been prepared based on 71 draft biodiversity strategy and action plans (BSAPs) at local (sub-state), state, ecoregional, and thematic levels, 31 draft sub-thematic reviews, large number of secondary sources and so on. The draft is under consideration of the Ministry of Environment and Forests.

Biosphere Reserves and Protected Areas

Economically important forest tree species have been conserved in gene banks, *in situ* and *ex situ* conservation sites with wide networking between the SFDs. A number of national parks (90) and other protected areas in the form of biosphere reserves (14) and wildlife sanctuaries (502), which have been regarded as *in situ* FGR C&M at the species level have been established. In addition, a variety of field repositories of genetic resources, including nature reserves and other protected areas, private and publicly owned, managed and unmanaged, natural forests and plantations, trees outside forests (TOF) managed in agroforestry systems and growing on homesteads and along rivers and roads, arboreta and botanic gardens, field trials and live collections, have also been developed within the framework of selection and tree improvement programmes to increase the productivity of forest.

Biosphere Reserves are multipurpose protected areas of terrestrial and coastal ecosystems to preserve the genetic diversity in the representative ecosystems, which are internationally recognized within the framework of United Nations Educational, Scientific and Cultural Organization (UNESCO)'s Man and Bioshpere (MAB) programme. These reserves are required to meet a minimal set of criteria and adhere to a minimal set of conditions before being admitted to the World Network of Biosphere Reserve designated by UNESCO for inclusion in the World Network of Biosphere Reserves. The major objectives of biospheres reserves are:

- To conserve biodiversity and integrity of plants, animals and micro-organisms;
- To promote research on ecological conservation and other environmental aspects; and
- To provide facilities for education, awareness and training.

So far 14 biosphere reserves have been set up. These are: Nilgiri, Nanda Devi, Nokrek, Great Nicobar, Gulf of Mannar, Manas, Sunderbans, Simlipal, Dibru, Daikhowa, Dehong Deband, Pachmarhi, Kanchenjanga, Agasthyamalai and Achanakmar-amarkantak. Financial assistance to the respective State Governments for C&M of the 14 Reserves designated are provided by the Ministry. In addition, research and development projects were also supported in these Reserves. On the basis of the proposal submitted to UNESCO, the Nanda Devi Biosphere Reserve from

Uttaranchal has been included in the World Network of Biosphere Reserves in October 2004 by UNESCO. Three Biosphere Reserves namely, Sunderbans (West Bengal), Gulf of Mannar (Tamil Nadu), and Nilgiri (Tamil Nadu, Kerala and Karnataka) were earlier included in the World Network of Biosphere Reserves. Efforts are on for getting the remaining Biosphere Reserves included in the World Network of Biosphere Reserves.

All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX)

On account of diverse ecosystem present in the country, all biodiversity must be identified, classified and described for present as well as for future use. So far, about 90 000 species of animals and 47 000 species of plants have been identified and described. However, a large number of animals and plants are yet to be explored, identified and described. The Ministry has set up an All India Coordinated Project on Taxonomy. The project has organized specialist groups drawn from Universities, Botanical and Zoological Surveys of India to take up taxonomic work on plant and animal species.

Mangrove Conservation Programme

Mangroves of the country are reservoirs of a large number of species and stabilize the shoreline. India harbours some of the best mangroves in the world with an estimated area of 6000 sq km. Thus, a Mangrove Conservation Programme was launched by Ministry of Environment and Forests in 1987 and, has so far, identified 35 mangrove areas for intensive C&M in the country. These mangrove areas are identified on the recommendation of National Committee on Mangroves and Coral Reefs on the basis of their unique ecosystems, biodiversity etc. Hundred percent central assistance is given under Management Action Plans (MAPs) for undertaking activities like raising mangrove plantation, protection, catchment area treatment, siltation control, pollution abatement, biodiversity conservation, sustainable resource utilization, survey and demarcation, education and awareness etc.

A National Mangrove Genetic Resources Centre has also been established in Orissa**.** This Centre will assist in conservation of the threatened and endangered species of mangroves. It will also contribute to research and development, which will enable us to qualitatively improve efforts for conservation, afforestation and regeneration of mangroves.

Programmes for conservation of medicinal plants

India probably has the oldest, richest and most diverse cultural traditions in the use of medicinal plants. Substantial headway has been made recently for conservation of these resources.

NMPB, under the Ministry of Health & Family Welfare has developed appropriate mechanism for coordination and implementation of policies relating to medicinal plants both at the Central and State levels to facilitate inter-Ministry, inter-state and institutional collaboration and to avoid duplication of efforts. The major objectives of the board is to coordinate all activities relating to medicinal plants, including

drawing up policies and strategies for conservation, proper harvesting, cost-effective cultivation, research and development, processing, marketing of raw material in order to protect, sustain and develop this sector. The NMPB has taken up following initiatives:

- At the national level, 32 medicinal plants have been prioritized for development; and
- Formulated schemes and guidelines for financial assistance in different areas of medicinal plants sector.

With the initiative of NMPB, 32 State Medicinal Plant Boards have been set up to address the related issues for development and growth of medicinal plants sector in the country at the regional/state level. These boards are engaged in improving the status of existing medicinal plants in their respective areas either by *in situ* or *ex situ* conservation.

A UNDP-Country Cooperation Framework-II project has been approved by the Ministry of Environment and Forests for implementation in nine states viz. Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Orrisa, West Bengal, Rajasthan, Maharashtra and Madhya Pradesh. The objectives of the project are:

- To assist nine project states to conserve wild population of medicinal plants;
- To revitalize the indigenous health care knowledge; and
- To enhance the health and livelihood security.

SFDs of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Maharashtra, in consultation with the Foundation for Revitalization of Local Health Traditions (FRLHT) and with the support of DANIDA and UNDP have established 54 forest gene bank sites called Medicinal Plant Conservation Areas (MPCAs). The network of 54 MPCAs, covering 200 to 500 ha each, has been established gradually since 1993 and represents all forest types with large bio-climatic and soil regime variation. These gene banks harbour 45% of recorded populations of flowering and medicinal plants of Peninsular India, including 70% of the red-listed.

Conservation of bamboo genetic resources

India is the second richest country in bamboo genetic resources after China. Commendable efforts have been made for conservation of bamboos in the country during the last decade. Large areas where bamboo occurs have been declared as National Bamboo Reserve areas and are being maintained.

Since a wide genetic resource base is required for selection and improvement, conservation of available genetic resource needs to be accorded the highest priority (Rao and Ramanatha Rao, 2000). Efforts have been made by the NBPGR of ICAR, New Delhi and its stations in Thrissur, Shillong and Ranchi and different institutions under ICFRE to collect and build up genetic diversity of bamboo for evaluation, utilization and maintenance. Considering the limitation in seed supply, vegetative methods for *ex situ* conservation and tissue culture work have started. ICFRE has perfected the macro-/micropropagation techniques for bamboos and transferred them to users for mass multiplication. The Kerala Forest Research Institute (KFRI) at Kerala has established a Bamboo Information Centre (BIC) for disseminating all relevant information on 137 species of Indian bamboo.

Keeping in view the potential of Bamboo, its present poor market linkage and sub optimal level technology application for manufacturing value added products in the industrial and cottage sector, the National Mission on Bamboo Technology & Trade Development has been mooted by Planning Commission to accord bamboo development as a strategic role in improving rural economy, poverty alleviation and bamboo based handicrafts and industrial development. The Mission document envisages coverage of 2 million ha under bamboo during the Tenth Five-Year Plan involving an investment of Rs. 26.08 billion for expansion of plantations of bamboo species, its scientific management with the involvement of JFMCs, local initiatives and entrepreneurship for presenting this raw material for the industries and assisting the industry to access and apply modern technology for producing globally competitive new generation bamboo products. The other features of the Mission include technology development and transfer for planting, technology intervention on process and products including standards and codes, handicraft development (including training), trade and market development for bamboo products, and technology development for building material.

To address the natural ecological phenomenon of gregarious flowering of muli bamboos (*Melocanna baciferra*) in the North-Eastern States, a Steering Committee which included representatives of NE States and concerned Ministries and Government organizations constituted three Task Forces on 'regeneration', 'harvesting and marketing of bamboos' and 'rodent control'. The Task Forces have held three meetings and an action plan for an amount Rs.1.05 billion for a period of five years (till 2008–09) was finalized to deal with this phenomenon.

Botanical Garden of Indian Republic (BGIR), Noida

The Botanic Garden of Indian Republic (BGIR) is being set up on 200 acres of prime land in Noida (UP) by the Botanical Survey of India under the Ministry of Environment and Forests, Government of India. The BGIR has been identified as a "Green Channel" Project under the National "Jai Vigyan" Science and Technology Mission of the Ministry of Science and Technology and with full support from the Planning Commission and other relevant ministries and departments. It aspires to attain an international stature and serve as a nodal centre for networking of Botanic Gardens in South East Region.

The National Botanical Garden would *inter alia* facilitate *ex situ* conservation and propagation of threatened/endangered plants of the country, serve as a centre of excellence for research and training, and thereby cater to the conservation needs of endangered species in the region. Its vast canvas will include components such as woodlands, arboreta, water bodies, display sections, experimental plots and nurseries as well as civil structures like an administration-cum-herbarium-library complex, interpretation centre and conservatories. A Multi-Disciplinary Expert Committee has been set up to look into diverse aspects for the development of the Botanical Garden of India Republic (BGIR) NOIDA, is a one of the most uniquely landscaped botanic garden of modern times. The botanic garden is mandated for conservation of rare and threatened plants of the country and would serve as a national centre of excellence for conservation, research and environmental education thus providing a window for interface between science and society. By developing

special innovative features, it is expected to become a major attraction for eco-tourism as it develops into one of the most uniquely landscaped botanic gardens of modern times.

Assistance to botanical gardens

The scheme on assistance to botanical gardens and centres for *ex situ* conservation has been taken up to augment *ex situ* conservation of rare endemic plants by the Ministry of Environment and Forests. A one-time financial assistance is provided to the existing botanical gardens for improvement of their infrastructural facilities to facilitate *ex situ* conservation of rare endemic plants. The achievements made by these botanical gardens are periodically monitored with the help of Botanical Survey of India and regional offices of the Ministry of Environment and Forests. The Botanical Survey of India helps in identification of rare endemic plants requiring *ex situ* conservation. During the 2004–05, 20 Botanical Gardens were recommended for funding.

Integrated Forest Protection Scheme

Integrated Forest Protection Scheme has been formulated with the following components:

- Infrastructure development;
- Working plan preparation/survey and demarcation;
- Strengthening of infrastructures for forest protection; and
- Forest fire control and management.

The scheme will cover all the States and UT's for the Tenth Five-Year Plan period. The Central Sector Component of the Scheme is to be implemented by the Ministry of Environment and Forests in association with Forest Survey of India, Dehradun and other Central Institutions like Indian Council of Forestry Research and Education, Dehradun, Indian Institute of Forest Management, Bhopal and National Center for Medium Range Weather Forecasting. The State Sector Component of the Scheme is being implemented by the SFDs of the concerned State Governments and UTs. The Central Assistance is provided for various activities, which will help to protect and improve the existing forests and FGR.

Why genetic diversity matters?

The social functions of forests are very important, as the forest fringe villages comprise 28% of the total number of villages in the country. Forests are inseparably linked with the livelihoods of people living on the forest fringes, as they depend on forest produce for self-consumption and cash income. More than 340 million people in India depend on forest-based livelihoods such as collection, processing and sale of fuelwood and NTFP (Bose and Saigal 2004). Most of the indigenous tribes depend upon many forest product species for their sustenance and cash economy. Forests also support grazing of nearly 60% of the livestock in the country (270 million out of about 450 million), and are used for collection of head loads of firewood for sale in

the market. It is reported that more than 3 million people are employed in the tendu-leaf collection and beedi-rolling industry and nearly half-a-million people are employed in safety-match making, saw milling and wood carving (Bose and Saigal 2004). This indicates that the livelihood of considerable number of people greatly depends upon sustained production and management of FGR.

The full implications of the loss or deterioration of FGR for humankind are not known. However, the loss of forest resources can lead to diminished income- and food-generating capacity for forest-dependent communities, higher rates of soil erosion and siltation of waterways, loss of species and genetic diversity and an increase in carbon emissions, which contribute to global warming (Kaimowitz *et a*l. 1998). Thus, forests need to be managed in a way that ensures their sustainable utilization, safeguarding the ecological process and genetic diversity essential for the maintenance of the resource base. However, this human dependence on forests for livelihoods is not always without a cost to the ecosystem, be it a reduction of local species productivity or a decline in ecosystem functioning.

In the recent past, large-scale commercial extraction driven by national and global market forces has led to enormous pressure on forest products. Unscientific harvesting of forest produce for example, de-barking stems of *Kydia calycina* (Uma Shaanker *et al.* 1997), or harvesting bamboo (Chalavaraju *et al*. 2001) or heartwood of sandal (Nageswara Rao *et al.* 2001) adversely affects the regeneration of the respective species and their genetic resources. Sandal, prized for its heartwood and oil, has been a major source of forest-based revenue for the government for the past several decades. Many traditional craftsmen depend on a regular supply of sandalwood for their livelihood. However, due to over exploitation over 50 years, the sandal genetic resources are fast declining. This has not only resulted in considerable reduction of income to the government but also losing hereditary source of income as well as skills associated with the craft to sandalwood craftsmen (Nageswara Rao *et al.* 2001).

International collaboration and future initiatives

India ratified the International Convention of Biological Diversity (CBD) on 18 February 1994 and became party to the Convention in May 1994. The CBD is an international legal instrument for the conservation and sustainable use of Biological Diversity taking into account "the need to share cost and benefit between developed and developing countries and the ways and means to support innovation by local people". To date, seven ordinary meetings of the Conference of Parties (COP) have been held.

The 7th meeting was held in Kuala Lumpur, Malaysia, from 9–27 February 2004, where one important decision related to genetic resources taken by the parties was on 'Access and Benefit Sharing'. It was resolved to evolve an international regime on access to genetic resources and benefit sharing with the aim of adopting an instrument/instruments to effectively implement the provisions of CBD.

Expert meeting of the Group of Like Minded Megadiverse Countries (LMMC)

Seventeen countries i.e. Bolivia, Brazil, China, Colombia, Costa Rica, Democratic Republic of Congo, Ecuador, India, Indonesia, Kenya, Madagascar, Malaysia, Mexico, Peru, Philippines, South Africa, and Venezuela rich in biological diversity and associated traditional knowledge have formed the Group of Like Minded Megadiverse Countries (LMMC). The LMMC Group holds nearly 70% of global biodiversity and is a recognized negotiating block in the United Nations and other international fora.

India has taken over Presidency of the LMMC on 19 February 2004 during the Ministerial meeting of the group in Kuala Lumpur in the margins of COP-7 meeting of Convention on Biological Diversity. India, in its capacity as the Chair of the LMMC had organized an Expert and Ministerial level Meeting of the LMMCs in New Delhi from 17–21 January 2005, under the patronage of the Honourable Minister of Environment and Forests as President of LMMC. This meeting has adopted the New Delhi Ministerial Declaration of Like Minded Megadiverse Countries on Access and Benefit Sharing, which is being seen as the beginning of a new era in the negotiations on International Regime on Access and Benefit Sharing as a Legally Binding Instrument (LBI).

Suggestions

In a country like India with vast natural resources and diversity, the extent of effort required for FGR conservation is enormous. Thus, for effective conservation and management establishment of National FGR conservation, network is essential. This network should have the following activities:

- Coordination and promotion of *in situ* and *ex situ* conservation of India's FGR;
- Facilitation of the exchange of genetic material and information; and
- Enhancement of public awareness of the need to conserve FGR.

There is also a need to strengthen capacities pertaining to research and development activities related to FGR in the country. Infrastructural facilities throughout the country should be improved by enhanced and continual allocation of monetary resources for conducting advanced research,. Human resource development of scientific/ technical personnel through national and international trainings will also lead toward efficient FGR C&M.

Immense possibilities exist for coordination and collaboration in the Asian/South Asian region for sustainable management, research and conservation of FGR. This may include:

- Coordination to evolve integrated FGR conservation/tree improvement programmes for threatened/economically important tree species among the member countries; and
- Constitution of forest tree genetic resource information and research network, which will evolve mechanism for dissemination of scientific progress as well as awareness for FGR conservation.

For efficient coordination and management of FGR at national and regional levels, APFORGEN should evolve mechanisms to strengthen and support networking, information sharing, capacity-building and research endeavours by establishment of regional centres of Bioversity International (formerly known as International Plant Genetic Resources Institute/IPGRI) in the representative countries. The member countries should also promote collaborative research and exchange programmes for scientists.

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Forest genetic resources conservation and management in Indonesia – An update on activities, challenges and needs since APFORGEN inception in 2003

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Policies

Indonesia is now in the process of finalizing the Bill on Genetic Resources Utilization and Conservation. The proposed law is intended to:

- Assure the utilization of genetic resources in a sustainable manner;
- Provide legal protection towards genetic resources and the owners so that they can obtain a fair benefit sharing;
- Promote community participation in utilization and conservation of genetic resources and improve their livelihood;
- Encourage Research and Development and collaboration in genetic resources utilization and conservation at various levels (national, regional, and global); and
- Ratify Cartagena Protocol through UU No. 21 in 2004.

The Indonesia Biodiversity Strategy and Action Plan was published in 2004 and the Minister of Forestry Decree on genetic resources of teak was enacted in 2004. The Decree requires that good quality planting materials are used to develop teak plantations.

Organizations

Organizational change in the Ministry of Forestry in 2005 resulted in a change in the institution of the APFORGEN National Coordinator of Indonesia. APFORGEN activities that were previously coordinated by the Centre for Forest Biotechnology and Tree Improvement Research and Development (CFBTIRD) in Yogyakarta were transferred to the Centre for Plantation Forest Research and Development (CPFRD) in the Bogor office.

In order to strengthen the network and to synergize research on forest genetic resources conservation and management (FGR C&M) and other related activities at the national level, the CPFRD has developed links and networks with related institutions and organizations working on FGR C&M. Institutions and organizations that are involved in the conservation network includes :

- DG of Forest Protection and Nature Conservation, Ministry of Forestry;
- Centre for Natural Forest and Nature Conservation Research and Development;
- National Commission on Germplasm, Ministry of Agriculture;
- Centre for Agricultural Biotechnology and Genetic Resources, Ministry of Agriculture;

- Ministry of Environment;
- Ministry of Research and Technology;
- National Board on Technology Assessment and Implementation;
- National Science Institute;
- Universities;
- Provincial and District levels government; and
- NGOs (Naturindo, Kehati Foundation).

Table 1. FGR C&M related activities for some priority species conducted by FORDA and other institutions/organizations.

