IUFRO World Series Volume 20-I

Keep Asia Green
Volume I "Southeast Asia"

Edited by Don Koo Lee

IUFRO

AKECOP

Yuhan-Kimberly

IUFRO

IUFRO World Series Vol. 20-I Keep Asia Green Volume I "Southeast Asia" Vienna 2007

IUFRO

IUFRO Headquarters
Hauptstrasse 7
1140 Vienna, Austria
Tel: + 43-1-877-0151-0
Fax: +43-1-877-0151-50
Email: office@iufro.org
Web site: www.iufro.org

International Union of Forest Research Organizations
Union Internationale des Instituts de Recherches Forestières
Internationaler Verband Forstlicher Forschungsanstalten
Unión Internacional de Organizaciones de Investigación Forestal

IUFRO World Series Vol. 20-I

Keep Asia Green
Volume I
"Southeast Asia"

Edited by Don Koo Lee

AKECOP

Yuhan-Kimberly

ISSN 3-901347-55-0

ISBN 978-3-901347-69-6

IUFRO, Vienna 2007

Recommended catalogue entry:
Keep Asia Green Volume I "Southeast Asia", 2007.
Don Koo Lee (editor)
IUFRO World Series Volume 20-I. Vienna, 241 p.

ISSN 3-901347-55-0
ISBN 978-3-901347-69-6

Cover photos:
1. Land conversion in Southeast Asia
2. Pitcher plants, a component of the region's rich biodiversity
3. Mangrove forest system

Photos by Michael Kleine

Published by:
IUFRO Headquarters, Vienna, Austria, 2007

Available from:
IUFRO Headquarters
Secretariat
c/o Mariabrunn (BFW)
Hauptstrasse 7
1140 Vienna
Austria

Tel.: +43-1-8770151-0
Fax: +43-1-8770151-50

E-mail: office@iufro.org
Web site: www.iufro.org

Price:
EUR 20.-
plus mailing costs

Printed by:
Eigner Druck, 3040 Neulengbach, Austria

TABLE OF CONTENTS

The eight country papers in this book have been structured on the basis of the following general contents:

PART A
STATUS OF LAND USE AND FOREST (AND LAND) DEGRADATION
Forest Land Use and Land Use Change
Status of Forest (and Land) Degradation
Causes of Forest (and Land) Degradation
Impacts of Forest (and Land) Degradation

PART B
IMPLEMENTATION OF FOREST RESTORATION AND REHABILITATION
History of Restoration/Rehabilitation
Current Policies Governing Land Use and Restoration/Rehabilitation
Forest Restoration/Rehabilitation Initiatives
Assessment of Existing Capacities of Stakeholders' Involvement

PART C
FUTURE ACTIONS FOR ENHANCING RESTORATION/REHABILITATION
Improving/Revising Policies
Building Research and Education Capacities
Reconciling Global and National Policies
Partnership and Collaboration with Private Sectors
Creating Public Awareness and Support
Community Involvement
Monitoring and Evaluation for More Effective Rehabilitation/Restoration
Effective and Practical Applications
Financing for Forest Restoration

PART D
MISCELLANEOUS
Forest Fires
Pests and Diseases

FOREWORD

Forests in Southeast Asia are a valuable natural resource of great variety playing a significant socio-economic role for the countries in the region. Its tropical rainforests are among the most complex and species-rich terrestrial ecosystems in the world. Widespread deforestation over the past decades, however, caused by many multifaceted factors such as increase in human population, poverty, and rapid industrialization has lead to significant changes in land use cover resulting in environmentally, economically, and aesthetically vulnerable landscapes.

To some degree the effects of deforestation have been compensated through natural forest regeneration and plantation establishments. Being acquainted with the past and ongoing rehabilitation initiatives in the region and comparing the achievements to date with the magnitude of the area in need of rehabilitation, it can easily be seen that a lot more efforts and investments are required to establish sufficient tree cover in the region. Hence, there is an urgent need to improve the quality of forest restoration and rehabilitation and to find effective ways to undertake these activities in the context of explicable environmental, social, and economic needs and interests.

The advent of a book series titled “Keep Asia Green” through the initiative of the ASEAN-Korea Environmental Cooperation Project (AKECOP) in cooperation with the International Union of Forest Research Organizations (IUFRO) through the Special Programme for the Developing Countries (IUFRO-SPDC) indicates a concerted effort to work towards rehabilitating the region’s devastated forests. I feel so inspired with this effort and I am so honored to be part of this undertaking as this will be a great contribution to the Southeast Asia region.

The book series “Keep Asia Green” aims to understand the national capacities in terms of forest rehabilitation and existing education programs and to analyze the need for further strengthening of forest landscape restoration efforts in each country as well as each region in Asia.

The first volume of the book provides state-of-the-art information about the forests of eight countries in the Southeast Asian region, namely Brunei Darussalam, Indonesia, Lao PDR, Malaysia, Philippines, Singapore, Thailand, and Vietnam. It includes historical perspectives of land use change in Southeast Asia, present state of forest degradation, and response to the forest rehabilitation needs including major lessons learned from the country’s case studies.
The lessons learned from the many reforestation and rehabilitation projects allow the formulation of recommendations for future actions. These actions aim at further enhancing the approaches to forest rehabilitation so that investments into trees and forests achieve an even greater impact on the landscape, thus providing enhanced environmental services and economic benefits for human well being of present and future generations.

This book is the first of its kind in Southeast Asia providing an important contribution towards the objectives of forest landscape restoration and an essential reading material for practitioners and decision makers involved in forest restoration.

Finally, please allow me to express my sincerest gratitude to AKECOP and its staff for initiating this noble deed; to all forest scientists in the different countries of the Southeast Asia region for sharing the necessary information to come up with this book; to Dr. Michael Kleine (Coordinator of IUFRO-SPDC) for his dedicated effort and great contribution to this project; and to Yuhan-Kimberly, Ltd. for substantial financial support to this publication and endeavor. The assistance

of Mag. Eva-Maria Schimpf and Mag. Margareta Khorchidi of IUFRO-SPDC in language editing and layout of the book is much appreciated. To all of you, thank you and let us continue the pursuit of keeping Asia green.

Prof. Don Koo Lee
IUFRO President

Rehabilitation of Degraded Forest Lands in Southeast Asia

A Synthesis

by
Daniel B. Krishnapillay, Michael Kleine, Lucrecio L. Rebugio, and Don K. Lee

1. Introduction

This publication represents the first volume of the book series "Keep Asia Green" providing state-of-the-art information about the forests and the status and causes of their degradation in eight Southeast Asian countries. Besides an evaluation of past and current rehabilitation efforts and achievements, the book aims at a better understanding of national capacities in terms of forest rehabilitation and existing education programs and analyzes the need for further strengthening of forest landscape restoration efforts in each country.

The book series “Keep Asia Green” is being compiled as a joint effort by experts on forest rehabilitation in the Asia Pacific region. Until the year 2010, a total number of five volumes, one each for Southeast Asia, Northeast Asia, Central Asia, South Asia and West Asia will be published. Overall, the project contributes to strengthening regional forest science cooperation and enhancing the exchange of scientific information on rehabilitation of degraded forests.

2. Historical Perspectives of Land Use Change in Southeast Asia

Over the past one hundred years the landscape in Southeast Asia has changed significantly. The period of colonial rule through the start of the 20th century up to present times has seen rapid diminution and degradation of forest resources in the region. Virtually all forest vegetation types have either been converted to other land uses or altered to a varying degree in terms of structure and species composition. Owing to the ecological diversity across Southeast Asia there is a great variety of forest types in the region. However, there is no standard way of classifying forest types and each country has adopted its own forest typology.

In general, the largest proportion of forests is located in the lowlands, foothills and mountainous regions with humid tropical to sub-tropical seasonal climates. The forest types range from evergreen lowland and hill dipterocarp forests mostly in Indonesia, Malaysia and the Philippines to dry dipterocarp, mixed deciduous forests as well as mixed coniferous and broadleaved forests primarily found in Lao P.D.R., Thailand and Vietnam. In coastal areas and in areas along lakes and rivers mangroves, beach forests, swamps as well as gallery forests can be found. Special forests types occurring on a smaller scale on various site conditions include bamboo forests, heath forests, scrub woodlands and savannah-like wooded areas.

Different forest use categories are applied in the various sub-regions in Southeast Asia making it somewhat difficult to directly compare the extent of forest uses between countries. However, broad categories such as production, protection, conservation and special use forests can be distinguished. Forest areas designated for timber management are generally called production forests, but in the Philippines these forests are also known as timberland. The term “protection forests” is applied to forest areas designated for uphill watershed protection, windbreaks and the protection of coastal lines (i.e. tidal breaks). Conservation areas have been established throughout the region and are mainly intended to conserve Southeast Asia’s rich faunal and floral diversity.

These forests include national and state parks, nature reserves, wildlife parks and other biodiversity conservation areas. In an urban environment like Singapore the term “urban streetscapes and parks” is used for tree cover in the city. In the context of forest uses it should be noted that there is a considerable proportion of land not classified as forests, for example labelled “unclassified land” in the Philippines or “state forest land” in Malaysia or other so-called “waste lands” that might be available for forest uses in the long-term.

Regardless of the forest classification or typology employed in all countries in the region, forests are considered a valuable resource and account for a significant part of the land area in each country. Except for Singapore and Brunei, where forests do not play an important role in the economy, all other countries derive considerable benefits from exploiting their forest resources. These forests used to be extensive in area and rich in biodiversity. Over the years, however, the extent and biological richness had decreased tremendously due to various economic, social and political factors. The most dominant development has been the conversion of forests to other land uses such as plantation agriculture, mining operations, human settlements as well as industrial and infrastructure development. These large-scale conversions are the logical consequence of an increasing population and the demands of an accelerated economic development. In most countries the forest area continued to decrease in recent years at annual rates of change ranging between 0.2 to 1.4 percent, with an average deforestation rate for the entire region in the period between 2000 and 2005 of 1.3 percent (FAO 2007). However, there are countries like the Philippines, Thailand and Vietnam that were able to reverse this downward trend due to considerable investments into forest rehabilitation and forest plantation establishment. This positive trend has recently been revealed and documented through the help of modern forest assessment methods employing remote sensing technologies and geographic information systems.