No.	Species	Research Activity	Organization
1.	*Acacia mangium* and *Eucalyptus* spp.	Forest protection, Multi site Test, Silviculture, Evaluation of SSO-F2, Reproduction Biology, Wood Technology, Hydrology, Plant Protection	CPFRD, Plantation Forest Research Institute in Palembang and Banjarbaru, BP2TPDAS IBB and IBT
2.	*Alstonia* spp.	*Ex situ* gene conservation, Vegetative and generative propagation, Microbiology, Establishment of propagation population and SSO, Silviculture	CPF, Nusa Tenggara Forest Research Institute, Plantation Forest Research Institute in Palembang and Banjarbaru
3.	*Araucaria cunninghamii*	*Ex situ* gene conservation, Vegetative propagation, Genetic Test, Establishment of CSO, Progeny Test, Silviculture	CPF, Papua and Maluku Forest Research Institute
4.	*Arthocarpus altilis*	*Ex situ* gene conservation, Establishment of propagation population, Evaluation of CSO and hedge orchard	CPF, Non-Timber Forest Product Research Station, Sulawesi Forest Research Institute
5.	*Diospyros celebica*	Silviculture, Geographical Distribution, Species-site matching, Microbiology	CFNC, Sulawesi Forest Research Institute
6.	*Dyera costulata*	Silviculture, Geographical distribution, species-site matching , Microbiology	Plantation Forest Research Institute in Palembang
7.	*Eusideroxylon zwageri*	*Ex situ* gene conservation, Vegetative propagation, Genetic Test, Progeny Test, Silviculture, Chemistry, Microbiology	CPF, Kalimantan Forest Research Institute, Plantation Forest Research Institute in Palembang and Banjarbaru
8.	*Gonystylus bancanus*	Establishment of genebank of *G. bancanus* through tissue culture	CPF
9.	*Intsia* spp.	*Ex situ* gene conservation, Vegetative and generative propagation, Genetic Test, Progeny Test, Silviculture, Chemistry, Microbiology	CPF, Papua and Maluku Forest Research Institute
10.	*Melaleuca cajuputi* subsp *cajuputi*	Establishment and evaluation of SSO/CSO, Reproduction Biology, Hydrology	CPF, Nusa Tenggara Forest Research Institute, BP2TPDAS IBB
11.	*Morus* spp.	Evaluation of CSO and hedge orchard, Establishment of propagation population	CFNC, Sulawesi Forest Research Institute
12.	*Santalum album*	*Ex situ* gene conservation, Vegetative propagation, Genetic Test, Establishment and	CPF, Nusa Tenggara Forest Research Institute, CFP

		evaluation of SSO, Forest Protection, Silviculture, Chemistry, Microbiology	
13.	*Shorea johorensis*	Silviculture, Species distribution, Species-site matching, Microbiology, Forest Protection	Plantation Forest Research Institute in Palembang and Banjarbaru, Kalimantan Forest Research Institute
14.	*S. stenoptera*	Silviculture, Species-site matching , Forest protection	CFNC, Plantation Forest Research Institute in Banjarbaru, Sumatra Forest Research Institute, Kalimantan Forest Research Institute
15.	*Shorea* spp. (producing illipe nut)	*In situ* gene conservation, Genetic Test	CPF, Forest Service of West Kalimantan
16.	*Swietenia macrophylla*	Silviculture, species distribution, Species-site matching , Forest Protection	CFNC
17.	*Tectona grandis*	Clonal Test, Intensive silviculture, Genetic Test, Establishment and evaluation of SSO/CSO, Wood Technology,	CPF, Plantation Forest Research Institute in Palembang and Banjarbaru, Nusa Tenggara Forest Research Institute, Sulawesi Forest Research Institute
18.	*Toona* spp.	*In situ* Gene Conservation, Establishment of SSO	CPF, Sumatra Forest Research Institute, Papua and Maluku Forest Research Institute, Ciamis Monsoon Forest Station
19	*S. leprosula, Lopophetalum* sp.	*Ex-situ* gene conservation	UGM, FORDA, Some State-Owned companies
20	Indigenous species of provinces	Species collection	National Science Institute
21	Indigenous commercial species	Village level gene conservation and management	Community and local government, with NGOs and/or private companies facilitation

FORDA : Forestry Research and Development Agency
CPF : Centre for Plantation Forest R&D
CFNC : Centre for Natural Forest and Nature Conservation R&D
CFP : Centre for Forest Product R&D
UGM : University of Gadjah Mada

Other related programmes include:

- Plantation development programme: 5 million ha. The target is to develop new plantations and 2 million ha private forest (2005–2009);
- National Movement on Forest and Land Rehabilitation (Ind. GNRHL) with 3 million ha target (2003–2007);
- Social forestry where farmers are given the opportunity to manage forest resources in a sustainable manner.

The Cluster of Science Centre (facilitated by National Science Institute), was created specifically to promote science to the young generation. The clusters include natural resources management, research and development and education.

Scientific projects

Scientific projects that have been initiated include:

- Compilation of basic data and information of some priority species for gene conservation and tree improvement by CPFRD (formerly compiled by CFBTIRD). Currently, basic data and information for thirty nine species are available;
- Basic data and information for fifteen species was compiled by CPFRD (formerly compiled by CFBTIRD) in collaboration with IFSP in 2004 (Rimbawanto and Pamungkas 2004). The species compiled are *Alstonia scholaris, Aquilaria malaccensis, Castanopsis argentea, Diospyros celebica, Elmerrillia ovalis, Manilkara kauki, Podocarpus imbricatus, Santalum album, Shorea javanica, S. macrophylla, S. palembanica, S. pinanga, Toona sureni. Vitex cofassus,* and *Zanthoxylum rhetsa;*
- Basic data and information for another 24 species was compiled by CPFRD in 2005 (Pamungkas *et al.* 2005). Those are *Agathis borneensis, Pterocarpus indicus, Dalbergia latifolia, Dipterocarpus sublamellatus, Duabanga moluccana, Eusideroxylon zwageri, Gyrinops verstigii, Gonystylus bancanus, Gonystylus macrophyllus, Koompassia malaccensis, Pericopsis mooniana, Pinus merkusii, Shorea balangeran, Vatica obovata, Vatica teysmanniana,* Dipterocarpaceae species producing illipe nut such as *Shorea macrantha*, *S. mecistopteryx*, *S. splendida*, *S. stenoptera*, *S. balanocarpoides, S. faguetiana*, *S. gibbosa*, and *S. seminis* (balau), and *Swietenia mahagoni;*
- Study on genetic diversity for some of the above priority species;
- Evaluation on the status of FGR using molecular markers;
- Identification of priority species for each region (province/regency);
- Setting up of arboreta of some regional priority species;
- Facilitating participation of local communities in FGR C&M; and
- The use of genetically improved seeds in *Melaleuca cajuputi* subsp. *cajuputi* plantation.

Centre for Plantation Forest/CPF (formerly CFBTI) and CSIRO have carried out collaborative research on *Melaleuca cajuputi* subsp. *cajuputi* since 1998. Genetically improved seeds of *Melaleuca cajuputi* subsp. *cajuputi* have been produced from its progeny trials since 2004. Those seeds have been formerly delivered to the Governor of Yogyakarta in 2004 and also distributed to several regions in eastern part of Indonesia.

Conservation strategies

At the national level, the Indonesia Biodiversity Strategy and Action Plan (IBSAP) is a guide for institutions and organizations working on FGR C&M in Indonesia. A number of activities under the IBSAP have been carried out by relevant institutions and organizations, based on their mandate and priority.

Under the umbrella of APFORGEN, the national secretariat of APFORGEN (at CPFRD) has facilitated and coordinated some activities related to FGR C&M.

Activities carried out or coordinated by CPFRD (APFORGEN Secretariat during 2005–2006) include:

- Consultations with the National Commission on Germplasm with the possibility to establish a separate national task force on FGR C&M. This is found necessary considering the existing high level of biological diversity in Indonesia and the currently limited focus of the existing National Commission on agricultural crops,
- Facilitating stakeholders' dialogues on the issues relevant to the "National Policy" on conservation and utilization of FGR (plant) in Indonesia;
- Facilitating the integration of conservation, exploitation and management activities of FGR into the national policy;
- Communicating the (draft) APFORGEN Action Plan to all relevant stakeholders through publication, electronic and other media;
- Annual national workshops;
- Field activities in 2006 of APFORGEN Secretariat include facilitating the establishment of *ex situ* conservation at the village level in two locations in Java; and
- In collaboration with universities in the region, facilitating the establishment of demonstration plot of SFM practice in small scale plantation by farmers in five locations in East Java and the surroundings.

Why genetic diversity matters?

There have been several government programmes on forest and land rehabilitation that were closely related to FGR C&M. For example, the national movement on forest and land rehabilitation (GERHAN) 2003–2007 with target locations in degraded watersheds. Species selection for different geo-physical conditions has been a critical factor. In a number of cases, it could not be carried out appropriately because of the high preferences of certain species, for example teak. The problem encountered was lack of genetic diversity of the planting materials used, and also the suitability of species with the target locations.

Programmes to encourage local community to grow trees have been challenged by farmers lacking access to good quality seeds. This resulted in limited levels of genetic diversity of the planting materials used because farmers in many cases only rely on several mother trees to produce a large number of planting materials. Impacts of using limited genetic diversity such as outbreak of pests and diseases will be experienced by farmers and affect their livelihoods.

International collaboration and future initiatives

Some of the international collaborations and activities that will be beneficial include:

- Financial resource mobilisation to support FGR C&M;
- Collaboration in Research & Development and raising awareness and capacity building;

- APFORGEN should improve its role in facilitating communication among member countries; and
- APFORGEN should facilitate exchange of genetic materials among member countries and with other countries or related international organizations.

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Forest genetic resources conservation and management in Lao PDR – An update on activities, challenges and needs since APFORGEN inception in 2003

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Introduction

The Lao People's Democratic Republic (Lao PDR) is considered to be one of the poorest countries in the world with constraints such as low population diversity and landlocked boundary (surrounded by five nations: China in the North, Viet Nam in the East, Cambodia in the South, Thailand in the West and Myanmar in the North-West). However, compared to the neighboring countries, Lao PDR has more forest coverage and can be classified as one of the rich genetic diversities in the world.

Most of the population live in the rural area and rely on forest products and non-timber forest products (NTFPs) as main income sources. Therefore, there are more occurrences of forest encroachment for gathering forest products and detrimental agriculture production practices such as slash-and-burn, which may cause forest reduction and genetic erosion in the region. There were attempts to stabilize shifting cultivation in upland and watershed areas but there are minimal actual genetic conservation and management (C&M) research activities nation-wide. However, recently there is an emphasis on genetic resources research and management at some macro and micro levels.

Policies

There are some existing regulations, policies and national strategies on forest genetic resources (FGR) (Phongoudome and Mounlamai 2004) in Lao PDR. These legal settings mostly have indirect influences on FGR. However, there are increasing involvements in conserving and managing natural resources which are the centres of biological diversity. The chronology of initiatives for conservation at the policy levels is as follows:

- In 1993, Prime Ministerial Decree No. 164 was initiated on a system of National Biodiversity Conservation Areas (NBCAs) (Samountry *et al.* 2000). The total area of 3.3 million hectares was devoted for NBCAs, which consist of 20 NBCAs country-wide (Theppavong *et al.* 2002);
- In 1996, the Lao government signed the international Convention on Biological Diversity (Samountry *et al.* 2000);
- In 2000, there was an initiative to formulate the Forestry Strategy up to the year 2020 (FS 2020) (Anon. 2005). The FS 2020 for biodiversity conservation consists of 'formulation of management plans of NBCAs with participation of local people and establishment of the Forest Management Fund to support conservation activities' (Samountry *et al.* 2000). The FS 2020 will attempt to

develop controls and regulations for protection of forest genetic resources and intellectual property rights to ensure that benefits from development of pharmaceuticals or other products, which may have been derived from genetic resources collected in Lao PDR or developed based on traditional knowledge of forest products, accrue to the national and rural communities (Anon. 2005);

- In the late 2005, a national workshop on 'International Treaty on Plant Genetic Resources for Food and Agriculture' was organized focusing on decision-makers and technical staff in order to clarify the concept of the treaty and analyse advantages and disadvantages of being a contracting party of the treaty;
- In March 2006, the government signed the agreement to be a contracting party of the International Treaty on Plan Genetic Resources for Food and Agriculture.

Organizations

There are many national and international organizations for FGR management and conservation activities in Lao PDR such as:

- Ministry of Agriculture and Forestry (MAF);
    - Department of Forestry (DoF)
    - Centre of Watershed and Conservation
    - National Agriculture and Forestry Research Institute (NAFRI)
    - Forestry Research Centre (FRC)
    - Tree Seed and Tree Improvement Research Unit
    - National Agriculture and Forestry Extension Service (NAFES)
    - Division of Forestry Extension and Rehabilitation
- Science, Technology and Environment Agency (STEA);
    - Department of Environment (Strategy and Action Plan on Biodiversity)
- National University of Laos (NUoL);
    - Faculty of Science, Department of Biology
    - Faculty of Forestry, Department of Forest Management (Education)
- International Union for the Conservation of Nature and Natural Resources (IUCN)/World Conservation Union Lao Office – government adviser;
- Danish International Development Agency (DANIDA) – supports Lao Tree Seed Project (LTSP) component of the Indochina Tree Seed Programme (ITSP);
- Swedish International Development Agency (SIDA) – supports research activities on upland agriculture and forestry research;
- Japan International Cooperation Agency (JICA) – supports activities such as training on field forestry and afforestation programme;
- Korea International Cooperation Agency (KOICA) – provides volunteers to work in fields of forestry and entomology at the provincial agriculture and forestry office level; and
- Asia Pacific Association of Forestry Research Institutions (APAFRI) – Lao PDR is a member of APAFRI.

In addition to the aforementioned organizations, the Agriculture Research Centre (ARC) under NAFRI has been engaging in germplasm breeding and genetic conservation through temperature controlled rooms called 'gene bank'. However, this centre has focused more on the agricultural aspect. As NAFRI is implementing the National Agricultural Biodiversity Programme (NABP), some research centres governed by the institute are involved in genetic resources management and conservation activities. For instance, Horticulture Research Centre (HRC) focuses on conserving and managing vegetable genetic resources, FRC emphasises on forest genetic C&M through an *ex situ* conservation of the important and priority species.

Even though many activities and projects related to FGR have been implemented, thorough discussions and responsibilities of institutes or organizations involved in FGR has been neglected. Most of the activities, for instance, *ex situ* conservation, consist of species collection from different provenances only. In addition to that, reforestation programmes for FGR is not the priority of donors at the present time.

Conservation strategies

Alongside policy reforms, the Lao government has attempted to formulate some conservation strategies related to FGR such as National Biodiversity Strategy to 2020, Action Plan to 2010 (NBSAP) (Phommakhoth 2004) and NABP which are supervised by the Ministry of Agriculture and Forestry (MAF) and the Science, Technology and Environmental Agency (STEA). Some activities have focus on FGR C&M under NBSAP and NABP. These are now being implemented by FAO Netherlands Partnership Programme (FNPP). An example of activities under FNPP is the National Information Sharing Mechanism (NISM) that is being established by the Global Plan of Action (GPA) on Plant Genetic Resources for Food and Agriculture (PGRFA) in Lao PDR. This covers 20 priority activity areas in Lao (as shown in Table 1). The purpose of the NISM is to exchange information on organizations and projects implementing genetic resources C&M, and on improved variety of species as well as references on PGRFA.

Table 1. Global Plan of Action – 20 priority activity areas

No.	Theme and topic priority
	***In situ* Conservation and Development**
1	Surveying and inventorying plant genetic resources for food and agriculture
2	Supporting on-farm management and improvement of plant genetic resources for food and agriculture
3	Assisting farmers in disaster situations to restore agricultural systems
4	Promoting *in situ* conservation of crop wild relatives and wild plants for food production
	***Ex situ* conservation**
5	Sustaining existing *ex situ* collections
6	Regenerating threatened *ex situ* accessions
7	Supporting planned and targeted collecting of plant genetic resources for food and agriculture
8	Expanding *ex situ* conservation activities
	Utilization of plant genetic resources
9	Expanding the characterization, evaluation and number of core collections to facilitate use
10	Increasing genetic enhancement and base-broadening efforts
11	Promoting sustainable agriculture through diversification of crop production and broader diversity in crops

12	Promoting development and commercialization of under-utilized crops and species
13	Supporting seed production and distribution
14	Developing new markets for local varieties and 'diversity-rich' products
	Institutions and capacity building
15	Building strong national programmes
16	Promoting networks for plant genetic resources for food and agriculture
17	Constructing comprehensive information systems for plant genetic resources for food and agriculture
18	Developing monitoring and early warning systems for loss of plant genetic resources for food and agriculture
19	Expanding and improving education and training
20	Promoting public awareness of the value of plant genetic resources for food and agriculture conservation and use

Why genetic diversity matters?

Forest genetic resources are crucial in improving local livelihoods and national economies because most of the people in Lao are living in rural areas and depend on natural resources (e.g. forest resources and NTFPs) for food security and income generation. Even though forest products and NTFPs may not directly contribute to income generation, local people use it to exchange for clothes, basic needs and even pharmaceutical medicines. When there is rice shortage, the local people use the wide variety of vegetation and tubers for subsistence and even the herbs and medicinal plants available for their traditional medicine needs. These people will not be able to survive without the support from the diverse varieties of species from forests.

As recognition of the importance of genetic diversity to livelihoods and national economy, there are many projects and activities implemented to conserve genetic resources which can possibly be used for variety improvement. However, these conservation projects do not focus on genetic variation, diversity identification, experiments and studies, etc.

FRC has been implementing *ex situ* conservation of valuable commercial tree species, indigenous and endangered forest species in its headquarters site and other demonstration plots. These *ex situ* conservations include species of *Aquilaria crassna, Pterocarpus marcrocarpus, Azadirachta indica, Acacia*, rattan and eucalyptus species. Some plots have been established for more than 10 years but some were only established a few years ago. Rich bio-genetic engineering information can be obtained if resources like laboratory experiments and studies can be used and shared both nationally and internationally.

The LTSP (under the administration of FRC/NAFRI) has set up indigenous seed sources nationwide for seed collection and distribution (shown in Table 2 and Figure 1). Even though these seed sources were established under the agreement between the LTSP and local authorities, the FRC currently lacks financial resources to monitor and evaluate the management of these seed sources. As a result, some seed sources under private ownerships (e.g. teak plantation and seed sources of valuable tree species such as eagle wood) were cut down and used for other purposes.

International collaboration and future initiatives

Lao PDR has collaborated with international agencies and non-government organization (NGOs) on FGR C&M of the country and has become a member of international organizations or programmes such as APAFRI and APFORGEN. Even though there are many projects/activities implemented in the country, most of them are not directed to improve genetic strains. These projects focus mainly on forest management and rehabilitation. This may be due to lack of skilled human resources and technologies as well as financial support constraint for implementing projects related to FGR (Phongoudome and Mounlamai 2004). Moreover, the existing *in situ* and *ex situ* conservation activities are new and there is limited information available (Phongoudome and Mounlamai 2004; Theppavong *et al.* 2002). The FGR activities mainly focus on species collections and not the identification of genetic varieties.

Therefore, it is essential to put emphasis on (i) capacity building, such as short term trainings on specific issues and long term studies on genetic resources management for countries lacking awareness and expertise in genetic resources such as Lao PDR; and (ii) allocation of financial resources for FGR projects. This is to upgrade knowledge in the region to conduct experiments in genetic diversity and share information on genetic resources that can lead to food security and poverty reduction. When genetic information is available in the region, improved varieties of species can be developed. These improved varieties will subsequently secure people's livelihoods.