3. Present State of Forest Degradation in the Region

In its Global Forest Resource Assessment (FRA) 2000 Main Report, the Food and Agriculture Organization (FAO) of the United Nations (UN) defined forest degradation as “changes within the forest which negatively affect the structure or function of the stand or site, and thereby lower the capacity to supply products and/or services” (FAO 2001).

“Forest degradation” is used in this book to refer to forest land that has had the trees removed and is being used in a manner unlikely to be sustainable in the future or to forest land that has been disturbed and has since been abandoned. Examples are abandoned agricultural land, ex-mining land, poorly stock logged over forests and ex-shifting cultivation areas. Table 1 provides a summary of the extent of degradation of forest land in Southeast Asia. The figures of degraded forest areas have been derived from inventory records and some of the countries’ strategic rehabilitation plans as presented in the country chapters in this book (e.g. FAO 2005, FAO 2006, FMB 2004). These provide rough approximations of potential forest areas in need of forest rehabilitation in each country. These estimations serve to illustrate the magnitude of the forest rehabilitation task and by no means express accurate rehabilitation targets.

Table 1. ***Proportion of degraded forest area in relation to total forest area in Southeast Asia (in million ha)***

Country	Total forest area	Degraded forest area
Brunei Darussalam		0.04
Cambodia	18.1	10.50
Indonesia	105.0	59.00
Lao P.D.R.	16.1	6.30
Malaysia	32.9	10.30
Myanmar	67.7	10.60
Philippines	14.8	7.60
Singapore	0.002	-
Thailand	14.5	6.00
Vietnam	12.6	7.00
Total	**198.4**	**117.34**

According to these estimations, more than 100 million hectares or 59% of forest land in the region are understocked and unproductive and, thus in need of some form of rehabilitation. In addition, there is scope for increasing tree cover outside the “traditional” forest land, such as woodlots on community land or agroforestry systems and trees in urban landscapes. Considering the above, it is quite obvious that the scope for investing into tree farming be it as timber plantations, natural forests management or other forms of tree cover establishment and protection, exceeds the above-mentioned 117 million hectares.

The types of forest ecosystems in Southeast Asia affected by degradation include moist evergreen tropical forests, seasonal evergreen and deciduous forests, lowland forests that had previously been mined or used for agriculture and then abandoned, peat swamp forests as well as mangrove ecosystems. Factors leading to degradation and their underlying causes have been analysed and discussed extensively over the past fifteen years or so. These factors are presented in this book for each country and can be summarised as follows.

- Timber exploitation of Southeast Asian old growth forests which are of high standing timber volume has been very attractive to the wood industry and the economy of individual countries. Recognising that environmentally sound harvesting of trees does not lead to forest degradation, it can be stated that weak institutions, poor law enforcement, and socially and environmentally insensitive private sector companies coupled with market demand for timber resources have been the main underlying causes for forest degradation.

- Uncontrolled fire is another important factor leading to the degradation of forests. Many a times such fires occur as a result of careless management of burning in forest conversion projects and shifting cultivation, and conflicts over land.

- Insufficient investments in the past into forest regeneration after harvesting have been caused by the comparatively unattractive returns from timber management in comparison with other investment opportunities such as oil-palm, rubber, and cocoa plantations.

Although there has been significant revenue collected by governments through royalties and other taxes, these have not been adequately re-invested into rehabilitation programmes. This has been largely due to poor law enforcement and governmental policies favouring other economic sectors.

- Insecure land tenure on the part of local communities living within or near the forest is another cause. Unresolved ownership and access-right issues both among different communities and between communities and the government have led to uncontrolled activities within the forests resulting in further degradation following logging.

- Leadership pursuing longsighted social and environmental goals is a pre-requisite to ensure proper implementation of and investment into forest rehabilitation for sustainability. This commitment is largely lacking due to the usually short-term nature of political tenure of high-level policy-makers and political leaders.

The consequences of forest degradation are of social, economic and environmental nature. Such implications from the perspectives of different segments of society are clearly outlined in the chapter on the Philippines in this book. Forest degradation leads to a reduction in the livelihood of forest dwellers that traditionally depend on the forests for their daily requirements in terms of meat, fruits, nuts, medicines, and household implements, and for their spiritual well-being. The loss of well-stocked forest cover also results in short and long-term ecological damages that cause severe soil erosion, an increase in surface run-off, and polluted water resources. It is also well established that the micro-climate drastically changes with the removal of tree cover leading to drier soil conditions and frequent fires. Such loss of environmental services results in conditions that are harsh for rural communities.

Forest degradation also contributes to global climate change through increased carbon emissions from land conversions and reduced capacity of the vegetation to act as carbon sinks. With the increasing intensification of land use, there is the strong need to maintain and restore forest cover that is able to support diversity of both flora and fauna and at the same time perform the other ecological services.

There is also a growing need, both locally and globally, for timber and other forest products. With the decline in the production from natural forests due to sustainable management practices, there is now an urgent need to complement the production from natural forests through more intensive tree cultivation and promotion of natural regeneration. This is only possible through rehabilitation of existing degraded forests which in Southeast Asia has been estimated at more than 100 million hectares.

4. Response to the Forest Rehabilitation Needs

Over the past decade considerable efforts were made by governments, the private sector and non-governmental organisations to address the issue of forest rehabilitation. These efforts were met with considerable constraints related to legal, administrative and policy frameworks. There was little pressure on policy-makers to invest in forest rehabilitation because of abundantly available forest resources for exploitation by the industry and wide-spread ignorance of the public at large on the importance of forests and their role for sustainable development. Following the United Nations' Conference on Environment and Development in 1992 in Rio de Janeiro, there has been a drastic change in the awareness and commitment towards forests and its role for human well-being globally. Towards this end, the following responses have been observed:

- Public awareness for environmental conservation has increased with a large portion of society today concerned over environmental degradation;

- Legislation and policies have been enhanced or new ones put in place favouring conservation and sustainable forest management;

- Intensive global debates on environmental issues including forests have been initiated and are exemplified by policy processes such as the United Nations Forum on Forests, the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change.

This book therefore has attempted to draw upon the experiences gained in rehabilitation of degraded forest areas in Southeast Asia. It highlights the full range of rehabilitation activities under different ecosystems and also relating to the socio-economic environments prevailing within the region. Successes achieved *albeit* on a smaller scale nevertheless provide good guidance and lessons learned to build upon for future rehabilitation initiatives. This will help in scaling up of forest rehabilitation in the region, and – in the long-term – achieve a substantial increase in the area of healthy and productive forest ecosystems.

As demonstrated for the individual countries, very different approaches have been attempted in order to drive rehabilitation works depending on forest ecosystems, rehabilitation objectives and socio-economic settings. In order to present a clear-case scenario, some of the successful rehabilitation activities described in detail in the country chapters of this book serve as case studies to support the lessons learned and have been grouped under the following classification:

- Parks development and forest rehabilitation for environmental services;

- Natural forest rehabilitation;

- Forest plantation establishment; *and*

- Community-based forest resources development.

4.1 Parks Development and Forest Rehabilitation for Environmental Services

Park and conservation areas require full protection from any form of timber cutting in order to allow natural regeneration and succession, thus ensuring the conservation of biodiversity, maintaining and enhancing wildlife habitats, safeguarding environmental functions related to air water and soils, and providing opportunities for recreation and nature tourism.

Fully protected areas such as national parks and other conservation areas have been established throughout the region. Successful examples include established parks like the Taman Negara in Malaysia and the Botanical Gardens of Bogor and Singapore. More recently, other significant conservation areas have been created and include the Maliau Basin Conservation Area in Sabah, Malaysia, the Mt. Makiling Forest Reserve in the Philippines, and the Doi Intanon Park in Northern Thailand. Major lessons learned from these case studies include:

- For conservation to be successful a sufficiently large area needs to be delineated, fully protected and excluded from any destructive exploitation.

- There must be laws and regulations in place ensuring long-term protection of the area, best through arrangements that can only be changed by sufficiently large parliamentary majorities.

- Issues related to forest dwellers need to be resolved by integrating their lifestyle and livelihood needs into park management concepts and programmes.

- Stakeholders' participation in all aspects of program planning and implementation is imperative to successful conservation programs.

- Proper maintenance and the availability of appropriate access and facilities are indispensable for continued attraction of visitors to the parks.

- A regular public funding commitment has to be in place to complement income generated by the park.

4.2 Natural Forest Rehabilitation

This type of rehabilitation aims to re-establish a natural forest that is composed of indigenous tree species and continues to be stable and productive in terms of wood and non-wood forest products providing environmental services such as clean water and air, soil protection, and maintaining biodiversity at the same time. Due to the changes in land use pattern in Southeast Asia, natural forests in the future will largely be confined to the more undulating and hilly terrains. As a consequence, the protection function of natural forests becomes more prominent, although there may be scope for timber production on a much smaller scale compared to past timber extractions.