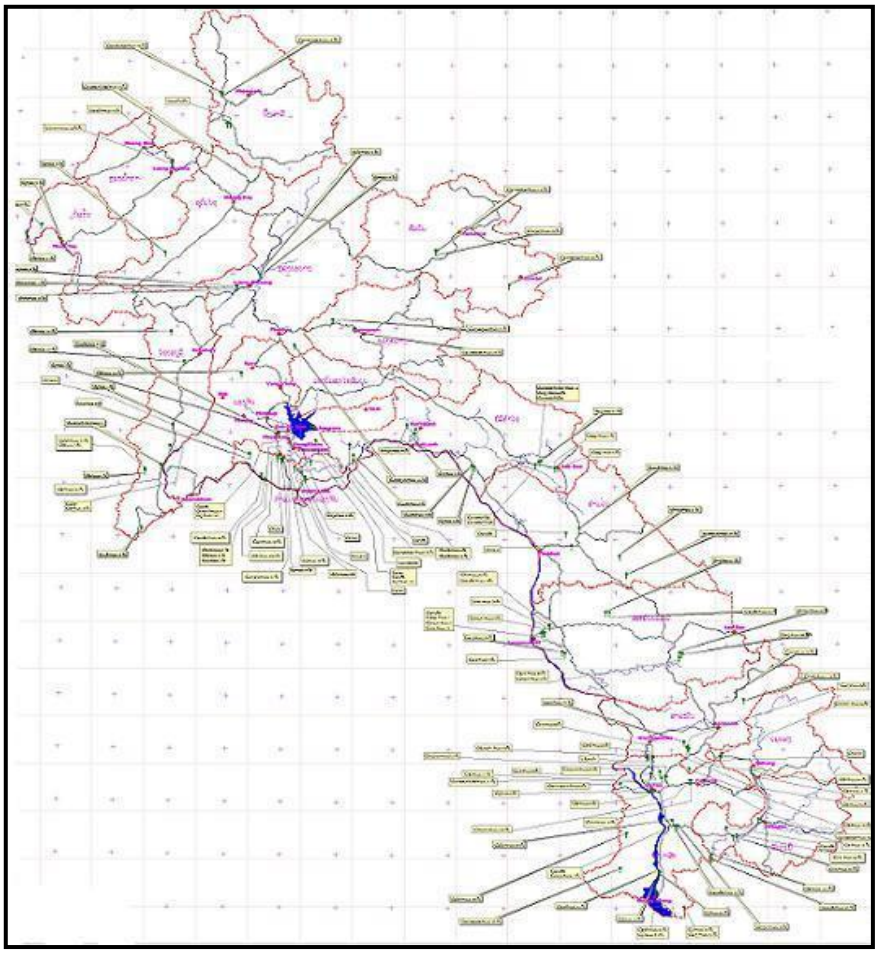
The APFORGEN, in the future, should extend its knowledge, experience and research activities to other member countries. There should be more pilot studies on genetic resources management and conservation implemented by APFORGEN in different countries.

Table 2. List of seed sources identified by the Lao Tree Seed Programme (LTSP)

No	Species	Provenance (origin)	Area (ha)	No. of mother trees
1	*Afzelia xylocarpa*	Seesa-ad/Saithanee/Vientiane Municipality	300	28
2	*A. xylocarpa*	Soh/Sangthong/Vientiane Municipality	300	31
3	*A. xylocarpa*	Nakhangaan/Paklai/ Sayaboury	222	37
4	*A. xylocarpa*	Viensavan/pakeou/LPB	100	26
5	*A. xylocarpa*	Nalanh/Pathoumphone/CHA	32	28
6	*A. xylocarpa*	Hieng/Soukumma/CHA	12	28
7	*Alstonia scholaris*	FRC/Nasaithong/Vientiane Municipality	1.5	57
8	*Anisoptera costata*	Nonsomboun/Bolikhan/ Bolikhamsay	330	22
9	*A. costata*	That/Khanthabouly/Savannakhet	300	34
10	*A. costata*	Hatngauw/Samansai/Attapeu	70	60
11	*Aquilaria* sp.	Viengkham/OUD	45	11
12	*Aquilaria* sp.	Lak 10/Phathumphone/CHA	2	133
13	Aquilaria sp. (large leaves)	Bhoong/Khamkeut/Bolikhamsay	40	-
14	Aquilaria sp. (small leaves)	Bhoong/Khamkeut/Bolikhamsay	40	-
15	*Azadirachta indica*	Nadaan/Sanasomboun/ Champasak	50	52
16	*Bombax* sp.	Longkuan/Thonpheng/Bokeo	35	30
17	*Chukrasia tabularis*	Pakloang/Chomphet/LPB	7	42
18	*C. tabularis*	Naumhar/Luangnaumtha/Luangnam	-	60
19	*Dalbergia cochinchinensis*	Thonchaleun/Khamkeut/ Bolikhamsay	350	46
20	*D. cochinchinensis*	That/Khanthabouly/Savannakhet	300	10
21	*D. cochinchinensis*	Nam Phao/Khamkeut/ Bolikhamsay	150	52
22	*D. cultrata*	Huai Houang/Don Khong/Champasak	60	24
23	*Dangnaum* sp.	Naumhar/Luangnaumtha/Luangnam	150	45
24	*Dipterocarpus alatus*	Mai Nai Nheng/Keo-oudom/Vientiane Province	500	22
25	*D. alatus*	That/Khanthabouly/Savannakhet	300	31
26	*D. alatus*	Dongsanghin/Saithanee/ Vientiane Municipality	300	39

27	*D. alatus*	Kietngong/Pathumphon/ Champasak	60	16
28	*D. alatus*	Alau Dong/Phin/Savannakhet	50	23
29	*D. alatus*	Phonsack/Phiang/Sayaboury	25	17
30	*D. alatus*	Hua Phu/Sanasomboun/Champasak	3	25
31	*D. costatus*	Nonsomboun/Bolikhan/ Bolikhamsay	330	19
32	*D. grandiflorus*	Nathoung and Phonsavanh/Mahaxai/Khammuanne	300	41
33	*Erythopoeum fordii*	Kapa/Taeoa/Salavan	0.5	25
34	*Eucalyptus camaldulensis*	Nachilit/Khanthabouly/ Savannakhet	5	501
35	*E. camaldulensis*	FRC/Nasaithong/Vientiane Municipality	5	296
36	*Hevea* sp.	Huothong/Bajieng/CHA	12	151
37	*Hevea* sp.	Nongkao/Bajieng/CHA	10	210
38	*Hopea ferrea*	Mai Nai Nheng/Keo-oudom/Vientiane Province	500	39
39	*H. ferrea*	Huai Ton/Sangthong/Vientiane Municipality	150	28
40	*H. ferrea*	Phonsavan/Latsaphon/Savannakhet	100	27
41	*H. ferrea*	Huai Luek/Thababath/Bolikhamsay	100	42
42	*H. ferrea*	Thongnamee/Thababath/Bolikhamsay	35	35
43	*H. ferrea*	Hak Khai/Thababath/Bolikhamsay	?	44
44	*H. odorata*	That/Khanthabouly/Savannakhet	300	19
45	*H. odorata*	Huai That and Mouang Khai/ Njommalat/ Khammuanne	237	30
46	*H. odorata*	Kietngong/Pathumphon/ Champasak	60	15
47	*H. odorata*	Hinlat/Samansai/Attapeu	2.5	25
48	*Nothaphoebe* sp.	Pinby/Samoua/Salavan	1.2	118
49	*Paramichelia baillonii*	Lak 43/Paksong/Champasak	4	168
50	*P. baillonii*	Lak43/Paksong/Champasak	4	169
51	*P. baillonii*	Khapeuh/Thateng/Sekong	0.76	60
52	*Pinus merkusii*	Vang Heua/Thoulakhom/ Vientiane Province	200	58
53	*P. merkusii*	Huai Hoh/Paksong/Champasak	85	52
54	*P. merkusii*	Phonphanpirk/Nakia/Khammuan	50	129
55	*P. merkusii*	Hong Gna/Mounlapamok/Champasak	45	32
56	*P. merkusii*	Piengsay,bounnea/Phongsaly	20	43
57	*P. merkusii*	Piengsay,bounnea/Phongsaly	18	30
58	*P. merkusii*	Nongkang/phoukouth/Xiegkhuang	10	106
59	*P. merkusii*	Sumyay/HOU/Sumnea	-	96
60	*P. khaya*	Lath gone/peak/Xiegkhuang	8	37
61	*P. khaya*	Nampong/Houaphan/Sumnea	-	110
62	*P. merkusii*	Lath gone/peak/Xiegkhuang	8	29
63	*P. merkusii*	Dongmerk/Sebangfai/Khammouan	4	45
64	*Pometia eximia hook*	Pakloang/Chomphet/LPB	7	25
65	*Pterocarpus macrocarpus*	Soh/Sangthong/Vientiane Municipality	300	11
66	*P. macrocarpus*	Veunkham/Don Khong/Champasak	250	50
67	*P. macrocarpus*	Banklouang/OUD	188	65
68	*P. macrocarpus*	Viensavan/pakeou/LPB	100	33
69	*P. macrocarpus*	Huai Houang/Don Khong/Champasak	60	27
70	*P. macrocarpus*	Siwilai/Nasaithong/Vientiane Municipality	55	35
71	*P. macrocarpus*	Mai Nai Nheng/Keo-oudom/Vientiane Province	50	15
72	*P. macrocarpus*	Khonkeo/Huai Sai/Bokeo	31	50
73	*P. macrocarpus*	Thongnamee/Thababath/Bolikhamsay	22	50
74	*P. macrocarpus*	Sanguansack/Pakse/Champasack	10	40
75	*Scaphium lychnophorum*	Khamhou/pathoumphone/CHA	300	60
76	*Tectona grandis*	Nasack/Paklai/Sayaboury	300	90
77	*T. grandis*	Nabone and Bong Dang/Lao Ngam/Saravane	36.73	405
78	*T. grandis*	Nabone/Laojam}Salavan	36.7	405
79	*T. grandis*	Sanguansack/Pakse/Champasack	10	40
80	*T. grandis*	Suam/Sayaboury/Sayaboury	5	135
81	*T. grandis*	Keewkem/Phiang/Sayaboury	5	185
82	*T. grandis*	Kwuam/Thonpheng/Bokeo	5	28
83	*T. grandis*	Lak 10/louangpabang/LPB	3	343
84	*T. grandis*	Champy/Sanasomboun/CHA	1.5	57
85	*T. grandis*	Thahin/Samakisai/Attapeu	1.25	147
86	*Toona febrifaga*	Pakloang/Chomphet/LPB	7	13
87	*Vatica cinerea*	Nakhangaan/Paklai/Sayaboury	222	21
88	*Xylia xylocarpa*	Phonsavan/Latsaphon/Savannakhet	100	26
89	*X. xylocarpa*	Sayeoudom/vapy/Salavan	70	38
90	*X. xylocarpa*	Alau Dong/Phin/Savannakhet	50	28
91	*X. xylocarpa*	Veunkham/Don Khong/Champasak	50	54
92	*X. xylocarpa*	Keppiueng/Laojam/Salavan	45	30
93	*X. xylocarpa*	Huaihod/Khemtao/Sayaboury	35	33
94	*X. xylocarpa*	Dongmarkfia/Saypothong/Savan	8	59
95	*X. xylocarpa*	Poum/Saypothong/Savannakhet	6	33
96	*X. xylocarpa*	Champy/Sanasomboun/CHA	5	38
97	*X. xylocarpa*	FRC/Nasaithong/Vientiane Municipality	3	58

Figure 1: Nation-wide location of seed sources of the LTSP



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Forest genetic resources conservation and management in Malaysia – An update on activities, challenges and needs since APFORGEN inception in 2003

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Introduction

Malaysia has one of the most complex tropical rainforest ecosystems in the world. The combination of warm equatorial climate and the variation of geographical, edaphic and climatic features has made Malaysia extremely rich in forest biodiversity (Anon. 1997) and ecosystems (Wyatt-Smith 1963; Withmore 1990). The country is still predominantly under forest cover (59.5%; Anon. 2004), in spite of the fact that, the country has lost some of its forest due to agricultural development and timber exploitation. This report provides an update of the status of forest genetic resources conservation and management (FGR C&M) in Malaysia since Asia Pacific Forest Genetic Resources Programme (APFORGEN) inception workshop in 2003 (Lee and Krishnapillay 2004) and APFORGEN National Coordinators (South East Asia) Meeting in 2004. The following information will be provided: (1) Policies and legislations relevant to FGR C&M, (2) Organizations or Centres of Excellence involved in FGR C&M, (3) Recent scientific projects related to FGR C&M, (4) Examples of conservation strategies developed, (5) Why genetic diversity matters? and (6) International collaboration and future initiatives.

Policies and legislations relevant to FGR C&M

- National – Land Conservation Act 1960; National Land Code 1965; Protection of Wildlife Act 1972 (amended 1976 and 1988); Malaysian Timber Industry Board Act 1973; Environmental Quality Act 1974 (amended 1985); National Forestry Policy 1978 (revised 1992); National Parks Act 1980 (amended 1983); National Forestry Act 1984 (amended 1993); Malaysian Forestry Research and Development Board Act 1985; National Policy on Biological Diversity 1998; Biosafety Act 2007; and Access and Benefit Sharing Bill (pending for approval);
- Sabah – Sabah Forest Policy 1948; Sabah Forest Enactment 1968; Sabah Forest Rules 1969; Sabah Park Enactment 1984; Sabah Culture Heritage (Conservation) Enactment 1997; Sabah Wildlife Conservation Enactment 1997; Sabah State Water Resources Enactment 1998; Sabah Environment and Conservation Enactment 1999; and Sabah Biodiversity Enactment 2000;
- Sarawak – Sarawak Forest Policy 1954; Sarawak Public Parks and Greens Ordinance 1993; Sarawak Forest (Amendment) Ordinance 1996; Sarawak Biodiversity Centre Ordinance 1997; Sarawak Forests (Planted Forests) Rules 1997; Sarawak Biodiversity (Access, Collection and Research) Regulations

1998; Sarawak National Parks and Nature Reserves (Amendment) Ordinance 1998; Sarawak Wildlife Protection Ordinance 1998; Sarawak Wildlife Protection Rules 1998; Sarawak Land Code (Amendment) Ordinance 1998; and Sarawak Natural Resources and Environment (Amendment) Ordinance 2001;

- New (national) – National Biotechnology Policy 2005, unveiled in April 2005 and outlined nine major initiatives to realize the country's potential in the biotechnology sector. One of the initiatives is to capitalize on the strengths of biodiversity in Malaysia to commercialize discoveries in natural products as well as position Malaysia in the bio-generics market. In general, this policy is related, amongst others, to the utilization of FGR (especially medicinal plants) through modern biotechnology tools towards economic development in the country.

Organizations or Centres of Excellence involved in FGR C&M

- Organizations – Forest Research Institute of Malaysia (FRIM); Forestry Department of Peninsular Malaysia; Forestry Department of Sabah; Forestry Department of Sarawak; Malaysian Timber Industry Board; Malaysian Timber Council; Department of Wildlife and National Parks; Sarawak Timber Industry Development Corporation; Malaysian Nature Society; and World Wild Fund for Nature (WWF) Malaysia;
- Centres – Sarawak Biodiversity Centre; Forest Research Centre Sarawak; Botanical Research Centre Sarawak; Timber Research and Technical Training Centre Sarawak; Semengoh Wildlife Rehabilitation Centre; Matang Wildlife Centre; Forest Research Centre Sabah; Sabah Forestry Institute; and Faculty of Forestry of University Putra Malaysia; and
- New (centre) – Tropical Forest Biodiversity Centre (TFBC)
  This centre was recently set up in FRIM to act as the plant diversity centre for Malaysia. One of the primary objectives of the centre is to promote the protection, conservation, and sustainable utilization of indigenous flora and their habitats in Malaysia. To fulfill the functions of TFBC, two bureaus were set-up within the centre: Kepong Botanical Garden and Forest Conservation. Among some key activities under this centre are: *ex situ* collection of indigenous plants of Malaysia; systematic botany and taxonomic research; conservation and ecology research; collation and management of information on threatened plants and habitats of Malaysia; developing conservation strategies and implementation of protection and recovery plans for threatened species and habitats; and developing monitoring systems towards the conservation of Malaysian plants and their habitats.

Scientific projects or national activities related to FGR C&M

National Initiative on Plant Conservation Strategy for Malaysia

Initiated by FRIM in 2001 with a proposal submitted to the Ministry of Primary Industries (currently known as Ministry of Natural Resources and Environment) for financial support to set up a Flora Malaysiana Centre with the aims, amongst others, to promote the protection, conservation and sustainable utilization of indigenous flora and their habitats in Malaysia.

In 2004, a meeting that involved FRIM, Forestry Development Division of Ministry of Natural Resources and Environment, Conservation and Environment Management Division of Ministry of Natural Resources and Environment, Forestry Department of Peninsular Malaysia, Forestry Department of Sabah; Forestry Department of Sarawak, Wildlife and National Parks Department and National University of Malaysia was held to discuss 16 plant conservation targets adopted from Global Strategy for Plant Conservation (Anon. 2002).

Consequently, a seminar on status of biological diversity in Malaysia and a workshop on threat assessment of plant species in Malaysia were conducted in 2005. Subsequently, TFBC was set up in FRIM to act as the plant diversity centre for Malaysia and to play the role to fulfill the gaps for plant conservation and studies in Malaysia. In addition, by using the 15 strategies of National Policy on Biological Diversity as the basis, TFBC also developed a programme to deal with botanical needs for Malaysia.

Under TFBC, numerous plant conservation related activities have been identified for the next five years (2006–2010), with funding allocation of approximately US$9 million from the Ministry of Natural Resources and Environment, Ministry of Science, Technology and Innovation and Ministry of Plantation Industries and Commodities.

One of the immediate outputs of the centre was the formation of Flora of Peninsular Malaysia database to serve as the checklist of vascular plants of Peninsular Malaysia (http://www.tfbc.frim.gov.my). At the moment, the checklist comprising 8,893 taxonomic names include short descriptions, habitat where they are found, distribution in Peninsular Malaysia, endemism to Peninsular Malaysia and conservation status (World Conservation Union/IUCN categories used).

Under the Tree Flora of Sabah and Sarawak project, five volumes have been published. The most recent volume covered mainly the large Dipterocarpaceae family as well as the smaller Apocynaceae, Symplocaceae and Thymelaeaceae families (Soepadmo *et al.* 2004).

The centre also published biannual bulletins, namely Conservation Malaysia, to support plant and animal conservation in Malaysia.

Others activities that have been identified are: threat assessment and monitoring of rare and threatened plants in Malaysia; *in situ* and *ex situ* conservation of Malaysian plants, checklist of vascular plants of East Malaysia; inventory of bryophyte flora in Malaysia; inventory of selected fungi in Peninsular Malaysia, inventory of selected insect groups; systematics of amphibians, systematics of reptiles; systematics of bats; checklist of mammals; and establishment of Kepong Botanical Garden.

Peat Swamp Forest Conservation Project

This project was initiated to safeguard the precious resources of Peat Swamp Forests in Malaysia, with the Ministry of Natural Resources and Environment and FRIM as the executing agency and implementing agency, respectively (http://www.psf-frim-undp.org).

It was funded by the United Nations Development Programme (UNDP)/Global Environment Facility (GEF) in collaboration with the Danish International Development Agency (DANIDA) for five years (2002–2007), with a grant of US$5.985 million (MAL/99/G31).

The project seeks to develop and implement plans to ensure the conservation and sustainable use of Peat Swamp Forests at three demonstration sites: Loagan Bunut National Park in Sarawak, the Klias Peninsula in Sabah and the South-East Pahang Peat Swamp Forest in Pahang.

Selected publications from this project include: Black Water Jewel – South-East Pahang Peat Swamp Forest (FRIM-UNDP/GEF 2004); A Handbook on the Peat Swamp Flora of Peninsular Malaysia (Faridah *et al*. 2005); Policy Analysis of Peatland Management and Conservation in the Klias Peninsula, Sabah (Rahim and Rashid 2005); and Biodiversity expedition: Sungai Bebar, Pekan, Pahang (Latiff *et al*. 2005).

Mangrove Restoration Project

This is a UNDP project initiated in October 2005. Partners in the project include the Terengganu State Economic Planning Unit and University College of Science and Technology Malaysia (KUSTEM).

This project aims (i) to train and build capacity of local communities on fostering and sustaining the growth of mangrove forests, (ii) to build capacity of local authorities to support mangrove forest protection, (iii) to support mangrove forest restoration and (iv) to develop a conservation/management plan for replanted areas and the surrounding mangrove ecosystem.

The state of Terengganu has been selected as the project area as mangrove ecosystem contributes to the livelihood of the local communities and currently the ecosystem is being threatened by development.

The project provides an opportunity to examine the condition of the mangrove ecosystem and to explore opportunities for conservation of the ecosystem through a community-led conservation initiative.

Conservation of Biological Diversity through Sustainable Forest Management

This is an International Tropical Timber Organization (ITTO) funded project (PD 165/02 Rev.3 [F]) with FRIM as the implementing agency. The duration of the project: is three years (2006–2009) with a grant of US$526 401.

This project will assist in biodiversity conservation in Malaysia's natural forests by formulating improved tools for the integration of biodiversity considerations into forest management decisions.

The specific objectives are: (i) to develop improved methods for assessing biodiversity to get a better understanding of the impacts of forest management

practices on it; (ii) to develop improved stand-level models for predicting the impacts of forest management systems on biodiversity; and (iii) to enhance the capacity of targeted stakeholders in tropical regions and disseminate tools and techniques developed by the project.

Conservation of Biological Diversity through Improved Forest Planning Tools

This is a UNDP/GEF funded project scheduled to start in the first quarter of 2006. It is undertaken by the Government of Malaysia with the Ministry of Natural Resources and Environment and FRIM as the executing agency and implementing agency, respectively to develop tools and generate knowledge to ensure forestry production systems are planned and managed,.

This project aims (i) to develop improved tools for rapidly assessing the biodiversity in tropical rainforests, (ii) to develop improved tools for estimating the economic value of goods and services associated with biodiversity in tropical rainforests,(iii) to develop improved models for predicting the biodiversity impacts, and associated economic benefits and costs, of alternative allocations of forests among different use categories at a landscape level and (iv) to enhance and disseminate knowledge as well as build capacity with view of replicating improved forest planning procedures.

National Forest Plantation Plan

This is an initiative by Ministry of Plantation Industries and Commodities to increase forest plantation areas from 250 000 ha to 500 000 ha in Malaysia for the next five years.

The Ministry recognized that the only way forward to ensure continuous supply of timber resources to support the downstream industries is through the establishment of forest plantations.

In order to facilitate this process, a National Task-Force for Forest Plantation Development was formed and it comprises of members from both the government and private sectors. This Task Force is chaired by the Deputy-Minister of Plantation Industries and Commodities. Two Committees were formed (Technical Committee and Financial Committee) to assist the Task Force.

The Technical Committee on Forest Plantation Development will focus on the various technical aspects of forest plantation establishment such as the selection of species, management and silvicultural regimes adopted and the potential market for the end-products

The Financial Committee on Forest Plantation Development has been given task to look into financial aspects of forest plantation such as potential financial incentives as well as physical incentives.

A comprehensive plan was submitted to the Cabinet at the end of 2005 for approval. Areas included in the plan are implementation, costing, manpower and expertise, private sector, government-linked companies and state governments involvement, via their state economic development corporations.

Transboundary Biodiversity Conservation Project

The project is conducted in Pulong Tau National Park (PTNP), Sarawak, an area with high biodiversity and unique ecosystems.

It is an ITTO funded project (PD 224/03 Rev.1 [F]) with the Forest Department of Sarawak as the implementing agency. The duration of the project is three years (2006–2009) with a grant of US$740 781.

The development objective of the project is to contribute to the conservation of natural ecosystems in the Kelabit Highlands of the State of Sarawak and to the sustainable development of local communities through the implementation of biodiversity conservation activities and support for local socioeconomic development initiatives; and

The specific objectives are (i) to initiate a process of sustainable C&M of the PTNP and (ii) to improve cooperation between Sarawak and Indonesia for the conservation of the transboundary ecosystem shared by Pulong Tau and Kayan Mentarang National Park in Indonesia.

Bornean Biodiversity and Ecosystems Conservation Programme

This five-year programme (2002–2007) is implemented by the Sabah State Government agencies and Universiti Malaysia Sabah, and assisted by Japan International Cooperation Agency (JICA).

The primary objective of the programme is to establish sustainable approaches for the conservation of the endangered and precious biodiversity and ecosystems of Sabah (http://www.bbec.sabah.gov.my); and the programme applies an integrated approach that comprehensively covers four essential fields for conservation: research and education; park management; habitat management and public awareness.

Conservation strategies

Since 2000, through various funding sources, many research activities were conducted in FRIM to establish conservation strategies for rare and threatened dipterocarps in Peninsular Malaysia. The overall objective of this initiative is to generate biological information of rare and threatened dipterocarps towards C&M. Multi-disciplinary research approach was adopted, which involved botanists, geneticists and ecologists. To date, comprehensive conservation strategies have been developed for two rare and endemic dipterocarps in Peninsular Malaysia, i.e., *Hopea subalata* (Chua *et al.* 2004) and *Shorea lumutensis* (Lee *et al.* 2006), and strategies are being developed for *H. bilitonensis*, *Neobalanocarpus heimii*, *Vatica yeechongii* and *Dryobalanops beccarii*.

Conservation strategy of forest habitat was initiated since 1950 (Wyatt-Smith 1950) through the establishment of a network of small protected patches of natural forests (Virgin Jungle Reserves). These areas were largely located within commercially productive forests throughout the country as ecological types of original conditions, particularly for studies. The usefulness and importance of the Virgin Jungle Reserve system in the conservation of forest patches has received positive comments in

reviews conducted by the Food and Agriculture Organization (FAO 1984). As of now, 120 Virgin Jungle Reserves had been established, covering an area of 111 800 ha representing several forest types, including mangrove swamp forests, beach forests, heath forests, peat swamp forests, lowland dipterocarp forests, hills and upper hill dipterocarp forests and montane forests.

Why genetic diversity matters?

In theory, genetic diversity reflects the genetic resources necessary for short-term ecological adaptation and for long-term evolutionary changes; species must have an available pool of genetic diversity if they are to survive environmental pressures exceeding the limits of developmental plasticity (Lande and Shannon 1996).

For example, if a virulent form of a disease arises, many individuals may be susceptible and die, but as a result of natural genetic diversity within local plant populations, there may be some individuals that are at least partially resistant and able to survive and perpetuate the species.

Although conserving FGR is the best way to guarantee its availability for present and future generations, conservation has little purpose unless the resources are used. One of the strongest arguments for conserving genetic diversity is its underlying potential as a usable resource for agriculture and industry. In economic terms, this means assigning an option value to benefits placed on a resource, even when there is no economic use at present (Falk 1991).

Depletion of FGR is of great concern as some of the genetic materials lost will not have their potential fully realized or their scientific information recorded. In Malaysia, forest resources are mainly used for building materials (e.g., *Neobalanocarpus heimii*), furniture (e.g., *Palaquium rostratum*), medicines (e.g., *Eurycoma longifolia*) and food (e.g., *Parkia speciosa*). Many crops originated from forests, where their wild relatives are still evolving. Examples are mango (*Mangifera* sp.), mangosteen (*Garcinia* sp.), breadfruit (*Artocarpus* sp.), rambutan (*Nephelium* sp.) and durian (*Durio* sp.).

It is anticipated that the future of forestry and many other industries in Malaysia may rest squarely on the ability to utilize genetic diversity present in wild species. For example, to use the resources to increase a tree's resistance to a new disease, to improve the quality of forest products, to make a tree more suitable for agroforestry and for drug discoveries.

International collaboration and future initiatives

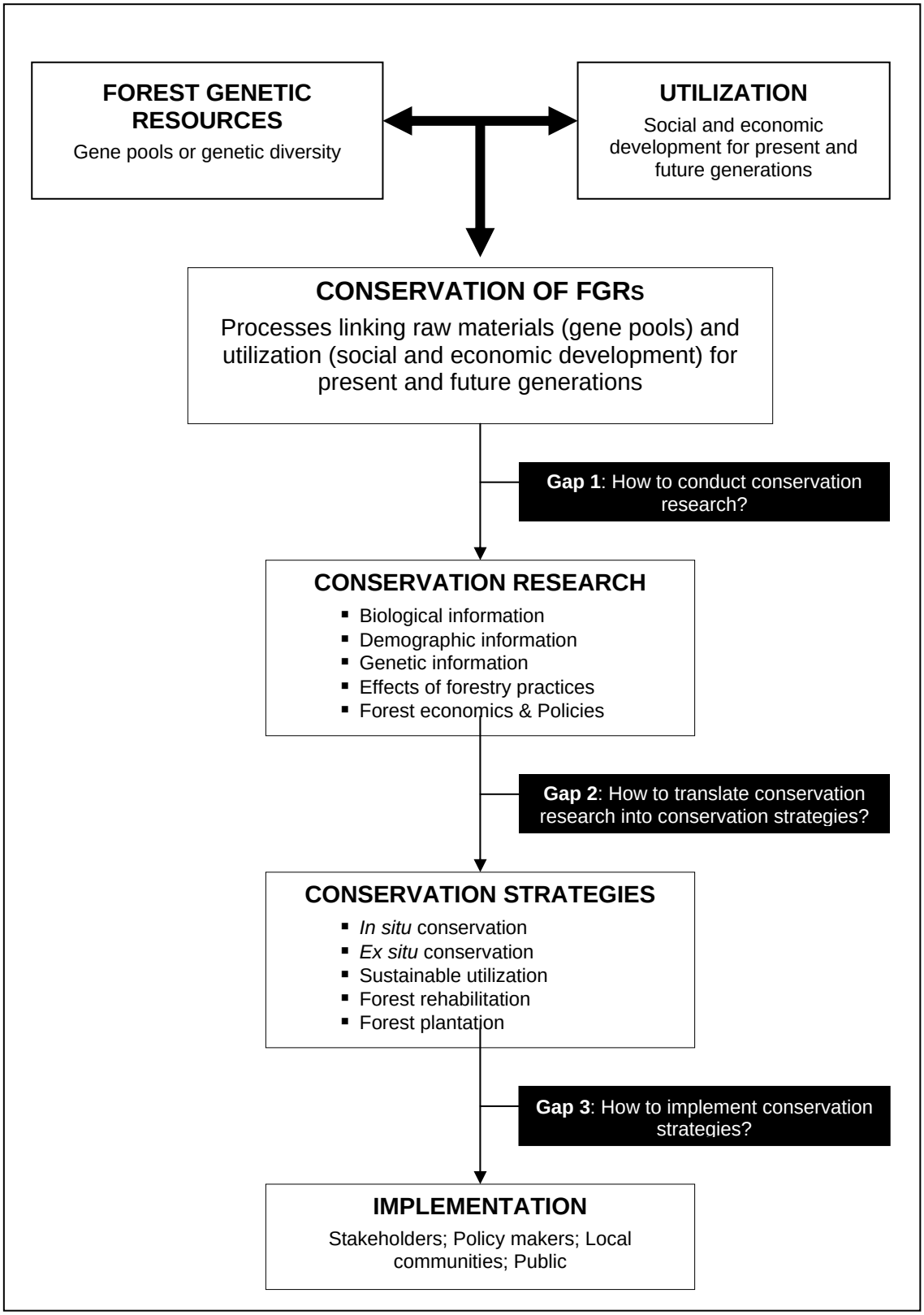
Conservation has a cost and conservationists face a series of essentially pragmatic decisions, with cost and benefits often imperfectly known. The policy makers and budgeters might ask whether it would be worth incurring the expense of competing with commercial interests to acquire and then conserve and manage FGR that are low or with unknown economic value. In addition, aesthetic justification alone for conservation might be too luxurious for the local people who depend on the forest area for their daily livelihood. Accordingly, any forestry policy that does not involve

the people who use and depend on forests for their living to make decisions and implement the conservation programmes is unlikely to succeed. A concept of FGR conservation and utilization in Malaysia is given in Figure 1.

In the past, there has not been any concerted effort to deal with FGR from the perspectives of both conservation and utilization. This is due mainly to the sectoral approach towards its management. The forest where almost all of the indigenous plant resources exist falls within the jurisdiction of a number of stakeholders. The Forest Department manages the forests mainly for timber production, Department of Wildlife and National Parks manages the protected areas mainly for animal conservation and the state governments which are the custodian of the forest land views the forest as assets that could be used.

Under the national initiative on plant conservation strategy for Malaysia, efforts have been put forward to link the gaps among conservation research, conservation strategies and implementation, which involves scientists, policy makers, stakeholders, local communities and general public. A similar effort to link the gaps could be proposed for regional collaboration and as the future activities of APFORGEN.

Figure 1. A concept of forest genetic resources conservation and utilization in Malaysia.



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Forest genetic resources conservation and management in Myanmar – An update on activities, challenges and needs since APFORGEN inception in 2003

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Policy and Legislation

Myanmar Forest Policy Statement 1995

The Myanmar Forest Policy Statement was formulated in view of the importance of the Myanmar Forestry Sector in enhancing national socio-economic development, ensuring ecological balance and environmental stability. It was formulated in a holistic and balanced manner within the overall context of the environment and sustainable development, taking full cognizance of the forestry principles adopted at the United Nations Conference on Environment and Development (UNCED). Six imperatives identified in the policy are:

- **Protection** of soil, water, wildlife, biodiversity and the entire environment;
- **Sustainability** of forest resources to ensure perpetual supply of both tangible and intangible benefits accrued from the forests for the present and future generations;
- **Basic needs** of the people for fuel, shelter, food and recreation;
- **Efficiency** to harness, in a socio-environmentally friendly manner, the full economic potential of the forest resources;
- **Participation** of the people in the conservation and utilization of forest; and
- **Public awareness** about the vital role of forests in the well-being and socio-economic development of the nation.

According to Myanmar Forest Policy Statement, the reserved forests system and protected areas system will be expanded to 30% and 5% respectively of the total area of the country. In the long term, the protected areas must be 10% of the total area of the country covering all types of ecosystems occurring in the country. At present, the protected area is 7.29%. (2.57% increment from the 2004 report)

Forest Law 1992 and Forest Rule 1995

The Forest Law focuses on a balanced approach towards conservation and development issues implicit in the concept of sustainable forestry. Highlighting environmental and biodiversity conservation, the law encourages community forestry and people's participation in environmental and forest management.

By this law, teak and some important commercial hardwood species have been declared as 'reserved trees'. In some regions of the country, native tree species are also protected. For example; some *Pinus* species are protected in the Shan State (eastern part of the country), *Acacia catechu* (Cutch) is protected in the dry zone of Central Myanmar and some medicinal plants are also protected.

Protection of Wildlife and Wild Plant and Conservation of Natural Areas Law 1994 and Protection of Wildlife and Wild Plant and Conservation of Natural Areas Rule 2002

This Law highlights habitat maintenance and restoration, protection of endangered and rare species of both fauna and flora, establishment of new national parks and protected area systems and buffer zone management.

The Law is based on the protection of the flora and fauna of the country. Within the framework of the legislation, nine national parks and 33 wildlife sanctuaries and wetlands have already been established throughout the country. Recently, some rare orchid species have also been protected by this Law.

Organizations

Five institutions under the Ministry of Forestry (MOF) are performing their specific duties and responsibilities mainly related to forestry. The institutions are:

- Planning and Statistics Department (PSD) – It coordinates and facilitates the tasks of the Forest Department in Myanmar Timber Enterprise and Dry Zone Greening Department through the directives of MOF. It deals mainly with policy matters and issues related to forestry.
- Forest Department (FD) – It is responsible for protection and conservation of biodiversity and sustainable forest management of the forest resources of the country.
- Myanmar Timber Enterprise (MTE) – It is responsible for timber harvesting, milling and downstream processing and marketing of forest products.
- Dry Zone Greening Department (DZGD) – It is responsible for restoration of degraded forest lands, protection and conservation of remaining natural forests, and restoration of the environment in the dry zone of Central Myanmar.
- National Commission on Environmental Affairs (NCEA) – It is responsible for controlling measures of environmental degradation and rehabilitation of some critical areas.

Under the guidance of FD, the Forest Research Institute (FRI) and the Nature and Wildlife Conservation Division have been undertaking Forest Genetic Resource (FGR) conservation and management (C&M) in Myanmar (Uga 1999).

Scientific projects

Currently, there are three ongoing forestry related projects

- *Ex situ* and *in situ* conservation of bamboo species;
- Promoting sustainable utilization of bamboo through community participation in sustainable forest management; and
- *Ex situ* and *in situ* conservation of teak to support sustainable forest management

All are jointly implemented by FRI of the FD and international organizations, namely International Tropical Timber Organization (ITTO) and Bioversity International (formerly known as International Plant Genetic Resources Institute/IPGRI).

Conservation strategies

The FGR conservation strategies and practices emphasize mostly on teak resources because Myanmar is the centre of genetic diversity of teak and also because of its high commercial value (FRI 2006; Oo 2004). The strategies followed are:

- Strengthening protected areas system for FGR C&M;
- Establishment of provenance trials for teak;
- Enhancement of seed production areas (SPA);
- Establishment of teak clonal seed orchards (CSO) (Kinkelday, 2002);
- Strengthening and development of tissue culture methods; and
- Establishment of teak hedge gardens.

Strengthening protected areas system for FGR C&M

In Myanmar, nine national parks and 33 wildlife sanctuaries and wetlands have already been established throughout the nation that cover 7.29% of the country's total land area. Specific scientific assessment is still needed in these areas for C&M of FGR

Establishment of provenance trials for teak

A number of provenance trials were established for teak (Table 1).

Table 1. The provenance trials established for teak resources conservation.

Year Established	No. of provenance trials	Location
1982	18	Pyinmana, East Bago Yomas
1983	16	Oktwin, East Bago Yomas
1986	12	Pyinmana, East Bago Yomas
1998	10	Oktwin & Paukkaung, East & West Bago Yomas

Even though phenotypically superior trees were selected, its genetic information is unknown.

Establishment of teak clonal seed orchards (CSO*)*

In Myanmar, teak seed orchards were established in Bago and Mandalay Divisions in 1981. A CSO comprising 34 ha was established in Toungoo District of Bago Division and another 6 ha at a research station in the Yemathin District of Mandalay Division. The FRI of the FD has been conducting germination tests on seeds collected from these orchards. Average germination percentage was not more than 15%. Genetic information of clones and progeny tests are still lacking for these seed orchards. Suitable layout designs will be needed for establishment of new CSO.

Enhancement of seed production areas (SPA)

A total of 98 SPAs have been established throughout the country (Table 2).

Table 2. Seed Production Areas that have been set up throughout the country up to 2005.

No.	Species	No. of SPA	Area (ha)
1	Teak (*Tectona grandis*)	83	1,774
2	Pyinkado (*Xylia xylocarpa*)	7	216
3	*Pinus* spp.	5	12
4	Yemane (*Gmelina arborea*)	2	20
5	Byu-u-ta-lon (*Bruguiera gymnorhiza*)	1	41
Total		**98**	**2,063**

Strengthening and development of tissue culture methods

Research on tissue culture of teak started in the late 1990s and the first batch of tissue cultured teak plants were planted in the field. Observation of these plants showed good health and performance. Other tissue culture research on bamboo and orchid is expected to yield more results.

Establishment of teak hedge gardens

The teak hedge gardens will be used for the production of vegetative planting stock by shoot-cutting and for conservation. Six teak hedge gardens were established in the following townships:

- Bago Township, East Bago Division;
- Oktwin Township, East Bago Division;
- Taikkyi Township, Yangon Division;
- Kyangin Township, Ayeyarwady Division;
- Lewe Township, Mandalay Division; and
- Nattalin Township, West Bago Division.

The teak hedge gardens are mainly located in Bago Yomas region which is situated in the heart of the country and said to be the best teak bearing area of Myanmar.

Importance of Forest Genetic Diversity

In Myanmar, forest genetic diversity is very important for the local people and the national economy. About 67% of the population who lives in rural areas depends mainly on forest genetic diversity. Timber export is a major source of national economy. The forestry sector contributes about 17% of the country's total export earnings.

The following activities show the importance of forest genetic diversity for local livelihoods and the national economy:

- Dry zone greening projects;
    - establishment of community forests for local people and rehabilitation of ecosystems
    - protection of watershed for conservation of upstream areas
    - establishment of fuel wood plantation for local people
- Bago Yomas greening projects;
    - teak and other commercial hardwood species plantations establishment for national economy and rehabilitation of ecosystem
    - protection of remaining forests for conservation of ecosystem and FGR
- Rehabilitation of mangrove forests;
    - establishment of community forests for local people and rehabilitation of mangrove ecosystems
    - maintenance of mangrove for conservation of mangrove genetic resources and protection from natural disasters.