Typical examples of natural forest rehabilitation for protecting watersheds have successfully been implemented in Thailand (e.g. Watershed Headlands in Lo Pa Krai located North of Chiang Mai), and the Philippines (e.g. Pilar Watershed Rehabilitation and Development Project in Bohol). With regard to coastal area rehabilitation, a couple of successful examples include the Mangrove Management Programme in Matang, in Perak, Malaysia, and two mangrove rehabilitation initiatives in the Bali and Papua regions in Indonesia.
Lessons learned from watershed rehabilitation projects include the following:

- It is primarily the task of governments to initiate and execute rehabilitation of watershed areas. However, to ensure its long-term sustainability, local communities will have to be involved from the very beginning in order to create a strong sense of ownership of such projects. This will entail participatory land use planning with the communities, provision of employment, and establishment of species that are a source of timber and non-timber forest products, ensuring sustainable household income.

- Communities that are negatively affected by such rehabilitation projects should be adequately compensated and their livelihood needs integrated into the project as to ensure its long-term success.

- Another important aspect is to develop medium to long-term plans that provide guidance and financial support to the local communities for economic activities, such as proper harvesting of forest produce, handling, packaging, and marketing of products.

As for coastal rehabilitation, mangrove forests are very important for the protection of coast lines and as breeding ground for a wide variety of marine and freshwater flora and fauna. Until today, very little is understood about the functioning of these ecosystems. In the past, the mangrove forest area has significantly been reduced due to coastal development activities such as shrimp culture, fish rearing, tourism and urban development, and timber exploitation. The recent tsunami event in the Indian Ocean became an eye opener for the crucial role of mangrove forests in the protection of coastal lines. Those areas where mangroves were still pristine were spared the onslaught of the tidal waves, while areas where the mangroves had been removed or degraded suffered tremendous damage and destruction. Based on these experiences there is now renewed interest to rehabilitate such damaged coastal areas through building of robust mangrove belts.

Major lessons learned from mangrove rehabilitation projects in the region are summarised as follows:

- Mangroves are very important ecosystems and must be managed and conserved on a sustainable basis.

- Mangrove forests can be utilised in a sustainable way by using the technical approaches developed by pilot projects in Malaysia and Indonesia where they are planted as a plantation and managed systematically (e.g. Matang Forest Reserve, Perak, Malaysia).

- In the managed mangrove swamps species diversity of shrimps and crabs tend to increase, as demonstrated in the mangrove rehabilitation project in Papua, in Eastern Indonesia. Main beneficiaries of mangrove rehabilitation initiatives are not only charcoal producers but more importantly local fishermen depending on marketing of fish, shrimps and crabs.

- Community participation in mangrove ecosystem restoration and rehabilitation is imperative.

- It should be realised that bringing back mangrove forests is by far more expensive compared to other natural forest types, thus requiring long-term financial commitments by governments to ensure successful coastal protection.

4.3 Forest Plantation Establishment

It is anticipated that in the next ten years or so the Southeast Asian region will experience a shortage of timber for its down-stream processing industry. Current conservation strategies followed by most of the countries are reducing their annual harvest levels and this will severely reduce the quantity of timber from natural forests. To ensure that the installed processing capacity of the timber industry will continue to drive and to satisfy increasing local and global wood demand, additional timber has to be produced through high-yielding tree plantations. Although this scenario of a shortfall of timber has been afloat for a long time (i.e. 15 years), the actual timber plantation hectarage has not significantly increased. In order to address this situation, a wide range of plantation projects primarily operated by the private sector are being implemented throughout the region. These projects focus on the creation of tree plantations for the production of timber using various indigenous and exotic species.

The experiences made with the establishment and management of timber plantations in South-east Asia are demonstrated in this book using examples from Thailand, Indonesia, Vietnam, and Malaysia. Major lessons learned include the following:

- An enabling policy and legal environment is indispensable for the establishment and long-term management of tree plantations. Important aspects in this regard are, for example, secure land tenure and tax incentives.

- Institutional changes are needed to create a climate of facilitation so that new technologies and research findings can more easily be shared between forest research institutions and plantation investors.

- Establishment of new forest plantations need not take place on existing well-stocked natural forests. Existing degraded forests can be successfully rehabilitated using appropriate native and/or exotic species. There is also scope for mixed species plantations using both fast growing trees for mass fibre production as well as quality timber species for high end products.

- Improved planting material should be used to ensure uniform growth and maximum yield. The lack of appropriate silvicultural management practices in the past has resulted in low quality of the harvested timber and as a consequence low prices were obtained in the market. Investments into pruning and thinning operations are essential to ensure optimal growth and good timber quality. These operations need to be systematically implemented based on proper forest management plans.

- The timber processing industry must be involved from the early stages when new plantation species are introduced. This is to ensure that these species undergo appropriate testing for their working properties as well as provide the samples for adequate marketing activities.

- The local communities living in the vicinity of the project area need to derive significant benefits from the various activities of managing the plantation. Such activities include income from planting operations, silviculture, fire prevention and control, and harvesting.

4.4 *Community-Based Forest Resources Development*

Community-based forest and tree resources development aims to generate income and other tangible and intangible benefits directly for local communities on a sustainable basis. In order to make this happen, the focus of investing in new tree crops need to be on both, subsistence values as well as marketable products and services.

There has been a diverse array of projects implemented in the region to identify and test best approaches workable under specific local conditions. Some of the more prominent success stories can be found in Lao.P.D.R (i.e. FOMACOP on natural forests and FORCAP on plantations and agroforestry), in the Philippines (i.e. ELCADEFE CBFM Planters Association on forest and agroforestry plantations), Vietnam (Reforestation with Dendrocalamus barbatus), and Indonesia (i.e. AKECOP Project on Gunung Walat Education Forest). In all these projects community-based resource development strategies have been adopted to ensure sustainability. Major lessons learned have been derived from the various levels of success achieved in these projects and include the following:

- Formation of effectively functioning local organizations is essential in community-based rehabilitation and management. In areas where an effective local organization is not in place, developments of such organizational arrangements need to be made before rehabilitation activities commence.

- Equitable benefit sharing among community members is a key to project sustainability.

- Enabling legal environment ensuring secure land tenure and access rights to forest resources is an essential pre-requisite for success.

- Realistic market opportunities for the products from tree resources should be created. A certain level of guarantee for the purchase of products must be put in place by the industry so that rural communities are encouraged to establish and maintain new trees.

- Funding agencies should build in after-care mechanisms following the expiry of their project so as to ensure sustainability.

- All in all, community-based forest resources development provides an excellent opportunity, not only to fight rural poverty but also to rehabilitate and build diversified forested landscapes integrating production, protection and environmental conservation.

Taking cognisance of the past and ongoing rehabilitation initiatives in the region and comparing the achievements to date with the magnitude of the area in need of rehabilitation, it can easily be seen that a lot more efforts and investments are required to establish sufficient tree cover in the region. If this is realised, the issues of poverty and environmental degradation will be sufficiently addressed in line with the Millennium Development Goals on the eradication of extreme poverty and hunger (Goal 1) and environmental sustainability (Goal 7).

5. Research and Educational Capacity for Forest Rehabilitation

In the early 20th century, few forestry research and education institutions were established to cater for the information needs and staff development of forestry departments (e.g. in Malaysia and Thailand). Some countries in the region like Laos did not have a professional forestry education programme and thus had to send their staff for training abroad. The focus of research and education was on traditional forestry subjects related to natural sciences (e.g. botany, entomology, soil science etc.) and forest management for timber (e.g. silviculture, mensuration and inventory, harvesting, and wood sciences). This did not change until the United Nations Conference on Environment and Development in Rio de Janeiro in 1992 which created global awareness of the importance of forestry in relation to the environment. Since then, a significant change in forestry research and education took place. On the one hand, many new training institutions and programmes have been established. Examples are the schools of forestry and environmental sciences created at two new universities in Sarawak and Sabah, Malaysia, and the Forestry Research Centre in Laos. On the other hand, forestry education has significantly broadened its scope with emphasis in syllabus development on issues related to conservation, reforestation, rehabilitation, agroforestry, community-based forest management, environmental services and poverty reduction among the rural poor and forest dwellers.

A significant impetus to the evolution of forestry research and education in the region has also been provided by international cooperation initiatives. Since the late 1980s numerous bi- and multi-lateral donor projects supported local universities and research institutions. Examples of such initiatives are the FAO's Forestry Research Support Programme for Asia Pacific (FORSPA); the Regional Community Forestry Training Centre (RECOFTC); the German support to the Forest Research Malaysia (FRIM), and more recently the ASEAN-Korea Environmental Cooperation Project (AKECOP).

With regard to the national capacity for research and education in forest rehabilitation and restoration the assessments in the countries show that the institutions are in place and a lot of work has been undertaken to change the focus of training and research has been undertaken. Considering the main constraints for large-scale forest rehabilitation and subsequent sustainable management in the region which are mostly related to social, institutional and economic issues, further amends will need to be made in forestry education. Besides good forestry including forest rehabilitation, forestry graduates need to contribute to broader rural development issues such as food security, natural resources management and poverty reduction. As outlined by the FAO Education Group and other experts, obvious areas that are required in modern forestry curricula include (Gasperini, 2001, Bourgeois, 2001):

- Public sector and community joint management of forest resources;
- Forestry and its role in biodiversity conservation;
- Forests as recreation sites including eco-tourism;
- Partnerships with the private sector for research, management, and timber processing (including business management and legal implications);
- Fundamentals of working as a team member and building relationships;
- Forests as carbon sinks and international trade in carbon sink credits;
- Civil society information delivery relating to forests and forestry issues;
- Communication skills for public presentations and technology transfer;
- Forest policy formulation and implementation (science-policy interface);
- Forestry education and training for non-traditional target groups; *and*
- Inter-relationships with other sectors such as agriculture, natural resources, management, education, tourism, infrastructure and trade.

There is also the need to incorporate international forestry issues into higher forestry education. The rationale for this is an increasing influence of global forestry issues that are driven by governments, business (i.e. international investors in forest rehabilitation), and pressure groups on national and local policy and management decisions. Forestry professionals therefore require a sound background in international forest and environmental policy processes and their implications for forests at the national and local levels (El-Lakany, 2001).

6. Recommendations and Future Actions

Over the past several decades a wealth of experience with forest rehabilitation has been accumulated in Southeast Asia and is documented in this book. The lessons learned from the many reforestation and rehabilitation projects allow the formulation of recommendations for future actions. These actions aim at further enhancing the approaches to forest rehabilitation so that investments into trees and forests achieve an even greater impact on the landscape, thus providing enhanced environmental services and economic benefits for human wellbeing of present and future generations.

6.1 Socio-Economic Issues

It cannot be over-emphasised that the key to successful establishment of forest resources in Southeast Asia and their sustainable management is the resolution of prevailing socio-economic constraints. Social concerns need to be addressed before actual rehabilitation operations can commence. Major issues to be resolved include:

- Ensuring that local communities have secure tenure over land and/or access rights to the forest resources;
- Establishing or enhancing community organisation, so that the management of forest resources can be fully integrated into the local economy;
- Supporting the development of local markets through market information systems and promotion of products;
- Emphasising equitable sharing of benefits from forest resource exploitation among all community groups;
- Mobilising long-term investments not only for the establishment of forest resources but also their management during the first rotation until returns can be obtained.

One of the options to address conflicting social and economic interests among forest stakeholders is through the so called forest landscape restoration approach. This approach has been defined by the Global Partnership on Forest Landscape Restoration as “bringing people together to identify and put in place a mix of land use practices that will help restore the functions of forests across a whole landscape, such as a water catchment. The aim of this approach is to benefit both communities and the natural world” (Global Partnership on FLR). Based on the experience of the many rehabilitation initiatives in Southeast Asia as outlined in this book, it is recommended that investors and funding agencies of forest rehabilitation should work with respective governments and civil society organisations towards reconciling their objectives with the overall land use strategy negotiated between stakeholders at the landscape level. If such a strategy does not yet exist, the project needs to initiate a multi-stakeholder decision-making process to at least obtain some indication whether or not the specific project focus is in agreement with the interests of key stakeholders in the area.

6.2 Enabling Environment

There have been many lessons learned from the rehabilitation projects on how to shape the enabling environment to further support and speed up forest rehabilitation efforts in Southeast Asia. An important aspect towards this end is to promote further decentralisation of forest management providing communities with opportunities to establish forest resources for their own benefits and enabling local governments to be more effectively involved in sustainable forest management. Likewise, policies need to be in place to enhance markets and market access for products from rehabilitation initiatives, thus allowing to cover the costs of long-term forest management and to generate adequate income for local communities. These issues need to be addressed in national forest programme processes involving governments, private sector companies, community representatives, and non-governmental organisations.

6.3 Implementation Issues

As has been demonstrated in the many case studies on forest rehabilitation in the region, actual implementation in terms of planning, project management and field operations for tree establishment and maintenance has been faced with only minor constraints. A wide array of successful technical approaches such as site preparation, species selection and procurement of planting stock, tree establishment, and forest protection exist. Many of these approaches require adaptation to fit into the local context in terms of cultural setting and economic development.

6.4 Capacities for Forest Rehabilitation

As outlined in the country chapters in this book, forestry education and research has undergone significant changes in recent years. Besides the need to broadening the scope of the subjects to include social, cultural and economic dimensions of managing forests, the special issue of planning, managing and evaluating forest rehabilitation projects needs to play a more prominent role in education programmes. Because restoring forest ecosystems or building new forests is an integral component of forestry education, other broader organisational and institutional aspects need to be addressed in future when revising forestry education. Some of the more important ones include:

- Given the diversity of knowledge and skills required in dealing with forests, forestry schools should make efforts to attract various types of students, not just those who love being in forests.

- Although forestry education programmes need to be enriched with knowledge of other specialised disciplines, sustainable forest management still needs to be taught in forestry schools, because of the need to deal with social, economic, and biological aspects in an integrated manner with focus of managing forest and tree resources. Some universities offer courses which are jointly designed and taught by several scientists from different backgrounds.

- Involvement of practitioners in lecturing is also a good way of incorporating field experiences into academic education and bringing the world of forestry to the classrooms.

- Given the constraints of declining financial resources faced by many forestry schools, national, regional and international cooperation needs to be strengthened.

- As a new development, an International Partnership on Forestry Education has been initiated. The partnership aims at promoting forestry education worldwide so that it will be responsive to locally and globally agreed needs and contextualized in locally relevant social, economic and ecological settings. It is expected that the partnership will help to raise the profile of forestry education, facilitate sharing of knowledge and experiences among forestry educators and strengthen the linkage between forestry education and society (International Partnership for Forestry Education, 2003).

6.5 Reaching the Rehabilitation Targets

To ensure the success of forest rehabilitation, it is vital that a plan of action highlighting the key activities in a strategic plan and the sequencing of these activities in the proper time frame be put in place in each country. This national plan should also indicate the responsible agencies for initiating action or assigning tasks to be accomplished to meet the objectives within the stipulated duration of time. This will assure coordination of all the key activities such that the implementation process will be orderly. Each strategic plan should include the following key activities:

- Identify the lead organisation to provide the LEADERSHIP ROLE in each country;

- Introduce a more proactive role of the National Forestry Council or National Forest Programme in further enhancing the national forest policy towards rehabilitation of degraded areas;

- Undertake necessary legal amendments or draft new legislation wherever necessary;

- Undertake the regulatory reforms and institutional changes to provide an enabling environment;

- Adopt the privatisation approach for forest rehabilitation processes;

- Obtain Government funds to jump-start the rehabilitation activities;

- Further explore international sources of funding for environmental protection, rehabilitation and forest plantation establishment through e.g. Clean Development Mechanism (CDM) and/ Global Environment Facility (GEF);

- Raise funding through the capital market and also from private sector investment;

- Create a timber futures market similar to that for crops like cocoa, oil palm or rubber;

- Coordinate the land development agencies' role in plantation management; *and*

- Combine private sector plantation management with small-holder out-grower schemes in the same area to boost income of local communities.

In closing, it is most vital that the Government of each country has a major role to play in forest rehabilitation by facilitating these activities and jointly working with the private sector and the local communities to ensure success in making their Nation Green and jointly as a whole Making Asia Green.

REFERENCES

El-Lakany, H.M. 2001. Looking outward: incorporating international forestry in higher forestry education and research. Paper presented at the Expert Consultation on Forestry Education, Rabat, 17-19 October 2001. http://www.fao.org/docrep/007/y5382e/y5382e16.htm

Food and Agriculture Organization (FAO), 2007. State of the World's Forests. http://www.fao.org/docrep/009/a0773e/a0773e00.htm

Food and Agriculture Organization (FAO), 2006. Global Forest Resources Assessment 2005. FAO, Forestry Paper No. 147. Rome.

Food and Agriculture Organization (FAO), 2005. State of the World's Forest. FAO, Rome.

Food and Agriculture Organization (FAO), 2001. Global forest resource assessment. Main report. 2000. FAO Forestry Paper 140. Rome.

Forest Management Bureau (FMB). 2004. Philippine forestry statistics. Forest Management Bureau, Department of Environment and Natural Resources, Quezon City, Philippines.

Gasperini, L., 2001. Forestry Education for the Future: Expanding the Scope. Paper presented at the Expert Consultation on Forestry Education, Rabat, 17-19 October 2001. http://www.fao.org/DOCREP/MEETING/007/Y2993E/y2993e18.htm

Global Partnership on Forest Landscape Restoration http://www.unep-wcmc.org/forest/restoration/globalpartnership/mean.htm

International Partnership for Forestry Education http://www.forestry.ubc.ca/ipfe/briefing.html

RFD, 2003. Forestry Statistics of Thailand. Planning Division. Royal Forest Department. Bangkok. Thailand

Forest Rehabilitation in Brunei Darussalam

by

Mahmud Yussof[1]

PART A
STATUS OF LAND USE AND FOREST (AND LAND) DEGRADATION

1. General Introduction

Brunei Darussalam is situated almost in the center of the ASEAN region, covering a total land area of 5765 sq km. Being one of the countries within the equatorial zone, the climate is rather uniform throughout the year characterized by high temperature, humidity and heavy rainfall.
According to estimations made in 2004, the population of the country amounts to 357,800 persons, Malay being the major indigenous community. Oil and gas are the major sources of the economy while other non-oil and -gas sectors are still considered growing sectors in Brunei Darussalam. In an effort to diversify the national economy, the forestry sector is gaining in importance.

Due to its constant high relative humidity and high temperature, the tropical rain forests of the country have developed on fertile soils on bedrock of tertiary age which consists of sandstone, shale and clays. The forest is rich in ecological diversity and has a varied topography ranging from hilly lowlands below 91 meters in the Western part of the country to rugged mountain ter-rains rising up to 1,850 meters above sea level. The coast has a wide, tidal and swampy plain where man-grove forests can be found.

2. Forest Resource Base

According to the latest estimation of forest cover of Brunei Darussalam with reference to FRA05, FAO and Forestry Department Statistic, 2004 (not published) the remaining total forest cover since then is 78%. A detailed statistics of forest cover is given in Table 1.