International collaboration and future initiatives

Expectations by participating in the AFORGEN would include:

- Information exchange;
- Organize long-term and short-term training courses on micro- and macro-vegetative propagation methods and *ex situ* and *in situ* conservation methods;
- Management and scientific study of PAS and natural forests for FGR conservation; and
- Assessment, evaluation and management of SPA and CSO and expansion of the existing areas.

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Forest genetic resources conservation and management in Nepal – An update on activities, challenges and needs since APFORGEN inception in 2003

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Introduction

Nepal is a relatively small, democratic landlocked Himalayan country. It is located between latitudes 26˚22' and 30˚27' N and longitude 80˚04' and 88˚12' E. The country is situated between China to the North and India on the South, West and East and is almost rectangular in shape and is approximately 880 km long east to west and 240 km broad from north to south. Nepal has an area of 147 181 km^2. Hills and high mountains cover about 86% of the total land area and remaining 14% are flat lands of the Terai. The altitude ranges from 60m to the world's highest point, Mount Everest, at 8848 m. The total population of the country is 23.2 million. According to the 2001 census, average population growth rate is 2.27%, highest in the Terai and lowest in the Mountains.

Even though the country has only about 0.09% of the total landmass of the world, it provides a disproportionately large diversity of flora and fauna at genetic, species and ecosystem levels i.e. Nepal provides habitat to about 2% of flowering plants, 3% of pteridophytes and 6% of bryophytes of the world's flora. In addition, 246 species of the total flowering plants and 248 species of the non-flowering plants have been reported to be endemic to Nepal. Scientists have estimated that about 7000 species of flowering plants can be found in Nepal's Himalayas. A total of 5833 species of flowering plants and 4216 species of non-flowering plants have been recorded so far.

Nepal is also rich in ecosystem diversity. A total of 118 ecosystems, 75 vegetation types and 35 forest types have been identified so far (DFRS 1999). Similarly, Nepal is also comparatively rich in faunal species. The country possesses over 4.3% of mammals and 8.5% of bird species of the world's total. Two species of birds and one species of mammal are endemic to Nepal.

Forest areas of Nepal were estimated to be 39.6% of which 10.6% of the area has been found to be degraded shrub land. Forest trees are an integral part of the rural livelihoods in Nepal. Seventy-five percent of the total energy consumption (fuel wood) and 40% of the fodder for livestock come from forests. Forest, agriculture and livestock are integral parts of farming system of Nepal.

According to the recent data of Department of National Park & Wild Life Conservation, Nepal has 19.42% of its area protected to conserve wildlife and forest genetic resources (FGR) and ecosystems. Many valuable tree species are growing inside the conservation areas (Appendix 1).

Due to the increasing population and high rate of poverty, biological species especially forests, are under great pressure at the national and regional levels. Deforestation, shifting cultivation and expansion of natural forest areas for cultivation have increased loss of biodiversity. In addition, development activities

have either been implemented in or passed through the natural habitats thereby damaging various valuable species. Human activities are dramatically increasing and have threatened the existence of biological species.

Therefore, Nepal signed the Convention on Biological Diversity (CBD) during the Earth Summit in Rio de Janeiro on 12 June 1992, and ratified it in the fall of 1993. The CBD has entered into force since 21 February 1994 in Nepal. The objectives of the CBD are: the conservation of biological species, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. Unlike other Conventions, CBD calls the Parties to conserve the species and to utilize them sustainably for socio-economic development and thereby contributing ultimately to poverty alleviation (Ghimire and Uprety 1999).

Policies

The Master Plan for the Forestry Sector (MPFS) Nepal 1989 has set one of the five long-term policy objectives to preserve ecosystem & genetic resource conservation (HMGN 1989). Under this, one of the six primary programmes is Ecosystem and Genetic Resources Conservation (HMGN 2002; HMGN 2005).

The recently adopted government policies that are pertinent to FGR conservation and management (C&M) are Breeding and Research Policy 2003, Involvement of Non-Government Organizations (NGOs) in Protected Areas Management Policy 2003, Medicinal Plant and Non-Timber Forest Products (NTFP) Development Policy 2004.

The Tenth Five-Year Plan Policy (2002–2007) gives importance to biodiversity Conservation as a means of poverty alleviation through sustainable use of forest components and broader participation of the local people. His Majesty's Government (HMG) of Nepal has already adopted a policy to hand over all the accessible government forests to the local communities as Community Forestry (>25% in the country). Now the Community Forest Programme is the highest priority programme in the forestry sector. The number of community Forestry User Groups (FUG) of 14000, covering total forest area of 1.12million ha represent 1.54 million households involved in this programme. The programme is successful in protecting and rehabilitating the forests. The FUG has the right to protect, harvest and manage the forest after it was handed over to them. Presently, FUGs are seeking technical assistance to manage and conserve forests.

HMG has adopted policies like *in situ* conservation in protected areas, national parks, and community forests and *ex situ* conservation of highly valued endangered and threatened wild species in zoological parks, botanical gardens, breeding seed orchards and others. The legislations and regulations related to it are:

- Aquatic Animals Protection Act 1961;
- National Parks and Wildlife Conservation Act 1973;
- Himalayan National Park Regulations 1979; and
- Buffer Zone Management Regulations 1996, and Buffer Zone Management Guidelines 1999.

Forest Act 1992 and Forest Regulations 1995 empower the government to delineate any part of the national forest that has a special environmental, scientific or cultural

importance as a protected forest. Recently HMG Ministry of Forests and Soil Conservation (MoFSC) has made a new policy Bill on conservation, access, sustainable use and equitable sharing of the benefits arising out of the utilization of the genetic resources from the local community. The Bill is waiting for endorsement. The policy has the following major objectives:

- Creating conditions to facilitate access to genetic resources and genetic materials for environmentally sound use and bio-prospecting (exploration of biodiversity for commercially valuable genetic resources and biochemicals);
- Ensuring that the benefits obtained through research and development from access, use and transfer of genetic resources and genetic materials are shared in a fair and equitable way;
- Ensuring access to and transfer of technology is employed in the access, use and transportation of genetic materials and genetic resources;
- Promoting and ensuring biotechnology and genetic engineering are used for the benefit of Nepal;
- Protecting the traditional knowledge;
- Discouraging and controlling bio-piracy; and
- Promoting cooperation between Contracting Parties of the CBD for access, use and transfer of genetic resources, genetic materials and benefit sharing.

In this Bill, HMG has established the National Genetic Resource Protection Council (NGRPC). The NGRPC is chaired by the Secretary of MoFSC, six members – (Environmentalist, Biologist, Botanist, Agriculturist, Forest Specialist and Agro-forestry Specialist), three members (should be gender balanced) nominated by HMG from indigenous tribes and disadvantaged ethnic groups, two gazetted class first officers from MoFSC and Agricultural Ministry and its Executive Director as secretary of the NGRPC. The following are the functions, duties and rights of the NGRPC:

- Formulate and implement necessary policy, plan and programme concerning protection, conservation and sustainable use of genetic resources and materials;
- Formulate and implement necessary policy, plan, and programme concerning accessibility, sustainable use, equity sharing of the benefit and order to be given for the export of genetic resources and materials;
- Formulate and implement necessary policy, plan and programme for monitoring and handing out to the above said tasks to the responsible proponents;
- Formulate and implement necessary policy, plan and programme for the protection of traditional and indigenous knowledge of the local community regarding the use of genetic resources and materials; and
- Fix royalty for preliminary studies, access, sample collection, registration, use and export of the genetic resources.

HMG has also formulated legislation for the penalty and punishment to be given for the illegal utilization of genetic resources and materials such as illegal export, illegal use, illegal sharing of the benefits, etc. In order to translate the policies into legislation, the Access to Genetic Resources and Benefit Sharing Bill and its

Regulations were proposed in the spirit of the CBD. The Bill will most likely promote the sustainable use of genetic resources and contribute to poverty reduction as well.

Institutional Framework (Organization)

Ministry of Forest and Soil Conservation (MoFSC)

Activities related to FGR C&M in Nepal lies with the MoFSC, which is the national focal point and lead ministry for the CBD. MoFSC chairs the National Biodiversity Coordination Committee (NBCC) and the Secretary of the MoFSC is the member secretary of the NBCC. Other members include representatives from each of the relevant government ministries, the private sector, civil society and major donors (12 to 15 members in total). The NBCC facilitates inter-sectoral coordination during the implementation of National Biodiversity Strategy (NBS) and oversees monitoring and evaluation. The National Biodiversity Unit (NBU) under the Environmental Division of MoFSC acts as the Secretariat for NBCC and serves as the forum for information exchange between government line agencies, NGOs and the private sector during the implementation of NBS. The NBU also prepares the status report to be submitted to the Secretariat of the CBD at five-year intervals.

Department of Forests

The Department of Forests has the responsibility to look after the protection, management and proper utilization of national forests that are not under the protected area system. The Department enhances the country's economy as well as develops forests by scientific forest management and technology. The Department has handed over more than 25% of national forests to be managed by the local people as community forests. The FUGs are concerned about maintaining a whole range of useful plants within their community forests other than fuel wood and timber and this has profound impact on the conservation of biodiversity.

Tree Improvement and Silviculture Unit (TISU) of the Forest Department is totally involved in FGR activities. TISU has established a number of Breeding Seed Orchards to conserve the genetic resources of *Dalbergia sissoo, Dalbergia latifolia, Azardarachta indica, Albizia labbeck, Bauhinia purpuria, Michelia Champaca, Choerospondias axillaris* etc in different parts of the country (Appendix 2).

Department of National Parks and Wildlife Conservation

This Department has the responsibility to conserve the country's major representative ecosystem, unique natural and cultural heritage, and protect the valuable endangered wildlife species and FGR. It also encourages scientific research for the preservation of wild genetic diversity. Under the Department, about 19.4% of the total area of the country representing all ecological regions (Terai, Mid-hills, High Mountains and Himalayas) is under the protected area system. Currently, the Department has nine National Parks, three Wildlife Reserves, three Conservation Areas, one Hunting Reserve and nine Buffer Zones representing major ecosystem in

Nepal (Appendix 1). Forest genetic resources of Nepal are preserved in these areas as *in situ* conservation.

The department's present priority is focused on participatory management of biodiversity conservation through partnerships with conservation and development organizations, stakeholders and local people.

Department of Plant Resources

The Department of Plant Resources under MoFSC is responsible for exploration, identification, scientific research of plant genetic resources and conducting biotechnology research to improve plants of economic value. It also carries out *in situ* and *ex situ* conservation of endangered, threatened, rare and endemic plant species and scientific authority for plant resources and housing of plant specimen.

Department of Forest Research and Survey (DFRS)

DFRS under the MoFSC is responsible to contribute to conservation, management and utilization of forest resources of Nepal through improved technologies and updated forest resource information base. It also carries out both *in situ* and *ex situ* conservation of valuable forest trees in the country. The Tree Improvement Section of the Department is fully responsible for designing and planning tree improvement research of important tree species in enhancing the genetic base of the species. Other important activities of the Section include identification, registration and management of natural seed stands of important tree species and establishment of breeding seed orchards in different parts of the country. The major goal of the Section is to conserve the genetic diversity of forest trees and to do research for quality seeds supply on a reliable basis for successful plantation programmes.

Ministry of Environment, Science and Technology (MEST)

MEST is one of the important government institutions for biodiversity conservation in Nepal through the application of the Environmental Protection Act 1996 and Environmental Protection Rule 1997. Before launching any development projects in Nepal, application of Environmental Impact Assessment (EIA) is made essential for eliminating and mitigating potential threats to biodiversity conservation. MEST is given more emphasis on enforcement of mitigation measures as prescribed in the EIA reports to be made in Nepal for such development projects.

NGOs/International NGOs (INGOs)

Local NGOs or Community-Based Organizations implement and manage biodiversity conservation programmes. INGOs like The Mountain Institute, World Wildlife Fund for Nature (WWF)-Nepal, The King Mahendra Trust for Nature Conservation, World Conservation Union/International Union for the Conservation of Nature and Natural Resources (IUCN)-Nepal, The International Centre for Integrated Mountain Development (ICIMOD) and other NGOs have joined HMG

and worked in collaboration for the conservation and management of biological diversity. Other institutions related to FGR are listed in Appendix 3.

Scientific projects

New research projects and findings

Tree Improvement Section of the DFRS & TISU is responsible in carrying out research for conserving the genetic diversity of the forest trees and to supply quality seeds for successful plantation programmes. The major research activities of the Section include identification, registration and management of natural seeds of important tree species and establishment of breeding seed orchard.

On June/July 2005, the Tree Improvement Section of DFRS established an intermediate level breeding seed orchard (BSO) of *Choerospondias axillaris* (Lapsi) in the central Kavre hill district with a view to produce genetically improved seeds. Lapsi is a very popular species in the hills of Nepal for farmers due to its income generating capacity. Farmers derive economic importance from this species because of its high value fruit that is extensively used in making pickles and sweetmeats.

About 4000 seedlings were produced in polypots at the nursery from the seeds collected from different mother trees distributed in five districts. Two thousand seedlings have been grafted by taking scions from selected superior mother tree of different population. The objectives set for this experiment are:

- To establish a seed bank of improved families for sustainable supply of genetically improved *C. axillaris* seeds;
- To test and demonstrate appropriate technology to produce improved female seedlings from vegetative means;
- To conserve genetic variation of *C. axillaris* that can be used in future breeding cycles and maximize production of fruits from a unit tree;
- To identify varieties and source of species with higher ratio of flesh and seed for greater income to the poor.

The ongoing research experiment of BSO on *C. axillaris* will continue for another ten years and this project is still at the preliminary stage. The Tree Improvement Section of the DFRS has planned to establish BSOs of *Pterocarpus marsupium* (Bijaya sal) and *Dalbargia latifolia* (Satisal) in the Department's Butwal Research Station (BRS) from the fiscal year 2006/07 and will identify the families, collect seeds and grow plants in BRS nursery.

Conservation strategies

National Conservation Strategy (NCS)

After the World Conservation Strategy 1980, HMG with the collaboration of IUCN-Nepal endorsed the theme of the World Conservation Strategy with the highlight on the needs for preparation and implementation of NCS since 1988. The guiding principles of NCS adopted were:

- Reflection of social and cultural values and the economic needs of Nepalese people; and
- Wise use, protection, preservation and restoration as the basic element of conservation.

The objectives of NCS related to biodiversity for Nepal are to:

- Ensure sustainable use of renewable resources;
- Maintain essential ecological and life supports systems; and
- Preserve biological diversity in order to maintain and improve quality of crop, livestock and variety of wild species.

The Conservation Action Agenda of NCS directly related to biodiversity of Nepal are:

- Conservation awareness programme, training and extension;
- Forest productivity including fuel wood, fodder, timber and medicinal plant; and
- Soil conservation and watershed management.

The integration of conservation with development process is a salient feature of the NCS for Nepal.

Species Conservation Strategy

HMG made an effort to conserve threatened, endangered and endemic forest species both locally and internationally to maintain genetic diversity. Since 12 February 2001, HMG has notified restriction and ban on collection, use, sale, distribution, transportation and export of three important medicinal plant species – *Dactylorhiza hatagirea* (Panch ounle), *Juglans regia* (Walnut) bark and *Picrorhiza scrophulariflroa* (Kutaki or Gentian).

Similarly nine wild medicinal species (*Nardostachys grandiflora* [Jatamansi or Spikenard], *Rauwolfia serpentina* [Serpagandha or Serpentina], *Cinnamomum glausecens* [Sugandhakokila], *Valeriana wallichi* [Sugandhawal, Indian valerian], *Lichen* species [Jhyau], *Rock exude* [Shilajeet], *Abies spectabilis* [Talispatra, Fir], *Taxus buccata* [Loth salla, Himalayan yew], and *Cordyceps sinensis* [Yarsa gomba]) were banned from export but the processed product of these species with the permission of Department of Forest were given permission to be exported.

Likewise HMG notified restriction or ban on felling, transportation and export of seven tree species for commercial purpose namely, *Michaelia champaca* (Champ), *Acacia catechu* (Khayar, cutch tree), *Shorea robusta* (Sal), *Bombax malabaricum* (Simal, silk cotton tree), *Pterocarpus marsupium* (Bijayasal), *Dalbergia latifolia* (Satisal, rose wood) and *Juglans regia* (Okhar, walnut tree).

In the species conservation strategy, HMG also listed 15 species on CITES (Convention on International Trade of Endangered Species of Flora and Fauna) – shown in Appendix 4.

Why genetic diversity matters?

Genetic diversity is the basis of heritable variation within and between populations of organisms. Farmers have used genetic diversity for thousands of years in agriculture. Hundreds of plant species have been domesticated and bred for desirable characteristics like size, disease resistance, productivity, etc. Though knowledge of genetic diversity of biological species in Nepal is poor, analysis of genetic diversity of rice using modern techniques has been done.

In Nepal, FGR is an integral part of local livelihoods and plays an important role in the socio-economic enhancement of the people. Due to over population and over-exploitation of forests, many important and valuable forest tree species such as *Dalbergia latifolia, D. sissoo, Pterocarpus marsupium, Azadirachta indica* and *Taxus baccata* are becoming rare and under threat thereby resulting in negative impact on local livelihood. Therefore, it is urgent to stop the genetic depletion of forest trees to conserve the resources for future generations and to uplift the local economy.

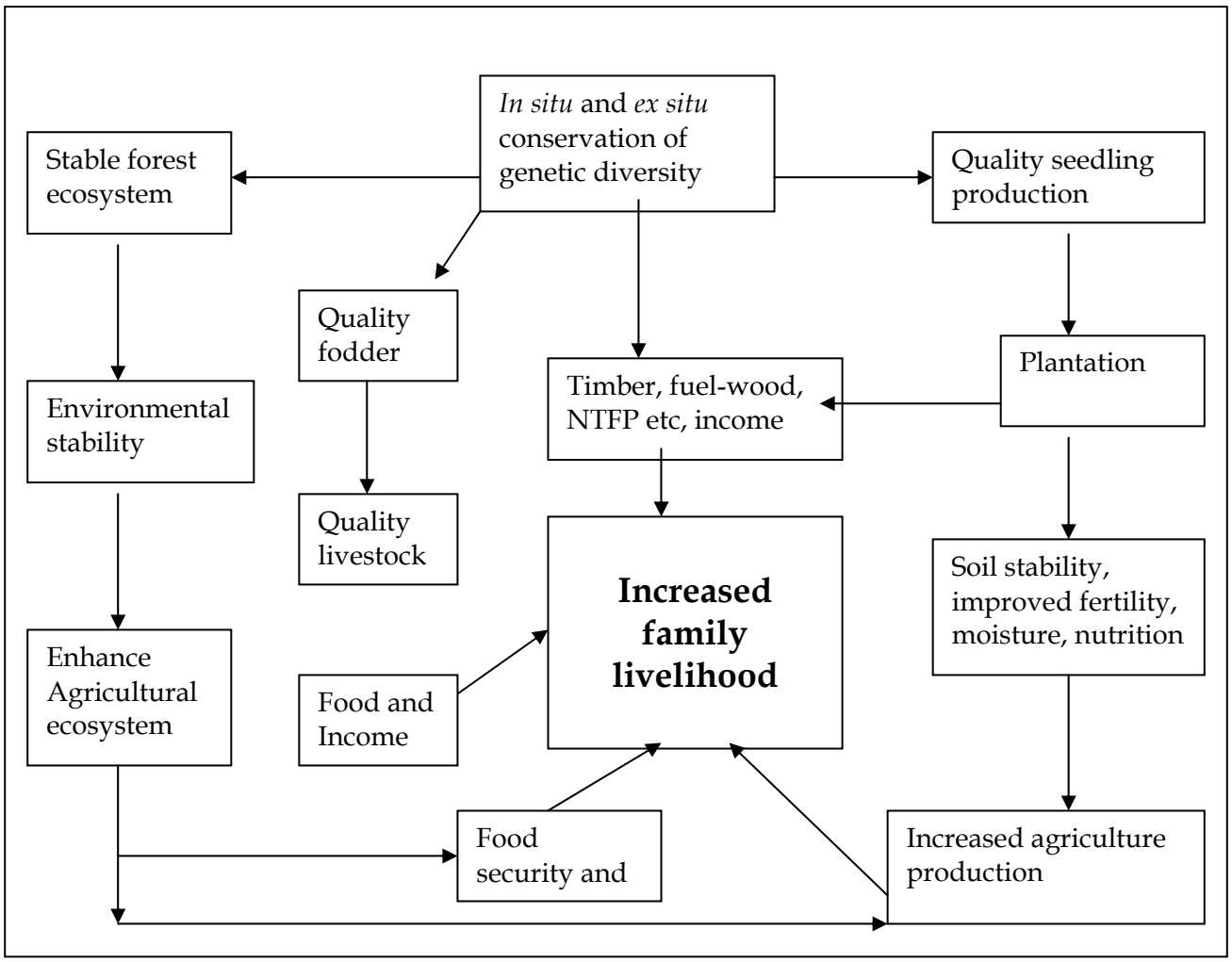
Identification of endangered plant species, establishment of gene banks and development of appropriate propagation techniques are urgently needed to initiate the conservation of forest genetic diversity.