Table 1. ***Forest cover in Brunei Darussalam***

FRA 2005 Categories	Area (1000 hectares)		
	1990	**2000**	**2005**
Forest	313	288	278
Other wooded land	142	155	160
Other land	72	84	89
Inland water bodies	50	50	50
TOTAL	**577**	**577**	**577**

Source: Global Forest Resources Assessment 2005[2]

[1] Silviculturist, Acting Deputy Director, Forestry Department, Ministry of Industry and Primary Resources, Brunei Darussalam

[2] FAO Forestry Paper 147 (http://www.fao.org/docrep/008/a0400e/a0400e00.htm)

Table 2. Forest functions in Brunei Darussalam

Categories/designated Function	Primary Function (1000 Ha)		
	1990	***2000***	***2005***
Forest			
Production	215	184	174
Protection	19	19	19
Conservation	75	81	81
Social Service	4	4	4
Total	**313**	**288**	**278**

Source: Global Forest Resources Assessment 2005[2]

As presented in Table 1, in the period between 1990 and 2005 there has only been an insignificant change in the forest cover in Brunei Darussalam, from 78% forest cover in 1990 to 76% in 2005. This is due to the fact that logging activities in the production forests and opening of forest areas for development projects on state-land are strictly controlled by the respective authorities. Since 1990, the national forest resources were categorized into four primary functions, as shown in Table 2. These represent the major management objectives pursued in each forest category.

3. Status and Causes of Degradation

Forest degradation in Brunei Darussalam is very often associated with ecological degradation which is also regarded as waste land. Once the sites undergo this condition, the sites very often are overgrown with grasses and shrubs. To some extent, the soils remain exposed without vegetation cover at all, and as a result the area experiences further ecological deterioration leading to a decrease in soil fertility.

Most of the affected areas are usually ex-sand mining and ex-stone quarry sites where the vegetation cover was almost or totally cleared during the mining activity, and ex-burnt sites due to frequent arson bushfires. Others such as naturally eroded areas especially along the coastal and steep and overexploited areas can be associated with development projects along major roads or construction sites especially on abandoned sites.

In addition, the frequent occurrence of bushfires always causes land degradation and the chances of restoring the area artificially and naturally are very low due to arson bushfires. Except in the case of sites planted with or invaded by *Acacia Mangium*, the wild fires stimulate the dormancy of the seeds and thus, the growth of *Acacia Mangium* seedlings would carpet the site a few weeks after the occurrence of fires. Overall, it is estimated that to date about 40,000 hectares of forest land are heavily degraded and require some form of rehabilitation.

[2] FAO Forestry Paper 147 (http://www.fao.org/docrep/008/a0400e/a0400e00.htm)

PART B
IMPLEMENTATION OF FOREST RESTORATION AND REHABILITATION

1. National Policy

The national policy on rehabilitation or restoration of degraded wasteland areas is laid down in the Forest National Policy of 1984, under specific policy statements on environmental forestry reading as follows:

"To rehabilitate wastelands in the country through re-vegetation for the protection of the site from further deterioration, and for the restoration of ecological stability"

In 1982, on the other hand, a decree to rehabilitate the logged-over forest areas by licensed loggers was introduced by the Government Secretary through two memos with reference number SUK O 46/82, dated 30th August 1982 and 25th September 1982. The loggers shall require the rehabilitation of the logged-over designated production forest areas once the logging activities have been completed. Only after the rehabilitation work has been completed new logging concessions will be granted.

2. Status of Rehabilitation Activities

Public awareness on the importance of keeping the forests intact has increased in accordance with the global environmental agenda. That is why the response from the public in Brunei Darussalam to rehabilitation activities and any related activities scheduled annually in conjunction with the World Forestry Day is quite impressive. Other large-scale rehabilitation activities have been incorporated into the 5-year National Development Plan first initiated in 1985. To date, 451 hectares of degraded wasteland area throughout the country have been restored by planting with fast-growing timber tree species, such as *Acacia Mangium*, *Pinus Caribea*, *Aracauria pines* and local fruit trees. This small figure suggests that land degradation is not a major problem in Brunei Darussalam.

On the other hand, restoration of logged-over designated production forests was initiated and funded by licensed loggers in the 1980s. Recently, restoration activities were incorporated into the projects funded under the National Development Plan, starting with the 7th National Development Plan. The restoration aims not only to increase the production capacity of the designated production forests but to speed up the ecological recovery process as to minimize the negative impact of logging on the rich floral and faunal diversity. To date, around 5,000 hectares have been planted with indigenous commercial species such as Drayobalanops and Shorea species.

The rehabilitation of the logged-over forests has been found successful as demonstrated by the previously degraded areas in the Berakas Forest Reserve. Other rehabilitation initiatives such as those in the Anduki Forest Reserve and Badas Forest Reserve in the Belait District are less successful because of frequent disturbance by arson fires.

3. Constraints

The success of large-scale rehabilitation projects under the 5-year National Development Plan very much depends on the capability of the contractors, since most of the projects are funded by the National Development Plan. On the other hand, the frequent arson bushfires during the dry spell is also the main limiting factor, as most of the sites are prone to arson fires due to easy accessibility and the presence of forest fuel during dry conditions. Unlike in the forest reserve area, rehabilitated areas of public land are left unmanaged by the Forestry Department, as soon as the rehabilitation work is completed due to the land status.

The communal development of projects that continue to take within and along the periphery of forest reserve area is unavoidable. Unnecessary opening up of forests may bring along soil problems. Vegetation loss leaves the land susceptible to erosion and landslides. The movement of heavy machinery during ground work causes soil compaction, as a result rehabilitation work is time consuming and difficult.

PART C
FUTURE ACTIONS FOR ENHANCING RESTORATION/REHABILITATION

1. Future Rehabilitation Strategy

1.1 National Development Plan

Despite the growing need to diversify the economy of the country, environment protection associated with the loss of forest cover is addressed in one of the main national forest programmes in Brunei Darussalam. The protection of the environment associated with the loss of forest cover in Brunei Darussalam is one of the main concerns of the national forest programme. The programme is part of the 9th National Development Plan. Given its importance, the Forestry Department will continue to monitor all future activities under this National Development Plan.

1.2 Public Involvement

The Forestry Department will continue to involve the general public in the rehabilitation activities in its strategic effort to further enhance awareness. All awareness activities involving the general public are scheduled under the yearly programme of the World Forestry Day which includes a mass planting ceremony, a forest excursion and nature camps exclusively for students. The Princess Rashidah Young Nature Scientist Award (PRYNSA) is an annual prestige award for lower secondary schools and designed to inculcate love for forests and nature to youngsters. It is jointly organized by the Forestry Department and Brunei Shell Petroleum under the patronage of Her Royal Highness Princess Hajah Rashidah.

Furthermore, the licensed loggers throughout the country continue to fund the rehabilitation of logged-over forests on top of the funds allocated under the National Development Plan.

2. Research and Development

At one time under the regional collaboration led by the Philippines in 1990s, Brunei Darussalam was one of the ASEAN member countries involved in the preparation of a manual for forest rehabilitation. Till now, the manual has been applied to guide forest rehabilitation and restoration projects in the country. Since the project was completed the R & D activities in this area were discontinued. However, in view of the current development of the forestry sector emphasizing on the need to protect and maintain the environmental stability and forest ecology, Brunei Darussalam is looking forward to intensify its collaboration with relevant international research institutions.

3. Conclusion

Brunei Darussalam strives for environmental stability to support its progressive development. Although the country has been moving fast towards economic diversification, the protection of its forest cover to alleviate the land and forest degradation is an important component of the National Forest Programme. To date, although this problem is evidently less significant, the Strategic Plan to continually monitor this issue has been formulated through various approaches involving all stakeholders concerned.

Rehabilitation of Degraded Forests in Indonesia

by

Suhardi, Eny Faridah, Handojo HN

PART A
STATUS OF LAND USE AND FOREST (AND LAND) DEGRADATION

1. Forest Land Use and Land Use Change

Forests in Indonesia are sub-divided into three groups based on their function, namely (a) production forest, (b) conservation forest, and (c) protective forest. Seventy-five percent of Indonesia's total land area of 191 million hectares is classified as forest land, and the tropical rain forest component make up the vast majority of forest cover. This is particularly so in Kalimantan, Sumatra, and Irian Jaya. Under Indonesian law a forest is described as an eco-system which has biodiversity dominated by trees.

- The production forest is used for the production of timber and non-wood forest produce.
- The protection forest is an area earmarked for watershed management, erosion control as well as the conservation of wildlife.
- Conservation forests are areas which have been earmarked specifically for the protection of ecosystems including their biological diversity.

During the mid-1980s the estimated rate of deforestation varied from 700,000 to more than 1 million hectares per year. According to a critical evaluation of the Indonesian forestry sector, it was found that deforestation could not be blamed on a single major factor but was instead due to a complicated interplay among commercial logging, transmigration program activities and shifting cultivation that is still being practiced largely in Kalimantan. The most immediate threat to Indonesia's forests was the government promotion of domestic timber processing, while the transmigration programme is considered a long-term threat to the forests.

According to a report by FAO, the loss of forest land in Indonesia from 1982- 1990 showed that over the eight year period Java lost about 90.5 % of its forest cover, while the figures for Sumatra are 59 %, for Nusa Tenggara 74.4 %; Kalimantan 38.8 %, Sulawesi 49.6 % resulting in the Indonesia average forest loss of 54.4 % excluding Maluku and Papua (Soemarwoto, 2001).

The interest in planting oilpalm has become rampant and most of the Districts showed interest in converting forest land to oilpalm plantations. Rubber plantations in some areas have also become very important but oilpalm seems to be the most preferred species throughout the state.

Mining of coal, gold and other precious metals also posed a great risk to the protected forest areas. President Megawati for example released a President’s Decree to allow the operation of 13 companies in protected forest areas. At the same time another 100 companies submitted their applications for permission to carry out mining activities also in the protected forest areas.

According to Simon (2004) in Indonesia landuse can be sub-divided into seven groups based on eco-regions and some socio-economic parameters, as shown in Table 1:

Table 1. ***Land use characteristics in Indonesia by region***

Sumatra	
Total land area	482.393 km^2
Main natural vegetation types	Extensive lowland dipterocarp forests, peat swamps and mangrove forests in the East part; hill forests in the West.
Population	42 140 000 or about 85 persons per km^2
Dominant land use	80 % of the population are farmers practicing shifting cultivation, and managing rubber and oilpalm plantations.
Forest area	Total forest is 23 million or 47.1 % of total land area.
Forest management	Sustainable forest management not yet introduced on a large-scale; large tracts of land are unproductive grasslands and degraded secondary forests, particularly in South Sumatra and Lampung.