Population pressure on the use of forestland could be minimized by producing more wood from the same area through the application of genetic diversity techniques like Tree Improvement Programme (TIP), which aims to improve productivity of forests through the application of technological advances in tree breeding and propagation. TIP is important in conserving the genetic diversity of forest trees through the selection of plus trees from different parts of the country and establishment of a gene bank and supply quality seeds on reliable basis for the plantation activities.

In Nepal, a single conservation programme is not sufficient to preserve all representative species and genetic diversity. An integrated conservation programme including *in situ* and *ex situ* conservation and community forestry is urgently needed to conserve the FGR of Nepal for sustainable use in future and for enhancing local livelihood.

Efficient management of buffer zone and community forest by sensitizing FUG can conserve forest genetic diversity and at the same time improve the economy of the local community (linkage as shown in Figure 1).

Figure 1. Linkage between Genetic Diversity and Livelihood



International collaboration and future initiatives

Though user's management approach has been found effective to conserve forest biodiversity, there is an increasing pressure on the use of FGR. The country is facing difficulty to document and register biodiversity and its products and associated traditional knowledge, skill, techniques, innovations and practices due to limited analytical facilities, financial and technical assistance. Hence genetic constituents of even the most traded species are not known for bio-prospecting purposes. Technical and technological capacity in handling FGR aspects is severely limited. Therefore Nepal needs regional and international collaboration for expanding biodiversity documentation and registration, human resource development for FGR conservation, development and utilization.

In order to best conserve and sustainably use Nepalese biodiversity to meet the national goal of poverty reduction, additional financial and technical support through regional collaboration is required for raising institutional strength, capacity building, technology transfer, raising awareness among stakeholders and FUG.

Therefore to mitigate the above problems, APFORGEN should take further initiatives for developing bilateral cooperation or regional collaboration for Nepal in the field of FGR C&M.

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Appendix 1

Protected Areas of Nepal: Wildlife Reserves, Hunting Reserves, Conservation Area and Buffer Zones. About 19.4% of the total area of the country (147181 sq. km), representing all ecological regions (Terai, Mid-hills, High Mountains and Himalayas) is under protected area system. Buffer zones have been designated in seven national parks and two wildlife reserves. Nepal has so far nine national parks, three wildlife reserves, three conservation areas, one hunting reserve and nine buffer zones, representing major ecosystems in Nepal.

	Categories of Protected Areas	Year of Declaration	Area (km^2)	Physiographic zone	Conservation focus
National Parks					
1.1	Khaptad National Park	1984	225	Middle mountain	Wild goat, blue sheep and spiritual site
1.2	Langtang National Park	1976	1710	High mountain	Musk deer and red panda
1.3	Makalu Barun National Park	1991	1500	High mountain	High altitude endangered plants
1.4	Rara National Park	1976	106	High mountain	Musk deer, red panda, and high altitude lake
1.5	Royal Chitwan National Park (WHS, 1984)	1973	932	Terai-Siwalik	Rhinoceros, elephant, tiger, bison etc.
1.6	Royal Bardiya National Park	1976/88	968	Terai	Rhinoceros, elephant, tiger etc.
1.7	Sagarmatha National Park (WHS, 1979)	1976	1148	High mountain	Musk deer, red panda, beer, snow leopard etc.
1.8	Shey Phoksundo National Park	1984	3555	High mountain	Wild goat, blue sheep, musk deer, lake.
1.9	Shivapuri Watershed and Wildlife Reserve (Renamed NP in 2002)	1984	144	Mid-hills	Conservation of capital city
					Wildlife Reserves
2.1	Koshi Tappu Wildlife Reserve (Ramsite site, 1987)	1976	175	Terai	Wild buffalo and migratory birds
2.2	Parsa Wildlife Reserve	1984	499	Terai-Siwalik	Tiger, deer, antelopes, bison etc.
2.3	Royal Suklaphanta Wildlife Reserve	1976	305	Terai	Swamp deer, rhinoceros, tiger
					Conservation Areas
3.1	Annapurna Conservation Area	1992	7629	Middle mountain	Endemic plants and animals
3.2	Kanchenjunga Conservation Area	1997	2035	Middle mountain	Endemic plants and animals
3.3	Manaslu Conservation Area	1998	1663	High mountain	Endemic plants and animals
					Hunting Reserve
4.1	Dhorpatan Hunting Reserve	1987	1325	Middle mountain	Blue sheep
					Buffer Zones
5.1	Langtang Buffer Zone	1997	420	High mountain	Aimed at expanding biodiversity
5.2	Makalu Barun Buffer Zone	1998	830	High mountain	

5.3	Royal Chitwan Buffer Zone	1996	750	Terai-Siwalik	conservation and community development to reduce pressure on national parks and wildlife reserves. Also aimed at bringing the local people in the mainstream of biodiversity conservation
5.4	Royal Bardiya Buffer Zone	1997	328	Terai	
5.5	Sagarmatha Buffer Zone	2002	175	High mountain	
5.6	Shey Phoksundo Buffer Zone	1999	1349	High mountain	
5.7	Royal Suklaphanta Buffer Zone	2004	244	Terai	
5.8	Koshi Tappu Buffer Zone	2004	173	Terai	
5.9	Parsa Buffer Zone	2005	298	Terai	
			4666		
	Total Area (km^2)		28 585	19.4% of the total area of the country	

Note: WHS= World Heritage Site

All the above conservation areas were named after the famous snow peaks of the Himalayas and places. These conservation areas are famous for eco-tourism. Annapurna Conservation Area is a major trekking destination for tourists in Nepal. The establishment of buffer zones around the Parks and Reserves is one of the remarkable initiatives in conserving biodiversity in Nepal and in resolving park and people conflicts. The primary objective is to minimize biotic interference on protected areas with the participation of local community as beneficiaries of conservation efforts.

Besides the above designated protected areas, about 1.1 million hectares of national forests (which totals to about 25% of the total forest area) are managed by the local people in the form of community forests. Similarly, around 3,000 hectares of the national forests are also managed in the form of leasehold forests by local communities.

Source: Anon. 2006. Nepal Third National Report to the CBD/HMGN/MFSC, March 2006

Appendix 2

List of Breeding Seedling Orchards, Seed Production Areas and Trial Plots established by Tree Improvement and Silviculture Unit (TISU)

	Species	**Category**	**Family #**	**Location**
1	*Dalbergia sissoo*	Progeny Trial	35	Tilkane, Chitwan
2	*D. sissoo*	Intermediate BSO	84	Sauraha, Chitwan
3	*D. sissoo*	Intermediate BSO	48	Hathausa, Kapilbastu
4	*D. sissoo*	Intermediate BSO	70	Dharan, Sunsari
5	*D. sissoo*	Intermediate BSO	54	Kohalpur, Banke
6	*D. sissoo*	Provenience Trial	4 Prov.	Maheshpur, Siraha
7	*D. sissoo*	Infusion Trial	84	Krishnapur, Kanchanpur
8	*Leucaena leucocephala*	Simple SPA		Tilkane, Chitwan
9	*L. leucocephala*	Simple SPA		Sauraha, Chitwan
10	*L. leucocephala*	Simple BSO		Hathausa, Kapilbastu
11	*Aesandra butyracea*	Intermediate BSO	40	Banstari, Palpa
12	*A. butyracea*	Intermediate BSO	50	Lendanda, Makwanpur
13	*Choerospondias axillaris*	Intermediate BSO	25	Thankot, Kathmandu
14	*C. axillaris*	Intermediate BSO	30	Ranipauwa, Nuwakot
15	*Emblica officinalis*	Intermediate BSO	25	Pumdi, Kaski
16	*E. officinalis*	Intermediate BSO	25	Tilkane, Chitwan
17	*Bauhinia purpurea*	Intermediate BSO	32	Tilkane, Chitwan
18	*B. variegata*	Intermediate BSO	42	Majhitar, Dhading
19	*Albizia lebbek*	Intermediate BSO	36	Tilkane, Chitwan
20	*Dalbergia latifolia*	Simple BSO	140	Tilkane, Chitwan
21	*Michelia champaca*	Intermediate BSO	40	Thankot, Kathmandu
22	*Ficus semicordata*	Simple BSO	21	Kalika, Kaski
23	*Artocarpus lakoocha*	Intermediate BSO	45	Maheshpur, Siraha
24	*Artocarpus spp.* (Latahar)	Intermediate BSO	63	Jalthal, Jhapa
25	*Gmelina arborea*	Intermediate BSO	55	Lalbandi, Sarlahi
26	*Cinnamomum tamala*	Intermediate BSO	36	Bhalam, Kaski
27	*Anthocephalus kadamba*	Intermediate BSO	76	Lalbandi, Sarlahi

Appendix 3.

The List of Institutions related to Forest Genetic Resources in Nepal

	Name of the Organisation/Institution
Government Organisations	
	Parliamentary Committee on Natural Resources and Environment
	Environment Protection Council
	Ministry of Forest and Soil Conservation National Biodiversity Coordination Committee National Bio-safety Committee Environment Division National Biodiversity Unit
	Ministry of Agriculture District Agriculture Offices
	Ministry of Environment, Science & Technology
	Ministry of Local Development
	Department of Forests Tree Improvement and Silviculture Component
	Department of National Parks and Wildlife Conservation National Park Offices Wildlife Reserve Offices
	Department of Forest Research and Survey Tree Improvement Section
	Department of Plant Resources District Plant Resource Offices Royal Botanical Garden
	District Biodiversity Coordination Committee District Development Committees Municipalities Village Development Committees
Autonomous, Bilateral and I/NGO	
	Tribhuvan University Institute of Science & Technology Institute of Forestry Institute of Agriculture & Animal Sciences
	Royal Nepal Academy for Science and Technology
	Nepal Agriculture Research Council
	Conservation Area Projects Annapurna CAP Manaslu CAP Kanchanjungha CAP
	I / NGOs – King Mahendra Trust for Nature Conservation Central Zoo – WWF- Nepal – IUCN-Nepal – ICIMOD – UNDP – The Mountain Institute – Others

Source: Parajuli *et al*. 2005.

Appendix 4.

Convention on International Trade of Endangered Species (CITIES) listed 15 species in 2003.

Species threatened with extinction: *Saussurea lappa*

Species not yet threatened with extinction, but which could become endangered if trade is not controlled:

Ceropegia	(Milkworts, 7 species in Nepal)
Cyatheaceae	(tree ferns)
Cycadaceae	(cycads, one species)
Dioscorea deltoidea	
Orchidaceae	(Orchids, over 300 species in Nepal)
Podophyllum hexandrum	(May apple)
Rauvolfia serpentina	
Taxus baccata subsp. *Wallichiana*	

Species identified by any party as being subject to regulation in that country and which require international co-operation to control trade.

Cycas pectinata (Himalayan cycad)
Gnetum montqnum
Meconopsis regia
Podocarpus neriifolius
Talauma hodgsonii
Tetracentron sinense

Source: CITES

Forest genetic resources conservation and management in the Philippines – An update on activities, challenges and needs since APFORGEN inception in 2003

Mitzi T. Pollisco and Agustin A. Pinol
Ecosystems Research and Development Bureau (ERDB),
Department of Environment and Natural Resource, Philippines

Policies

The following policies and regulations are relevant to FGR conservation and management:

- Executive Order No. 514. The National Biosafety Framework (NBF). Prescribes Guidelines for its implementation, strengthening the National Committee on Biosafety of the Philippines and for other purposes. Approved by the President of the Philippines on 17 March 2006 it covers all work involving genetic engineering and the importation, introduction, field release and breeding of organisms that are potentially harmful to people and environment. The Departments concerned shall allocate from their present budgets such amount as may be necessary to implement the NBF, including the support in the operations of the National Committee on Biosafety of the Philippines and its secretariat;
- Joint Department of Environment and Natural Resources (DENR)–Department of Agriculture (DA)–Philippine Council for Sustainable Development (PCSD)–National Commission for Indigenous People (NCIP) Administrative Order No. 1 Series of 2005. Guidelines for bioprospecting activities in the Philippines. Approved by the heads of agencies on 14 January 2005. The Guidelines set a uniform procedure for evaluating and granting access to biological resources and avoid the potential problem of inconsistency of bioprospecting regulations for various components of biodiversity under the management jurisdiction of different government agencies. Provides equitable sharing scheme for benefits derived from bioprospecting activities among the government and the host communities or resource providers;
- DENR Administrative Order No. 2004-37 to 50. Declaring certain portions of the Public Forest as Agricultural Land (Allowable & Disposable) for cropland and other purposes and setting aside certain parcels for permanent forest purposes;
- DENR Administrative Order No. 2004-32. Revised Guidelines on the Establishment and Management of Community-Based Programme in Protected Areas. Emphasis is made on the use of endemic and/or indigenous plant species in specific areas within the protected area or buffer zone with the objective of returning back as much as possible to the original vegetation type. Approved by the DENR Secretary on 31 August 2004;
- DENR Administrative Order No. 2004-30. Revised rules and regulations governing the Social Industrial Forest Management Programmes;

- DENR Administrative Order No. 2004-29. Revised rules and regulations for the implementation of EO 263, otherwise known as the Community-Based Forest Management Strategy;
- DENR Administrative Order No. 2004-15. Establishing the list of threatened species and their categories, and the list of other wildlife species under the jurisdiction of the DENR pursuant to RA 9147, The Wildlife Resources Conservation and Protection Act;
- DENR Memorandum Circular No. 2004-06. Guidelines in the integration of rainforestation farming strategy in the development of open and denuded areas within protected areas and other appropriate forest lands. Approved by the Secretary of DENR on 5 August 2004. The Memo Circular defines rainforestation as a concept in forest restoration, wherein only indigenous and endemic tree species are used as planting materials which include but is not limited to dipterocarp species, premium tree species, etc It aims to preserve biodiversity and expand Philippine forests and simultaneously sustain human food production;
- DENR Administrative Order No. 2004-04. Guidelines on utilization and transport of planted trees in private lands;
- DENR Administrative Order No. 2003-42. Interim guidelines for the establishment of a specific use of forestlands for herbal/medicinal plantations. Approved by the DENR Secretary dated 29 August 2003;
- DENR Administrative Order No. 2003-21. This amends certain provisions of Department Administrative Order (DAO) No. 99-53, the regulations governing the Integrated Forest Management Programme;
- DENR Administrative Order 2003-18. Identification of forest areas for establishment of African Oil Palm (*Elaeis guineensis* Jacq.) plantations, dated 19 September 2003;
- DENR Administrative Order No. 2003-09. Recognizing the Tree for Legacy programme in Nueva Vizcaya and authorizing the concerned DENR regional field officials to issue appropriate permits for the harvesting, cuttings and transport of products under the programme;
- DENR Administrative Order 2003-05. Revocation of Memorandum Order No. 99-29 and DAO No. 2001-03 which prescribed the guidelines in the implementation of rights in tree farming;
- Memorandum from the Secretary dated 15 October 2002. Framework for the National Clonal Forestry Programme (NCFP);
- Developed the Philippine Biodiversity Conservation Priorities (PBCP) in 2002. The PBCP is an update of the National Biodiversity Strategy and Action Plan (NBSAP), which provides the basis for development programmes on biodiversity conservation. Five strategic actions were identified to ensure that the Philippine biodiversity crisis is addressed: (i) harmonize research with conservation needs, (ii) enhance and strengthen the protected areas system, (iii) institutionalize appropriate biodiversity conservation approaches - the biodiversity corridors, (iv) institutionalize monitoring and evaluation systems of projects and biodiversity and (v) develop a national constituency for biodiversity conservation in the Philippines. These strategic actions fine-tuned

five of the six strategic actions prescribed in the NBSAP;
- Developed the Philippine Plant Conservation Strategy and Action Plan (PPCSAP). The PPCSAP provides a framework to enhance existing initiatives aimed at plant conservation, identify gaps where new initiatives are required, and promote mobilization of the necessary resources. It also provides 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; and
- Through the Philippine Plant Conservation Committee, develop the national list of threatened Philippine plants or plant species that need priority attention for protection and conservation.

It must be noted that Forest genetic resources (FGR) conservation and management (C&M) cuts across many sectors. This implies that initiatives with their corresponding budgets spent by other relevant sectors, which are directly or indirectly benefiting FGR conservation should also be accounted for as investments toward this purpose. However, there is no standardized financial reporting and monitoring financial resources given to FGR conservation initiatives.

It has been noted that both the government and Non-Government Organizations (NGOs) have been very aggressive in sourcing out for funds for FGR conservation projects.

International developments affecting the institutional setting for FGR conservation

These include the following:
1. Cartagena Protocol on Biosafety.
2. United Nations Convention on Biological Diversity.
3. Convention on International Trade on Endangered Species of Wild Fauna and Flora (CITES)

Organizations

Most of the organizations carrying out activities related to FGR C&M are identified below.

Government Agencies

The Protected Areas and Wildlife Bureau (PAWB)

The missions of the agency are the following: (i) the conservation of the country's biodiversity through the establishment, management and development of the National Integrated Protected Areas System (NIPAS), (ii) conservation of wildlife resources, and (iii) information and conservation for nature education. The vision is the perpetual existence of biological and physical diversity in a system of protected areas and such other important biological components of the environment, managed

by well-informed and empowered citizenry for the sustainable use and enjoyment of present and future generations.

The Forest Management Bureau

The Forest Management Bureau of the Department of Environment and Natural Resources provides support for the effective protection, development, occupancy management, and conservation of forest lands and watersheds. The Bureau recommends policies and/or programmes for the effective protection, development, occupancy, management and conservation of forest lands, watersheds, including grazing and mangrove areas, reforestation and rehabilitation of critically denuded/degraded forest reservations, improvement of water resource use and development, ancestral lands, wilderness areas and other natural reserves, development of forest plantations, including rattan, bamboo and other valuable non-timber forest resources, rationalization of the wood-based industries, regulation of utilization and exploitation of forest resources including wildlife, to ensure continued supply of forest goods and services.

The Ecosystems Research and Development Bureau (ERDB)

ERDB was the result of the merger of the former Forest Research Institute (FORI created under P.D. 607) and the National Mangrove Committee of the then Natural Resources Management Center (NRMC) of the former Ministry of Natural Resources. The ERDB is DENR's Research and Development (R & D) arm to assist interested parties who need technical or research-based information pertaining to the forest, grassland and degraded areas, upland farms, coastal zone and freshwater areas, and urban ecosystems. It maintains a rattan genebank, bambusetum, dipterocarp species hedge garden and plantations, seed production areas for acacias and eucalypts and other tree species and gmelina seed orchard. The regional field counterparts called the Ecosystems Research and Development Sectors (ERDS) also maintain their own plantations and experimental forests. Laboratory facilities and nurseries are also available. The most recent equipment acquisition was from Japan International Cooperation Agency (JICA) for the Forest Molecular Laboratory based in ERDB (www. erdb.gov.ph).

The Bukidnon Forests, Inc. (BFI)

The BFI is a subsidiary of the Natural Resources Development Corporation (NRDC), which is the corporate arm of the DENR. BFI aims to operate as a commercially viable enterprise in the business of plantation forestry that will provide an alternative wood resource to the rapidly depleting indigenous timber supply. This will help to remove exploitation pressures from the remaining natural resources (BFI 1999). BFI maintains species and provenance trial plantations of acacias and eucalypts, including the *E. deglupta* x *E. pellita* from PICOP. BFI serves as the source of superior planting materials of exotic tree species for the whole of Mindanao and even the other major islands of the country.

The National Museum of the Philippines (NMP)

As a scientific institution, the NMP conducts basic research programmes through integrated laboratory and field work in anthropology, archaeology, geology,

paleontology, botany and zoology. It maintains reference collections on these disciplines and promotes scientific developments in the Philippines. The Botany Division of NMH is dedicated to the study and conservation of Philippine plants. As an advocate of the plant kingdom, it pursues its goal through its research and education programmes. The work of the Botany staff such as training college biology students, identifying plants, reaching out to school children and garden enthusiasts, and developing sound strategies for conservation has become increasingly appreciated (National Museum Philippines Annual Report 2002).

Academe

University of the Philippines Los Baños (UPLB)

The UPLB through its College of Forestry and Natural Resources, the Agricultural Systems Cluster, the National Plant Genetic Resources Laboratory (NPGRL) and the Seed Science and Technology Division, helps to promote forest genetic resources conservation and management through education and extension programmes. UPLB has well-equipped laboratory and field facilities and links with other research agencies both local and abroad. They conduct researches on germplasm collection, nursery propagation techniques, micro-propagation, evaluation of local and exotic species for fodder production and socio-economic research.

Silliman University (SU)

SU is known for its biological researches. SU has earned respect for its biological sciences and institutional interest in the Philippine ecosystems. Biodiversity conservation has already been integrated in most of the courses offered by the University. SU has a Centre for Tropical Conservation Studies (CENTROP) and a Museum of Natural History.

Southern Luzon Polytechnic College (SLPC)

The main campus of SLPC is located at the foothills of Mt. Banahaw in Lucban, Quezon. SLPC is very much involved in the biodiversity conservation of the Mt. Banahaw-San Cristobal National Park. Many indigenous plant species have been documented in these areas under the leadership of SLPC.

Camarines Sur State Agricultural College (CSSAC)

CSSAC is one of the premier institutes of higher learning in the Bicol region. CSSAC has already managed to integrate biodiversity conservation into the curriculum of several courses. They made conscious efforts to mainstream biodiversity conservation information into their teaching. Presently, CSSAC has formulated the protocols for research grants and the development of training courses on biodiversity conservation education and research methodology.

Leyte State University (LSU)

LSU was formerly known as the Visayas State of College of Agriculture (VISCA). The LSU adheres to the philosophy of promoting and inculcating the core values of truth, knowledge, work and relevance. Its programmes in Instruction, Research, Extension and Production converge and complement each other to help make Philippine agriculture globally competitive and sustainable (www.lsu-visca.edu.ph).

LSU started rainforestation as a farming technology developed by the Applied Tropical Ecology Programme of LSU through a joint research project of the Philippine-German Applied Tropical Programme. Realizing that reforestation failed to restore the lost forests and instead created a negative impact on biodiversity, LSU saw the need to restructure the ideology behind reforestation by planting native species instead of exotic ones.

Mindanao State University – Iligan Institute of Technology (MSU-IIT)

MSU-IIT is one of the seven campuses of the MSU dedicated to tertiary education across Mindanao. Currently, the university has several biodiversity conservation research projects such as those in Mt. Malindang, Mindanao and the Agusan Marsh.

Central Mindanao University (CMU)

CMU has broad capacity and experience in forestry and natural resource management. The Department of Biology implemented a research project on forest biodiversity in the Kitanglad National Park under the Sustainable Agriculture and Natural Resources Management Project with ICRAF as the principal investigator. The project conducted an inventory of all plant species in the park.

Misamis Oriental State College of Agriculture and Technology (MOSCAT)

Its College of Agriculture, specifically has a four-year programme with a degree on Agroforestry. They are involved in domestication of fruits, timber and multi-purpose tree species, diversification of timber species to include indigenous species. MOSCAT has extensive field facilities for research and staff.

Non-Government Organizations (NGOs)

Haribon Foundation, Inc. (Haribon)

Established in 1972, the Haribon is today regarded as a pioneer of the environmental movement and one of the most active environmental organizations in the Philippines. In 1984, it was registered as a science and research foundation conducting floral and faunal studies and is accredited by the Department of Science and Technology. It is also accredited with the DENR and the United States Agency for International Development (USAID) as a private voluntary organization.

Known as Haribon for short, the name refers to the endangered Philippine Eagle and the organization has its roots as a birdwatching society. The name has been retained despite the broadening of the mission, because the critical status of the Philippine Eagle symbolizes the environmental state of the country.

In the pursuit of conservation through community-based resource management, Haribon adopts an integrated, multi-disciplinary approach that is participatory and scientifically sound. Its programmes include science and research, community-based resource management, environmental defense and membership development.

Haribon is a member of the World Conservation Union/International Union for the Conservation of Nature and Natural Resources) (IUCN) and collaborates with international organizations such as Greenpeace, the Wild Bird Society of Japan, Ocean Voice International, and World Wide Fund for Nature (WWF) and BirdLife International. It maintains a strong network with local environmental groups such as

the Green Forum and is a member of the Board of Trustees of the NGOs for Protected Areas (NIPA).

Soil and Water Conservation Foundation, Inc. (SWCF)

Its mission is the promotion of natural and human resource development through implementation of projects and programmes which are participatory, cooperative, community-building and sustainable. SWCF endeavours are designed to be technically appropriate, culturally sensitive, economically viable, and socially acceptable while creating a more ecological sound and sustainable environment.

The goals of SWCF are: (i) establishment and perpetuation and comprehensive environmental ethics in individual and communities which leads to wise use, management, and conservation of our resources, (ii) poverty alleviation through establishment of stable livelihood opportunities for individuals and communities, (iii) advocacy, dissemination and replication of the ideals, philosophies, values and practice of the Foundation for the betterment of the communities in which we live; and (iv) empowerment of individuals and communities in the development of sustainable and equitable democracies.

Bantay Kalikasan

One of the prime-movers of Mt. Banahaw rehabilitation and protection, this NGO has been actively involved in FGR C&M. Bantay Kalikasan made possible the temporary suspension of visits to Mt. Banahaw because of the destruction it has caused to the area.

Agroforestry Tree Seed Association of Lantapan (ATSAL)

A group of 63 farmers, ATSAL is involved in tree seed collection and distribution. They are knowledgeable in tree selection, seed collection, and seed processing and short-term storage. Their seed is primarily sold and traded locally. The association is a low-cost and effective seed supplier. It could provide a model for community-level seed production organization in other parts of the Philippines or Southeast Asia.

The Philippine Tropical Forest Conservation Foundation, Inc. (PTFCF)

The PTFCF is a new foundation with a mission to support tropical forest conservation in the Philippines. It was established under two bilateral agreements between the governments of the United States (US) of America and the Republic of the Philippines (RP) under the US Tropical Forest Conservation Act. These Agreements, signed on 19 September 2002 with $41.5 million over 14 years, to be deposited by the RP in pesos in a Tropical Forest Conservation Fund. The Fund is administered by a Board comprising two US representatives, two representatives of the RP and five representatives of the non-government sector appointed by the RP Board Members. Funds are jointly owned by the US and RP until disbursed to grantees or for other purposes such as administration.

International Organizations

ASEAN Regional Centre for Biodiversity Conservation (ARCBC)

The ARCBC is a joint cooperation Project between the European Union and the Government of the Philippines on behalf of the ASEAN. ARCBC serves as the main

focal point for the networking and institutional linkage among ASEAN Member Countries (AMC) and between ASEAN and European Union partner organizations to enhance the capacity of ASEAN in promoting biodiversity conservation. After the project's completion, the ASEAN Conservation of Biodiversity (ACB) will continue on with the programme with expanded functions.

International Centre for Research in Agroforestry (ICRAF)
ICRAF is a Consultative Group on International Agricultural Research (CGIAR) centre with a base in the Philippines. Their activity is farmer-based and promotes the use of both indigenous and exotic species for utilization. They have satellite project sites in Bukidnon, Misamis Oriental, Bohol and Cebu. The primary focus in Misamis Oriental is Landcare approach, used to diffuse inexpensive effective agroforestry technologies among farmers. In Bukidnon, ICRAF is working at the buffer zone of the Kitanglad National Park, Lantapan. The work includes domestication/tree plantation activities.

International Institute for Rural Reconstruction (IIRR)
The IIRR is a non-profit NGO dedicated to the improvement of the quality of life of the rural poor in developing countries of Africa, Asia and Latin America. IIRR develops the capacity of the rural institutions through training, technical support and sharing of information. IIRR's tree domestication activities are based on species with high market value or potential.

National Coordination Bodies or Task Forces formed for FGR

Philippine Plant Conservation Committee. DENR Special Order No. 32 dated 20 January 2003 – In pursuit of RA 9147, otherwise known as the Wildlife Resources Conservation and Protection Act of 2001, and to address the Philippine commitments to the Convention on Biological Diversity and the conservation needs of plant resources in the country. It is composed of expert representatives from different agencies of the DENR, the National Museum, the National Academy of Science and Technology and other academe.

Rain Forest Restoration Initiatives – a loose and open group composed of representatives from the government, NGOs, the church, academe, people's organizations, industry, private sector and citizens in concerted actions to fulfil and to draw public attention to the state of Philippine rain forests and the need to stop and reverse their continuing loss and degradation. It is affiliated with the Haribon Foundation, Inc. Its vision, dubbed as ROAD 2020, is at least a million hectares of restored forests, through the Rainforestation strategy adapted to different typologies (i.e. agroforestry, plantation forestry, enrichment planting, etc) that will support viable populations of native species of trees and other plants, birds, mammals, reptiles, amphibians, insects, and other arthropods throughout their natural range.

National Fora held for the various FGR

Some of them include the followings:

- Agronomy Seed Fair and Exhibit. "Birthing a seed for societal transformation in the academe." University of the Philippines at Los Baños College of Agriculture. 21–23 March 2006.
- National Policy Forum on Tree Seeds, 27 January 2006, entitled "Better trees in agroforestry farms and plantations in the Philippines through the use of high quality seeds. The Sulo Hotel, Quezon City.
- National Conference on integrating Forest Conservation with Local Governance. 9–12 Nov. 2004. Legenda Suites, Subic Bay Freeport Zone, Zambales.
- National Consultation on Philippine Rainforest Restoration. Imperial Suites Hotel, Quezon City. 16–18 November 2005.
- Towards sustainable Development in the Uplands: Policy Forum. 22 September 2005. Bahay Alumni, UP Diliman, Quezon City.
- Second National Agroforestry Congress. Provincial Capitol Convention Centre. Pili, Camarines Sur. 26–27 October 2005.
- Round table discussion on Philippine Rainforest Restoration. Leyte State
- University, Baybay, Leyte. 24–27 July 2005.
- National Congress on local seed systems for Genetic Conservation and Sustainable Agriculture, ECOTECH, Lahug, Cebu City. 17–26 April 2001.
- Strengthening human resource capability in biodiversity conservation and protected area management. 2002
- National Workshop on understanding and managing biodiversity in the provincial and landscape level. 2001.
- Seminar-workshop on biodiversity and management of alien invasive species in the Philippines. 2002
- Seminar-workshop on the role of gender and development in biodiversity conservation. 2001
- Biodiversity training, education and awareness seminar workshop. 2002
- National trainers' training on biodiversity conservation and sustainable development education at the tertiary level. 26–29 June 2001.

Some scientific projects implemented

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 as the largest flower in the Philippines. This discovery marked a milestone in the history of Philippine Botany. The specimens that were collected served as very important acquisitions of the Philippine National Herbarium (PNH).

The discovery of additional new plant species includes the following: (i) *Cycas zambales* Madulid and Agoo sp. nov. It is a new *Cycas* species found in ultramafic soil of Zambales in 2005; and (ii) *Rafflesia magnifica* Madulid sp. nov. second largest flower in the Philippines found in Compostela Valley, Mindanao, 2005.

Field survey of endangered plants of the Philippines – It is aimed 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.

The recent study conducted by ERDB on livelihood opportunities for the forest dwellers around the periphery of the Seed Production Areas (SPAs) in the Philippine regions revealed that People's Organizations (POs) have developed income generating activity of producing seedlings.

A report (Tolentino 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: (i) Documentation of seed origin is seldom practiced, (ii) 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 (Government Organization-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; (iii) Basic policies (DENR Administrative Order 95-9 and its implementing guidelines DENR Memorandum 95-20) to insure the quality of seeds were laid out 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 determination of appropriate nursery methods for propagation and establishment, documentation of growth, herbage production and persistence of the selected IFTS grown in Cagayan, Isabela, Laguna and Nueva Ecija and assessment of the feeding value, animal performance, nutrient composition and digestibility. Young male native goats that fed on 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 and 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.

Production of high quality planting materials for reforestation and industrial plantations involved the macro and *in vitro* propagation, establishment of SPAs of exotic species, identification of potential plus trees inside designated SPAs throughout the country by ERDB and the ERDS.

Macro-propagation of indigenous species for conservation purposes involved the use of the non-mist system of vegetative propagation and the wilding technology chamber. The non-mist system was equally effective in rooting of dipterocarp cuttings from 1–5 year old stock plants. The wilding technology chamber greatly increased survival of wildings regardless of age.

Comparison of different sampling methods for estimating floral diversity in selected biodiversity sites in the Philippines. The project compared the most commonly employed sampling methods as applied in diverse forest ecosystems in the Philippines. The study tried to draw inferences as to which method is more efficient and effective from among the four sampling techniques: strip sampling, randomized circular plot sampling, systematic circular plot sampling, and point-centred quarter method (PCQM), as against quadrant sampling technique (QST). Further studies were recommended to include more ecosites in the country because there were only three sites used in the present study (Mt. Kitanglad, Bukidnon, Mindanao; Mt. Makiling, Laguna; and Mt. Pangasugan, Leyte). Time, space and economic factors should b incorporated in the equation in future studies.

Conservation strategies

Rainforestation Farming

A farming strategy developed by the LSU through a joint research project of the Philippine-German Applied Tropical Ecology Programme, which is focused on using native tree species in the reforestation and development of closed canopy and high diversity forest farming system. Langenberger *et al.* (2005) as cited by Fernando (2005), likened 'rainforestation' to so-called 'successional analogs' or 'analogs' which try to imitate original forest structure and processes. In 2004, DENR issued a Memo Circular regarding the adoption of rainforestation farming in the restoration of denuded areas inside protected areas and other sites.

Community-Based Forest Management (CBFM)

It is the primary strategy in ensuring sustainable management of the country's forest land resources. This is being undertaken in cooperation with different sectors of society: Government Organizations – DENR, LGUs; civil society and the business community. It is now recognized that the upland communities are key forest land resource managers. The DENR is committed to guide upland communities and support their effort to sound management. The DENR is also bent to continue giving provision of enabling environment and support mechanisms to strengthen and capacitate upland communities to better respond to varying upland situations. It is a social forestry project of the DENR. Communities participating in this programme have access to the harvest of forest resources, thus there is social incentive to the communities. DENR Administrative Order No. 2004-29 provides the revised rules and regulations for the implementation of CBFM strategy.

National Integrated Protected Areas Programme (NIPAP)

NIPAP emphasized a community-based sustainable protection strategy within the framework of the NIPAS. The management of NIPAS areas involves the following relevant actions: (i) creation of interim Protected Area Management Board (PAMB),

(ii) formulation of NIPAS support policies/guidelines, (iii) establishment of the Integrated Protected Area Fund and (iv) designation of Protected Area Superintendent (PASu).

Biological Corridors

Biological corridors are strips of vegetation connecting two habitats with the purpose of conserving the biodiversity of the habitats. The habitats may be two distant protected areas far apart from each other such as two distant mountains, or it may be two patches of forests connected by the vegetation strip. The concept stems from the idea that wildlife, whether flora or fauna, need protection as they exchange genetic materials over long distances, as they travel from one point to the other. Without the biological corridor, wildlife would be very exposed to predation, damage, and environmental uncertainties. The corridors would ensure the safety of travel, providing food, shelter and protection as flora and fauna move from habitat to habitat.

The Philippine Environmental Impact Assessment (EIA)

Central to the system is the consideration that projects to be located in Environmentally Critical Areas (ECAs) are required to prepare EIA and secure an Environmental Compliance Certificate (ECC). ECAs include biodiversity-rich areas and critical habitats.

Integrated Protected Areas Fund

The NIPAS Law provides for an Integrated Protected Areas Fund (IPAF). It is a trust fund for the purpose of promoting the sustainable financing of the system. The fund may receive revenues generated within protected areas, donor support and other funds as provided by law and disburse the same to finance projects of the NIPAS. The IPAF is in principle an incentive measure for biodiversity protection. In practice, however, its effectiveness is yet to be proven since experiences for the past showed that accessing the Fund to finance NIPAS project is difficult. This mechanism has to be looked seriously by DENR so that this instrument could be fully utilized as a management and incentive tool for biodiversity conservation.

Assisted Natural Regeneration (ANR)

ANR is a method of restoring the forest cover of denuded forest lands by assisting the young trees and seedlings or natural tree regenerations surviving in the area to grow through appropriate silvicultural treatments. ANR is the most economical and cost-effective method of stimulating the rapid growth of native species that have been suppressed by pests, diseases or fire. An area subjected to ANR will result in a multi-storey, multi-species forest stand which is more effective for watershed protection and wildlife habitat than a traditional plantation.

Why genetic diversity matters?

The following cases are examples of why genetic diversity is important:

(i) Genetic diversity gives assurance as a source of resistance to pest and diseases. Though it may be more on the source/provenance and not on variety, *Eucalyptus deglupta* from Mindanao is resistant to varicose borer while *E. deglupta* from Papua New Guinea was found to be susceptible.

(ii) Genetic diversity assures source of variation. Second to *durian* (*Durio zibenthus*), *marang* (*Artocarpus odoratissimus*) is also a favourite fruit in Mindanao. In the supermarkets of Luzon, it commands a high prize almost equal to *durian*. Its size, colour, sweetness and time of ripening vary, indicative of genetic diversity which has not been thoroughly studied yet. Some people prefer the green or brown fruit varieties, but both are equally good. In most areas, both green and brown varieties co-exist and may have actually hybridized. Yearly fruiting of *marang* generates sure income for farmers. The tree sources are wild and have naturally evolved through the years. As stated by Leakey Jaenicke (1995), the extent of genetic diversity in populations of undomesticated tropical tree species is sufficient to allow considerable gains in yield and quality.

International collaboration and future initiatives

These activities include the followings:

- ASEAN-Korea Environmental Cooperation Project (AKECOP), in collaboration with the UPLB has an ongoing project entitled "Philippine Programme on Forest Restoration, Agroforestry and Biodiversity Conservation";
- JICA donated equipment for the Molecular Laboratory of ERDB; and
- ICRAF/WAC in collaboration with ERDB, UPLBCFNR and KVR, Denmark on a proposal for a forest seed enterprise for Indonesia and the Philippines.