Java	
Total land area	127.499 km^2
Main natural soil or vegetation types	Mostly fertile soils and in some areas with volcanic parent material
Population	910 people per km^2
Dominant land use	65 % of the population are farmers with only 0.2 ha agricultural land per family; traditional home gardens developed over time represent an important element in integrated farming systems.
Forest area	3 million ha or 23 % of total land area, mostly protection forests in the highlands; about 1 million ha of teak plantations
Forest management	High social pressure on forests due to increasing population density

Kalimantan	
Total land area	547.891 km^2
Main natural soil or vegetation types	The soils are podzolic and not fertile in wet conditions
Population	Population about 11.5 million and about 20 people per km^2
Dominant land use	Forestry and increasingly oilpalm, rubber and timber plantations
Forest area	37 million ha or 66,9 % of the total land area dominated by dipterocarp forests
Forest management	Forest conditions rapidly deteriorate due to fire and land clearing; sustainable forest management not yet introduced on a large-scale; large tracts of land are unproductive grasslands and degraded secondary forests.

Sulawesi	
Total land area	191.800 km^2
Main natural soil or vegetation types	The soils are podzolic and not fertile in wet conditions.
Population	Population about 15 million and about 72 people per km^2.
Dominant land use	Farming area mostly rice cultivation in the South; however, several of those areas are hilly.
Forest area	Forest area about 12 million ha (62.7% of total land area). However, 8 million ha converted to other use and the rest also occupied and planted by cocoa and other crops.
Forest management	Ecosystem based forest management not yet defined.

Nusa Tenggara	
Total land area	87.744 km^2
Main natural soil or vegetation types	Climate influenced by monsoon and partly semi-arid. Only West Lombok considered as fertile area.
Population	Population about 11 million and about 125 people per km^2.
Dominant land use	Pasture management and agroforestry systems well developed.
Forest area	Forest area is about 3,4 million ha or 38,3 % of total land area.
Forest management	Ecosystem based forest management not yet defined.

Maluku	
Total land area	77.871 km^2
Main natural soil or vegetation types	
Population	Population about 2 million and about 26 people per $km^{2.}$
Dominant land use	
Forest area	Forest area is about 5 million ha or 62,8 % of total land area
Forest management	Ecosystem based forest management not yet defined.

Papua	
Total land area	421.981 km^2
Main natural soil or vegetation types	Mostly dominated by hilly land, swampy lowlands and also mangroves, especially in the South and West.
Population	Population about 2,2 million and only about 6 people per km^2
Dominant land use	Several large-scale mining projects for gold, oil and other minerals are also found in this area
Forest area	Total forest area about 28,8 million ha or 68,3 % of total land area.
Forest management	Ecosystem based forest management not yet defined.

2. Status of Forest (and Land) Degradation

Most of the degraded forests are still considered as forest production areas. However, it has been found that some of these areas have already been occupied legally or illegally and converted to gardens, oilpalm and rubber plantations. Cocoa is also planted in some protection areas, particularly in Southeast Sulawesi. In Lampung, South Sumatra, cocoa and coffee are produced in the forest production and protection areas. The people used these lands illegally and so far the government has been reluctant to remove them from these areas. This is partly due to the opportunities for income generation and development and at the same time to overcome socio-economic constraints.

Generally, after illegal logging and forest fires there is a significant rate of conversion of the production forest area into other land uses. The production forest area in 1983 was about 64.39 million ha while it has been reduced to about 58.25 million ha until 1999. According to the 1945 constitution, the government has the ownership rights to all natural forests in the country. However, this ownership could be temporarily reassigned in the form of timber concessions, known as Forest Exploitation Rights (Hak Pengusahaan Hutan), or permanently transferred, as in the case of land titles granted to transmigration families. The average concession size was 98,000 hectares, and the usual duration was twenty years. In the 1970s concessionaires were slowly phased out to conserve the forest resources foreign timber, and by 1980, of more than 500 active forest concessions, only 9 were operated by foreign firms.
In 1990, there were 564 forest concession holders with a total area of 59.62 million ha. By 1997 the number of forest concession holders decreased to only 450 with a total area of 52.8 million ha. The production was 23 million m^3/year or 0.45 m^3/ha/year. In 2006, there are only 289 forest concession holders covering an area of 28.27 million ha with a total productivity of about 8.2 million m^3/year or 0.29 m^3/ha/year.

Log production peaked at 25 million cubic meters in 1979, of which about 18 million cubic meters were exported as unprocessed logs. Restrictions on unprocessed exports in the early 1980s contributed to a decline in total log production, which fell to 13 million tons in 1982. However, increasing demand for sawn timber and plywood began to boost production again, bringing it up to 26 million cubic meters by 1987. In that year, about half of the total log production was exported in the form of sawn timber and plywood, the rest going into domestic consumption. Log production again dropped at the end of the 1980s, falling to 20 million cubic meters by 1989. The government attributed this decline to policies designed to ***preserve the natural forest***. One such policy was the increase in a levy imposed on loggers for reforestation, which was raised from USD 4 to USD 7 for every cubic meter of cut log.
Forest degradation data in Indonesia varies depending on the source from where the data is procured. The government reported that forest degradation was about 1.8 million ha per year from 1997- 2000 while Forest Watch reported that this degradation amounted to about 4.1 million ha from 2001- 2003. The recent data of forest degradation released by the government (2005) reported about 2.8 million ha per year.

3. Causes of Forest (and Land) Degradation

Each day, some 600 hectares of Indonesia's forests are cleared by logging alone. According to data from the World Resources Institute (WRI), only 28% or 40 million ha of Indonesia's forests preserve was left in 1997. Longgena told visitors at the 2001 Environment Expo, "If the government doesn't impose the moratorium now, I would call it a national suicide." The forum proposed a gradual moratorium over a two to three year period, with the first phase being a stop in the

issuance of new licenses as well as the extension of existing logging licenses. A ban on log exports should also be imposed. The next step would be to terminate forest concessions of troubled companies, especially companies riddled with debts (Anonymous, 2001).

Other main causes of forest degradation are forest fire. Forest fire in fact causes great problems not only in several areas in Indonesia like West Kalimantan, East Kalimantan, Central Kalimantan, South Sumatra, Jambi, and Pekanbaru where most of the land clearing for oilpalm shifting cultivation using fire is practiced .The haze created by these fires concerns also Malaysia, Singapore the Phillipines causing great problems to human health and the safety of the transportation sector.

Gonner (1999) reported that the forest and land fires in 1997/1998 affected more than 5.2 million ha in Kalimantan alone. Fires are likely to occur again due to the large amount of remaining debris in the forest.

The other causes of forest degradation are coal mining which is practiced extensively in the country due to the need for income of both the local and national governments. Despite the fact that rehabilitation costs of ex-mining areas are not very high, efforts to rehabilitate such areas is minimal.

Illegal logging is also another important cause of forest degradation. About 2.9 million ha are logged illegally every year. The domestic and export requirements for timber are much higher than the wood supply. This has resulted in heavy degradation of forests. Wood consumption for the industry in Indonesia is about 72 million m^3/year. The volume supplied accounts for 30 million m^3/year of sawn timber, 18 million m^3/year of plywood and 24 million m^3/year as pulp and paper.

Sustained yield level of wood production is only about 17 million to 25 million m^3/year. The Government in 2002 decided to limit production of timber to 6 million m^3/year, but then on 2004 this was increased to 20 million m^3/year. Thus, there is a shortfall of wood supply of about 47 to 55 million m^3/year.

4. Impact of Forest Degradation

Owing to degradation several areas lost their biodiversity and water resources became scarce. This resulted in loss of food production in some areas. In 2002, about 46,906 citizens in Samarinda were living below the poverty level and this number increased to 48,137 in 2004 or about 10% the population in Samarinda. In East Kalimantan out of the 2.7 million people, 328,597 were found to be living below the poverty line. The poor population in Kutai Kertanegara increased from 69,100 in 2002 to 75,404 in 2003 of a total population of 480,499 (Jakarta Post June 18, 2005). In the past East Kalimantan was the biggest dipterocarp timber producer and the richest forest state in the country. Now this state has became degraded and in recent years problems related to the environment health and poverty have significantly increased.
There are also other examples in several regions where forest degradation has caused damage to the water resources. One example is the Manisrenggo Klaten District known for its high rice production. The success of this production was due to the weekly supply of irrigation water. Today this area is irrigated only once every month.
In the Gunung Kidul area (Kompas, 2006) the 282 sources of water have now been reduced to 217. Likewise, in NTB in the East of Indonesia only 223 sources of water are available compared to 600 water resources available in the past.

The impact of forest degradation has also significantly affected the wood supply to the local wood industries all over Indonesia.

PART B
IMPLEMENTATION OF FOREST RESTORATION/REHABILITATION

1. History of Restoration/Rehabilitation

According to Simon (2004) timber extraction especially in Java started as early as the 8th century applying several methods i.e. conventional method by the Kingdom of Java until 1650, and the modern method by the East Indian Company (VOC) from 1650 to 1800, and by the Government of "Netherlands Indie", from 1808 to 1849. This was followed by the establishment and management of timber plantations based on plans by the Mollier team from 1849 to 1890 and its implementation by Djatibedrijfs from 1890 to 1942. In that period a new forest law for Java and Madura was created replacing the existing one of 1865. The period between1942-50 was rather chaotic without a systematic approach to forest exploitation. However, the situation improved through the work of the Forestry Department in the period 1950-1963. The management of forests was then taken over by PN Perhutani (1963-1972), and Perum Perhutani from 1972 until now. Simon (2004) also states that due to social problems after 1998, the problem of illegal logging became a very significant phenolmenon. The social forestry approach has been tested from 1974-1980, followed by the methods of PMDH and Perhutanan Sosial between 1976 and 2000, and community based forest management from 2000 until today (i.e.PHJO and PHBM Pengelolaan Hutan Bersama Masyarakat).

In the forest areas outside Java significant exploitation began in 1967 after the Forestry Act No. 5 had been established. Uncontrolled timber extraction and uncertain legal circumstances have caused Indonesian forest degradation within only 20 years with an estimated total area of 64 million ha left severely damaged. This is much greater than the damages caused by the VOC on Java's forests leading to a total area of 650.000 ha of degraded forests within 200 years (Simon, 2004).

After large-scale timber extraction especially outside Java from 1970 to 1980 the Indonesian Government started to reduce timber exploitation and launched the Presidential Regulation No. 35 1980 declaring that forest concession holders have to pay into a reforestation fund (DJR Dana Jaminan Reboisasi), a fee for each cubic meter timber extracted. The intention was that if the forest concession company replants or regenerates the over-logged forest area, the DJR will be paid back to the respective forest concession company. Later in 1989, a new Presidential Regulation No 31 was launched establishing a reforestation fund (DR: Dana Reboisasi). Under this regulation the forest concession company must pay the DR for each cubic meter timber extracted and is also responsible for the rehabilitation of the logged forest area, while the Government is responsible for the rehabilitation of areas outside the forest concession company such as industrial tree plantations (HTI: Hutan Tanaman Industri) through a loan without interest and a governmental fund sharing arrangement. The DR funds are to be deposited with the Ministry of Forestry. The use of the funds for any purpose needs to be coordinated by the Ministry of Forestry and the Ministry of Finance and requires approval by the President.

In 2001 the government initiated a program called "Gerakan Penanaman Pohon", which encourages individuals or groups of people to voluntary plant trees, for example before a marriage.

Under the same programme planting trees is compulsory for those who enter elementary and high schools or universities. In 2002, the government started a new program called “Gerakan Rehabilitasi Hutan dan Lahan” that continues until today and concentrates on the rehabilitation of watershed areas (Daerah Aliran Sungai).

2. Current Policies Governing Land Use and Restoration/Rehabilitation

The National Movement of Forest and Land Rehabilitation (Gerakan Nasional Rehabilitasi Hutan dan Lahan) has been promoted in 2003 by the Indonesian Government during President Megawati’s reign and planned for at least 5 years involving several ministries i.e. Ministry of Forestry, Ministry of Agriculture, Ministry of Social Welfare, and Ministry of Education. About 300,000 ha of forest areas have been rehabilitated in the first year (2003) and increased to 500,000 ha in 2004.

In 2003, an area of 163.114 ha of state forests and 136.856 ha of other land outside the state forests were rehabilitated through this program covering 29 watershed areas prioritized in 15 provinces and 145 districts. In 2004, the project increased the rehabilitation area to 500.000 ha consisting of 226.957 ha state forest area and 273.043 ha outside state forests in 141 watershed areas, 31 provinces and 372 districts (Anonymous, 2006).

With regard to stakeholder involvement in rehabilitation activities the government decided to better coordinate the participation of several ministries, such as the Ministry of Forestry, the Ministry of Environment, the Ministry of Community Welfare, the Ministry of Infrastructure, the Ministry of Internal Affair and also the Ministry of Education. Stakeholder participation also takes place at the operational level, for example, by communities working in the nurseries for seedling production and also through project control and evaluation by universities. However, the program is not so easy to implement since the enforcement of laws and evaluation procedures are still not strong enough to accelerate the program.

3. Forest Restoration/Rehabilitation Initiatives

Forest rehabilitation in Indonesia takes place mainly on state forest land following degradation by forest concessions, illegal logging, and fire. These activities aim at reparation of the ecosystem for productivity and environmental services.

Sumatra

In Sumatra restoration initiatives began with the rehabilitation of grass land (i.e., imperata cylindrica) using mostly fast yielding species. This project was supported by JICA in South Sumatra in the early 1980s at Binakat followed by investments through Musi Hutan Persada which planted *Acacia mangium* for pulp production on a larger scale. Other companies followed this example. The Kansai Engineering Company started cooperation with the Gadjah Mada University in 1992 to plant dipterocarps with mycorrhiza in Muara Tebo Jambi. The project was terminated in 2005. Several methods of rehabilitation using dipterocarps were developed and tested and the plot today can be used for demonstration purposes of successful rehabilitation of dipterocarp forests. BIOTROP also developed a model of rehabilitation and conservation of tropical forests in the Muara Tebo area of Jambi.

Java

After deforestation by VOC in the 17th century the Dutch Government of Indonesia in the 18th century succeeded to rehabilitate some areas (Simon, 2004). *Pinus merkusii* sp. was planted in mostly in the high lands and produced terpentine as well as gum. Paraserianthes falcataria was planted not only in forest areas but more successfully as mixed crops in homegardens and agro-forestry systems. Several restoration/rehabilitation initiatives such as Wanagama I in Gadjah Mada University Yogyakarta, (about 600 ha) started in 1966 as rehabilitation of karst or dry land areas for education, training and also ecotourism.

Coastal rehabilitation was also conducted from 1995 onwards by the University Gadjah Mada Team as RUT Project (Integrated Competitive Research Fund) sponsored by the Ministry of Research and Technology and LIPI (The Indonesian Institute of Science). The project is a successful model for the protection from extreme winds and also reduces the impact by tsunamis. Until today, implementation has reached 9 km of rehabilitated coastal area. The initiative is not only pursued by the university but also by farmers who are aware of the important role and economic value of coastal forests particularly for protection and increase in productivity of wood and non-wood forest produce. Private companies such as PT Indokor also succeeded in rehabilitating their coast lines and were able to widen their production area. IPB (Bogor Agriculture Institute) in Kadipaten also initiated to promote Paraserianthes falcataria to increase the income of farmers.

Bali

The ongoing cooperation between JICA and the Directorat of Forest Rehabilitation and Social Forestry and the Department of Forestry promotes the establishment of a model for mangrove rehabilitation. A larger plot was established at Denpasar with additional project activities in order to promote also the conservation of mangroves in other areas.

Kalimantan

Planting of *Acacia mangium* began with the involvement of the Finnish Government in projects in South Kalimantan and West Kalimantan. The aim of the projects was to replant deforested area covered by imperata cylindrical created through illegal logging and shifting cultivation.

JICA, in cooperation with the Higher Education Department, initiated the rehabilitation of tropical rain forests and established a model of rehabilitation in Bukit Suharto, East Kalimantan. JICA also assisted the Mulawarman University, IPB, and University Gadjah Mada in forestry research and education. German Technical Assistance through GTZ also concentrated on research, education and training of forest scientists. PT Sumitomo of Japan also promoted the establishment of a model for tropical forests in Sebulu, East Kalimantan, and produced several publications on this experiment.

Sulawesi

Planting of gmelina for pulp production after deforestation was quite successful. However, the best results were obtained by the planting of 27,000 ha of teak (muna) in Konawe (Southeast Sulawesi). Long-term sustainability is at risk because of illegal cocoa plantations established within the forest plantation area.

Nusa Tenggara

There are only few rehabilitation activities, one of them by Perhutani, which has successfully planted teak on more than 20,000 ha. After the contract was completed, however, problems arose in the management and also with security of the area.

Maluku

For a long time the Maluku region has been an area of conflict and therefore the forest rehabilitation programme is not well established. The total forest area of 5 million ha will be targeted for conservation and should be rehabilitated mainly with indigenous species.

Papua

Mangroves in Papua are a very important group of tree species for the industry. Several companies such as PT Freeport and PT Bintuni try to conserve and develop forest areas and conduct different types of research using various mangrove species.

Numerous examples of past and ongoing forest rehabilitation initiatives exist in various localities in Indonesia. A wide range of stakeholders such as government agencies, universities, private companies, and local communities are involved in these initiatives. The selected case studies are briefly described using the following aspects:

- Driving factors
- Project success evaluation
- Factors contributory to success/failure
- Lessons learned

Case Study 1: *Fast Yieding Species (Acacia mangium):*

More than 100,000 ha in South Sumatra; oldest age class is 20 years

Driving factors	The rehabilitation effort was primarily driven by the desire to commercially produce short rotation timber from bare land areas.
Project success and impacts	In terms of production the project is successful. The whole area is now fully stocked with the planted *Acacia mangium* and bigger companies operating for pulp production. The major impacts of the project include employment for the people living in the surrounding areas. The project also contributed to skills development and assisted graduate students to experience practical work in plantation management and industry.
Reasons for success/failure	The plantation company could use funding from the HTI project released by the government. The debt was successfully returned to the government.
Lessons learned	During the establishment of the plantation there were conflicts with local people living in the surrounding areas because of ownership issues. By pursuing a social approach to satisfy local needs such as vegetable growing, cattle rearing and other social development projects such conflicts could be avoided.