Suggestions for FGR-related initiatives that are beneficial for regional collaboration in FGR C&M:

- Training on FGR C&M database management; and
- Training on DNA fingerprinting/molecular level diversity analysis.

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Forest genetic resources conservation and management in Thailand – An update on activities, challenges and needs since APFORGEN inception in 2003

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Policies

Although forest genetic resources conservation and management (FGR C&M) in Thailand has been implemented for a long time ago, there is no specific policy on this issue. However, there are several existing policies that are relevant to forest genetic resources conservation and management. These are as follows:

- The 9th National Economic and Social Development Plan (2002–2006);
- The National Policies, Action Plans on Conservation and Sustainable Utilization of Biodiversity (2003–2007);
- The Promotion and Conservation of Quality of Environment Policy and Plan (1997–2016);
- The policy Declaration by the Cabinet to the Parliament on 23 March 2005; and
- The Policy of the Ministry of Natural Resources and Environment (MONRE) for 2005–2008.

Currently, the four-year Public Administration Plan (2005–2008) of MONRE (MONRE 2005) has been adopted for implementation, especially the government policy on 23 March 2005 and the MONRE policy for 2005–2008.

Organizations

Several organizations are undertaking FGR C&M activities (either directly or indirectly) in Thailand include the following:

- The National Park, Wildlife and Plant Conservation Department (DNP);
- The Royal Forest Department (RFD);
- The Forest Industry Organization (FIO);
- The Thai Plywood Company Ltd. (TPC);
- The Botanical Garden Organization (BGO); and
- The Faculty of Forestry, Kasetsart University (KU);

Unfortunately, there is no specific forum to discuss these initiatives. However, three organizations are planning to have a memorandum on cooperation for forest plantation research. Those organizations are RFD, FIO and KU. The drafting of the memorandum is ongoing.

Scientific projects

Unfortunately, there are no new research projects and findings.

Conservation strategies

Under the MONRE's four-year Public Administration Plan (2005–2008), four key strategies related to FGR C&M were formulated as follows:

- Natural resources C&M in a balanced manner and consistent with sustainable development;
- Management for sustainable and fair utilization of biodiversity;
- Participation and integration at all levels in management and improvement of natural resources capacity; and
- Improvement of administrative systems to achieve the best practices.

To fulfill those strategies, some key projects/activities were planned and implemented under each strategy. Some examples of the projects/activities are shown in Table 1.

Table 1. Key projects/activities under the strategies related to FGR C&M.

Strategies	Projects/Activities
1. Natural resources C&M in balanced manner and consistent with sustainable development.	1.1 Forest resources protection 1.2 Forest resources rehabilitation 1.3 Protected forest areas demarcation 1.4 Land allocation and promotion of forestry occupation 1.5 Natural tourist sites improvement within its carrying capacity.
2. Management for sustainable and fair utilization of biodiversity.	2.1 Biodiversity database development 2.2 Bio–resources value creation.
3. Participation and integration at all levels in management and improvement of natural resources capacity.	3.1 Promotion of participatory management on forest sustainability 3.2 New form of forest villages under the Royal Initiative 3.3 Increment of forest areas with citizen participation.
4. Improvement of administrative systems to achieve the best practices.	4.1 Studies and research on natural resources.

Why genetic diversity matters?

It is well understood that biodiversity, especially forest biodiversity, plays an important role by providing goods and services to all lives on earth. In Thailand, more than half the population still rely on natural resources, particularly after the financial crisis in 1997. In addition, eco-tourism has become one of the top priority national income earners, especially after the financial crisis. Therefore, a healthy and wealthy genetic diversity means a good livelihood for the rural people, good source of national income and provides support for a strong national security. However, the FGR C&M in Thailand still needs improvement due to the lack of sufficient genetic resources, expertise and funding.

International collaboration and future initiatives

International collaboration in FGR C&M is still needed to obtain improvements in this area. Links among countries in the region should be established to share and exchange information and knowledge in this field. Training course(s) and on-the-job training on FGR C&M should also be arranged for working officials of member countries by using regional and international experts. Workshops as well as study tours are also effective means for learning and standardization of FGR C&M. APFORGEN should work along the above-mentioned initiatives. In addition, financial support from international organizations should be sought by APFORGEN to help run the programmes of member countries. There is also work to be done to integrate natural resources management to help balance economic growth and environmental sustainability. Some of the key priorities include:

- Monitor all action plans closely;
- Develop policy-making tools;
- Create an active high-level policy forum; and
- Strengthen the capacity of local administrative organizations.

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Forest genetic resources conservation and management in Viet Nam – An update on activities, challenges and needs since APFORGEN inception in 2003

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Policies

In Viet Nam, conservation of genetic resources in general and conservation of forest genetic resources (FGR) in particular has received much attention from Government, institutions as well as society for a long time. Recognizing the importance of native species and varieties in development, the Ministry of Science and Technology (MOST), (or formerly known as Ministry of Science, Technology and Environment (MOSTE), issued the first Regulation on Management and Conservation of Plant, Animal and Micro-organism Genetic Resources in 1987. Ten years later (in 1997), the second official Regulation on that matter was issued which guides the scope of work and methods of conservation and management (C&M) of genetic resources. The Regulation emphasized the importance of conserving native, precious and rare genetic resources which can be assessed and used in future for economic development of the country. Since 1989, continuous funding has been given for research projects relating to genetic resources C&M for agricultural crops, FGR, animal and micro-organisms. The Forest Science Institute of Viet Nam (FSIV) has been appointed by MOST and the Ministry of Agriculture and Rural Development (MARD) as the focal point for research on FGR C&M in Viet Nam. Some new regulations relevant for C&M of FGR adopted in Viet Nam are as follows:
Decision No. 58/2001 issued on 23 May 2001 by MARD on the list of precious and rare crop and animal varieties that are prohibited for export;

- Government's Decree No. 13/2001 issued on 23 January 2003 on Regulations on new varieties;
- MARD's Decision No. 188/2003 issued on 23 January 2003 on Standards for approving new forest plant varieties;
- President's Decree issued in 2004 on crop varieties including FGR;.
- MARD's Decision No. 13/2005 issued on 15 March 2005 on the list of main forest species for planting; list of forest species for production etc.;
- National Forestry Strategy (2006–2020); and
- National Forestry Research Strategy (2006–2020).

The above-mentioned new policies are mostly concerned with crop varieties such as genetic improvement and approval of new crop varieties (including forest plants as well as breeders rights) but not directly with conservation of FGR. To date, a National Plant Conservation Strategy has not been developed but conservation activities may be included in the National Forest Tree Improvement Strategy which is being drafted.

Organizations

The Forest Science Institute of Viet Nam (FSIV) is a leading institution for FGR conservation research in Viet Nam. FSIV and its research centres are also involved in the establishment of arboreta, living tree collections, *ex situ* conservation stands as well as in guiding both *in situ* and *ex situ* conservation. Species-provenance trials and breeding programmes are also carried out by FSIV. The research programmes or projects conducted during 2001–2005 were as follows:

- Genetic Improvement Programme for Agricultural and Forest Crop (includes some FGR related research projects carried out by FSIV scientists):
    - Tree breeding for some main tree species;
    - Artificial hybridization of some main tree species (Eucalypts, Acacias, Melaleucas, pines); and
    - Selection of disease resistant and high yielding clones of Eucalypts and Acacias
- National Programme for Conservation supported by MOST and MARD:
    - Conservation of Forest Plant Genetic Resources in Viet Nam (carried out by FSIV)
- Other research projects:
    - Species diversity and *ex situ* conservation of some bamboo species in Viet Nam – supported by Bioversity International (formerly known as International Plant Genetic Resources Institute [IPGRI])
    - Collection of FGR for five tree species in Viet Nam and China for conservation (joint research project between Viet Nam and China)

The Central Forest Seed Company (CFSC) is working on the establishment of some seed production areas (seed stands and seed orchards for some main tree species such as *Pinus merkusii* and *P. kesyia*). Recently, a project on gene conservation plots for certain species have been established with support from a Danish International Development Agency (DANIDA).

The Forest Inventory and Planning Institute (FIPI) is working on baseline inventory work, such as species lists and planning for nature reserves in Viet Nam. Other research institutes and universities (Institute for Ecology and Biological Resources – IEBR, Institute for Biotechnology – IBT, Forestry University - FU) carried out mostly inventory work and basic research only.

Scientific projects

The research project titled Conservation of Forest Plant Genetic Resources in Viet Nam was carried out by FSIV scientists during 2001 to 2005. We realized that conservation in the form of living trees or populations (*in situ* and *ex situ* conservation stands) is more appropriate for forest tree species. Even though *in situ* conservation is implemented in nature reserves, it focused mostly on general nature conservation and not conservation of individual species (Table 1). *Ex situ* conservation is also widely applied but it requires considerable time, money and

knowledge. Therefore, only a few important tree species have been included in the *ex situ* conservation programme in Viet Nam (Table 2).

Table 1. Arboreta and bambuseta established for conservation.

Location	Number of species	Area (ha)
Cau Hai, Phu Tho	250 trees and 100 bamboo species	20
Trang Bom, Dong Nai	120 trees and 20 bamboo species	8
Lang Hanh, Lam Dong	20 rare tree species	10
Mang Linh, Lam Dong	40 rare tree species	10
Cuc Phuong, Ninh Binh	100 tree species	100

Table 2. *Ex situ* conservation stands established

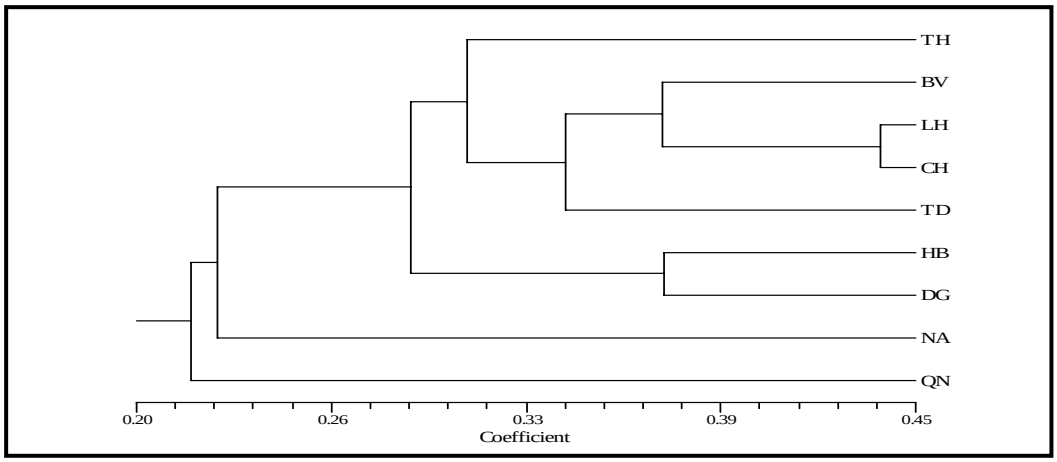
Species	Number of seed sources	Number of trees or area (ha)
Erythrophloeum fordii	8	2.5
Dipterocarpus retusus	2	2
Madhuca pasquieri	2	6
Calocedrus macrolepis	2	2000 trees
Fokienia hodginsii	1	2000 trees
Taxus wallichiana	4	1000 rooted cuttings
Shorea falcata	1	3000 trees
Hopea cordata	1	500 trees
H. reticulata	1	500 trees

In collaboration with the IBT, we have carried out research to evaluate relativeness of species in some genera or family as well as genetic diversity of some species (Table 3) by using RAPD and Choroplast DNA (cpDNA) techniques. An example of results for *Erythrophloeum fordii* is shown in Figure 1.

Table 3. Evaluating genetic diversity of some tree species by using DNA markers

Family/Species	Sample	Evaluating for
Dipterocarpaceae	17 species	Relativeness of species within family
Dipterocarpus spp.	12 species	Relativeness of species within genus
Erythrophloeum fordii	9 provenances	Relativeness of provenances within species
Erythrophloeum fordii	3 provenances	Genetic diversity of each provenance
Hopea cordata	50 individual trees	Genetic diversity of the species

Figure 1. Relativeness of nine provenances of *Erythrophloeum fordii* (Lien *et al.* 2004)



TH: Thanh Hoa, CH: Cau Hai, HB: Ha Bac, LH: Lang Hanh, DG: Dong Giang, BV: Ba Vi, TD: Tam Dao, NA: Nghe An, QN: Quang Ninh

The research project titled "Species diversity and *ex situ* conservation of some bamboo species in Viet Nam" (supported by Bioversity International during 2003–2005) has collected many bamboo samples in Cau Hai bambusetum for planting and identification. A list of 216 bamboo species (Nghia 2005) and endangered conifer species (Nghia 2000) in Viet Nam has been preliminarily established (Nghia 2004). The lists are shown in Table 4 and Table 5.

Table 4. List of bamboo genera and species in Viet Nam (Nghia 2005).

Genera	No. of species	Genera	No. of species
Acidosasa	5	*Gigantochloa*	18
Ampelocalamus	3	*Indodasa*	12
Arundinaria	8	*Machlurochloa*	16
Bambusa	67	*Melocalamus*	8
Bonia	2	*Oligostachyum*	1
Cephalostachyum	4	*Phyllostachys*	8
Chimonobambusa	3	*Pseudostachyum*	1
Chimonocalamus	2	*Sasa*	1
Dendrocalamopsis	3	*Schizostachyum*	16
Dendrocalamus	29	*Sinarundinaria*	2
Fargesoa	1	*Thyrsostachys*	2
Ferrocalamus	1	*Viet Namosasa*	2
		Sinobambusa	1

Table 5. Endangered conifer species in Viet Nam (Nghia 2004).

	Species	Identification
1	*Cephalotaxus mannii* Hook.f.	EN C2a
2	*Calocedrus macrolepis* Kurz	VU A1cd
3	*Cupressus* sp. (*Cupressus torulosa* D.Don)	EW
4	*Fokienia hodginsii* Henry & Thomas	VU A1cd
5	*Abies delavayi* ssp *fansipanensis* Rushforth	EN D
6	*Keteleeria davidiana* (Bertr.) Beissn.	EN D
7	*K. evelyniana* Masters	VU A1cd
8	*Pinus dalatensis* de Ferre	NT
9	*P. kesiya* Royle ex Gordon	LC
10	*P. krempfii* H.Lecomte	VU A1cd
11	*P. kwangtungensis* Chun ex Tsiang	EN D
12	*P. massoniana* D.Don	LC
13	*P. merkusii* Jungh. & de Vries	LC
14	*Pseudotsuga brevifolia* Cheng & Fu	VU A1cd
15	*Tsuga sinensis* var. *sinensis* Pritzel	EN D
16	*Dacrycarpus imbricatus* (Blume) de Laub.	VU A1cd
17	*Dacrydium elatum* (Roxb.) Wall	VU A1cd
18	*Nageia fleuryi* (Hickel) de Laubenfels	VU A1cd
19	*N. wallichiana* (Presl.) Kuntze	VU A1cd
20	*Podocarpus neriifolius* D.Don	VU A1cd
21	*P. pilgeri* Foxworthy	VU A1cd
22	*Amentotaxus argotaenia* (Hance) Pilger	NE
23	*A. hatuyenensis* N.T.Hiep	EN D
24	*A. poilanei* D.K.Ferguson	NE
25	*A. yunnanensis* H.L.Li	NE
26	*Taxus chinensis* Pilger	EN D
27	*T. wallichiana* Zucc.	CR C2a
28	*Cunninghamia konishi* Hataya	VU A1cd
29	*C. lanceolata* (Lamb) Hook.f.	LC
30	*Glyptostrobus pensilis* (Staunton) K.Koch	CR D

31	*Taiwania cryptomerioides* Hataya	EN D
32	*Xanthocyparis Viet Namensis* Farjon & Hiep	EN D
33	*Calocedrus rupestris* sp.nov.	EN D

Conservation strategies

Conservation measures have been developed individually for different species. An example of strategy for *Anisoptera costata* (Nghia 2000) is as follows:

Strict protection for all individual trees which are found scattered in Nature Reserves, National Parks and Forest Enterprises. In addition, a small area must be planned for establishing conservation/seed production stands. The most important areas to be conserved are:

- Cat Tien National Park (Dong Nai province);
- Bu Gia Map National Park (Binh Phuoc);
- Yokdon National Park (Dac Lac);
- Phu Quoc National Park (Kien Giang);
- Binh Chau - Phuoc Buu Nature Reserve (Ba Ria - Vung Tau);
- Ninh Hoa Forest Enterprise (Khanh Hoa);
- Tan Phu Forest Enterprise (Dong Nai); and
- Dipterocarp Seed Stand at Dong Giang (Binh Thuan);

Guidelines for seed collection, sowing and planting must be disseminated to local technicians to enable a large scale planting programme for the species. A suitable site should be selected for establishment of dipterocarp collection in combination with conservation.

Why genetic diversity matters?

Positive examples

Illicium verum: a very valuable tree species that provides fruits for export. The local people in Lang Son province planted these trees in their forest and harvested it after 10 years for their own consumption;

Cinnamomum cassia: The local people in Yen Bai plant these trees on occasions such as when a child is born or when their children get married. They believed that planting of the tree will bring prosperity for their children in the future. The local variety is also planted because the price and market of products from this tree are stable.

Negative example

Cinnamomum cassia: To fulfil the goal of planting more *C. cassia* in the Quang Nam province the people introduced other seed sources from North Viet Nam for planting without a trial phase. The consequence of this action was seen after 10 years, where the essential oil content from these trees was low and this reduced the price.

International collaboration and future initiatives

Some of the activities could include:

- Information exchange;
- Exchange of expertise in some research fields such as taxonomy;
- Training on assessment methods, species identification and conservation methods; and
- Study tours to visit *in situ* and *ex situ* exemplary conservation sites of FGR in the region

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Annex 1

Programme

DAY 1: Saturday 15 April 2006

Session 1: Chair: Dr. Sim H.C.– APAFRI

14:00–14:30 Opening of the meeting
Welcome address (ICFRE)
Opening remarks (Dr. Abd. Razak Mohd Ali, Chairman of APAFRI)

14:30–14:45 Adoption of the meeting programme and objectives

14:45–15:15 Updates on APFORGEN programme
APFORGEN Inception Workshop revisited: Update on development since the Inception Workshop of 2003 and recent developments on FGR conservation (Sim H.C. & Hong L.T.)

Session 2: Chair: Dr. Markku Larjavaara – Bioversity International

15:15–16:30 Country updates on FGR conservation and management since 2003
- Cambodia
- China
- India
- Viet Nam

16:30–16:45 Coffee/tea break

16:45–18:00 Country updates on FGR conservation and management since 2003 – continued
- Indonesia
- Laos PDR
- Malaysia
- Myanmar

DAY 2: Sunday 16 April 2006

Session 3: Chair: Dr. Anders Pedersen

8:30–10:30 Country updates on FGR conservation and management since 2003 – continued
- Nepal
- Philippines
- Sri Lanka
- Thailand
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10:30–10:45 Coffee/tea break

Session 4: Chair: Dr. Markku Larjavaara – Bioversity International

10:45–11:45 Revisit drafted action plans – status

11:45–12:45 APFORGEN – programme workplan for the next year(s)

12:45–14:00 Lunch

Session 5: Chair: Hong L.T.– Bioversity International

14:00–15:00 Information sharing and dissemination (Anders Pedersen)

15:00–15:45 Future proposal – Reforestation and FGR (Markku Larjavaara)

15:45–16:45 Resource generation strategies (Anders Pedersen and Markku Larjavaara)

16:45–17:00 Closing of the workshop

17:00–17:15 Coffee/tea break

17:15–19:00 ITTO Project: *Strengthening National Capacity and Regional Collaboration for Sustainable Use of Forest Genetic Resources in Tropical Asia* – Discussion on activities and finalizing yearly plans (Hong L.T. & Sim H.C.)

Annex 2

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