Case Study 2: *Tropical Rain Forest Rehabilitation*

About 1,000 ha in Jambi established 13 years ago by KEEC & UGM

Driving factors	The rehabilitation efforts were primarily driven by the desire to do research on mycorrhiza suitable for dipterocarp forest rehabilitation. The secondary purpose of this project is to find other useful models for the rehabilitation of tropical rain forest areas.
Project success and impact	In terms of biophysical accomplishments the project is successful on at least 1,000 ha of test sites and also produced more than 200 scientific papers presented in national and international seminars and journals. The major impacts of the project are: • Model of rehabilitation of the tropical rain forest has been tested; • Wildlife species tend to return to the area; • Since the approach combines rubber trees with dipterocarps, short term income can be generated to support sustainable production in the long term; • Private companies are increasingly interested in cooperating with Gadjah Mada University on sustainable forest management.
Reasons for success/failure	Gadjah Mada University was able to obtain funding from KEEC/Kansai Osaka, Japan, with an average allocation of 500 million Rupees annually, excluding equipment and vehicles. Researchers from both Japan and Gadjah Mada University produced at least 16 topical papers per annum.
Lessons learned	A major lesson learned is the threat through illegal logging and monoculture plantation development such as oilpalm and *Acacia mangium* by big private companies in the surroundings. In additional also local people tried to encroach into the area. The pressure for additional land might endanger the sustainable management of multi-species natural forests.

Case Study 3: *BIOTROP on Tropical Rain Forest Rehabilitation*

Implemented in Jambi Province

Driving factors	The rehabilitation efforts were implemented primarily to develop research on tropical rain forest ecosystems.
Project success and impact	The project is unsuccessful and will not be continued because of logistic reasons (i.e.the great distance to the field sites and high operational costs to maintain the project).
Reasons for success/failure	Limited budget from the BIOTROP research programme which should have involved more domestic and international agencies.
Lessons learned	Illegal logging and land occupation need to be minimized and requires sufficient funding to ensure security.

Case Study 4: *Sengonisasi*

Implemented in Java over a period of more than 20 years

Driving factors	This rehabilitation effort primarily aims to produce short-rotation timber in order to satisfy the increasing demand for timber in highly populated regions such as Java.
Project success and impact	The project is successful in promoting *Paraserianthes falcataria* plantings in home gardens belonging to farmers and big companies such as Perhutani. Many companies followed this example and established timber plantations of P. falcataria for exporting light wood products to Japan and other countries. This species is not so allelophatic and can also be combined with other species such as durian, jack fruit, and several kinds of vegetables generating income for people.
Reasons for success/failure	The promotion by the Government and an increasing demand for light timber in local and regional markets.
Lessons learned	Planting of *P.falcataria* can easily be managed by farmers and does not need high investments and labour input. When planting is carried out in cooperation with private companies, farmers further benefit due to reduced harvesting and transportation costs. Marketing is not a problem since many companies buying the raw material exist in different locations.

Case Study 5: *Forest Education Project*

Implemented in Yogyakarta and several provinces throughout the country over 40 years

Driving factors	The rehabilitation efforts were primarily driven by the need of the University of Gadjah Mada to develop research models for rehabilitation of marginal lands, especially in dry areas. Providing opportunities for practical work for students and training for extension workers.
Project success and impact	In terms of biophysical accomplishments the project is successful with the establishment of 600 ha of rehabilitated forests using several species such as *Santalum album, Swietenia mahagony, Tectona grandis, eucalyptus sp, acacia mangium, A. auriculiformis, dyospyros celebica.* The project was successful in (a) training of more than thousand students and extension workers; (b) promotion of the area for ecotourism and attraction of students and colleagues from Singapore for more than 5 years to stay and study environment in the center. Most of the ministries and at least two presidents of Indonesia have visited the area. Several organizations used this area for general meetings or recreation, movies, TV programme and camping.
Reasons for success/failure	There was sufficient funding from the government, communities and also from local schools and universities from Singapore.

Lessons learned	One major problem is illegal logging of *Santalum album* for cosmetic products, timber of mahagony and also leaves of *Santalum album* and *Swietenia mahagony* for cattle feeding especially in the dry season.

Case Study 6: *Coastal Rehabilitation*

Implemented in South of Yogyakarta Province over 10 years; 450 ha

Driving factors	The rehabilitation efforts were primarily driven by the importance of wind breakers for the protection and development of the agriculture area in coastal zones.
Project success and impact	In terms of bio-physical achievements the project is successful. The agriculture area could significantly be improved with many areas becoming productive. Shrimp production e.g. by companies like PT Indokor could be enhanced. The protection function was also improved and lead to a reduced tsunami effect in June 2006.
Reasons for success/failure	Sufficient funds were supplied through the RUT fund and the Department of Forestry's budget for Gerhan (Movement of Rehabilitation of Forest and Land) in the coastal area.
Lessons learned	The major problems are related to illegal cutting and overhauling for bonsai. However, since the people are interested in planting, the tree planting area could be expanded to also cover home gardens, road sides, and park areas.

Case Study 7: *Mangrove Rehabilitation*

Implemented near Denpasar, Bali, over more than 5 years

Driving factors	The primary objective of the mangrove rehabilitation project in Denpasar is to reduce abration of the airport of Ngurah Rai Denpasar and to develop a model for rehabilitation of mangrove areas in Indonesia.
Project success and impact	The project is successful in terms of biophysical improvement of mangrove areas with newly established mangrove trees showing excellent growth. Training and an action programme of mangrove rehabilitation by communities and a student's movement became popular.
Reasons for success/failure	JICA supported the project through funding and facilities such as expertise and scientist's involvement. The government also provided support through local facilities and organization of seminars and workshops on mangrove management.
Lessons learned	The project is limited and has not yet been implemented on a larger scale.

Case Study 8: *Acacia Afforestation (Finnish Project)*

Implemented in South Kalimantan for more than 15 years.

Driving factors	The rehabilitation effort was primarily driven by the desire to commercially produce short rotation timber to supply the demand of wood and pulp for paper production. *Acacia mangium* and eucalyptus are the main species used in this project.
Project success and impact	A devastating fire after plantation establishment occurred and made this programme unsuccessful.
Reasons for success/failure	The project was funded by the Finnish Government in cooperation with the Indonesian Government.
Lessons learned	Frequent fire events inflicted great damage to the *Acacia mangium* plantation and the entire ecosystem and biodiversity of the region. The regrowth of *Acacia mangium* was very poor with extraordinary high mortality rates. In addition, homegardens of the local farming community were invaded by *Acacia mangium* regeneration.

Case Study 9: *Tropical Rainforest Rehabilitation*

Implemented in Bukit Suharto, East Kalimantan for more than 10 years.

Driving factors	The rehabilitation effort was primarily driven by the objecttives to restore the natural vegetation of indigenous trees in Bukit Suharto, East Kalimantan. Secondly, to develop a model for the rehabilitation of tropical rain forests.
Project success and impact	The project is considered successful and provided scholarships for PhD and MSc studies in Japan.
Reasons for success/failure	JICA funded the project and provided laboratory facilities, expertise and scientists. The support also included scholarships for cooperation with several universities in Indonesia, such as IPB, UGM and UNMUL. GTZ of Germany also provided support through scholarships for several PhD and MSc studies on ecology.
Lessons learned	The major constraint in running the project after external support had been terminated was the lack of local expertise to manage the sophisticated laboratories. Project knowledge on rainforest rehabilitation was also insufficiently transferred to the field.

Case Study 10: *Teak Rehabilitation*

Implemented in Konawe, South East Sulawesi; 27,000 ha

Driving factors	The rehabilitation effort was directed towards the production of high quality timber.Teak is ecologically suitable for the project area. Another objective was to generate employment for rural communities in this area.
Project success and impact	This project is considered successful. The establishment of the plantation generated employment and in addition, produced local food cultivated under the teak forests such as ginger and yam (*Dioscorea hispida* POIR).
Reasons for success/failure	The government supported the project through the Department of Forestry.
Lessons learned	After several years, however, the plantation area was affected by illegal logging and insufficient management control.

Case Study 11: *Mangrove Rehabilitation (Gesang et al., 2006)*

Implemented in Papua (PT Freeport Indonesia Contract of Work) over 8 years; 59,5 ha

Driving factors	The primary objective is to rehabilitate the mangrove area in Papua after mining, particularly to accelerate mangrove colonization and succession in the Ajkwa estuary; • Identify the most suitable species to be used for Colonizing of newly formed area by sedimentation; • Investigate the best planting methods; • Assess the success of assisted colonization by measuring the effectiveness of colonization/planting, the rate of recruitment of flora and fauna, and the performance of basic ecological processes.
Project success and impact	Survival rate of plantings is about 2.4 % to 31.2 % for *Avicenia marina, and Rhizophoa mucronata*. 15 news species of crabs were identified during five years of monitoring (2000-2005). The number and species of crustaceans and mollusks recovered to levels comparable with the natural ecosystem.
Reasons for success/failure	The willingness and dedication of the PT Freeport Indonesia Contract of Work.
Lessons learned	Many scientists were engaged to carry out studies and surveys of the mangrove ecosystem.

PART C
FUTURE ACTION FOR ENHANCING RESTORATION/REHABILITATION

1. Improving and Revising Existing Policies

A number of changes have been brought about to existing policies, for example, the Presidential Decree No.35, 1980, revised and issued as Presidential Decree No 31, 1989 as well as the Government Decree No.35, 1999 on non taxable national revenue known as PNPB or Penerimaan Negara Bukan Pajak (Government Decree No 35 2002). However, in spite of these revisions, there still continued to be many problems and weaknesses because of loopholes in these revised regulations. These loopholes became tools for individuals to benefit. For example the revised Government Decree No. 35, 2002 encouraged District Heads (Bupaties) to use the allocated funds not only for rehabilitation but other purposes such as putting it in a bank as fixed deposit to attract interest.

In order to make rehabilitation work move more rapidly, the Government established a programme on “Revitalising agriculture, forestry and plantations” (Revitalisasi Pertanian, Kehutanan dan Perkebunan). In addition, a new law was also instituted to increase the effectiveness of extension (Penyuluhan) work. Simon (2004) suggested that the rehabilitation work should follow five strategies:

1. Social forestry should be given priority based on the resolutions taken at th VIII World Forestry Congress held in Jakarta in 1978;

2. Poverty eradication among rural communities should be the prime objective to be pursued;

3. Sustainable forest management should be the governing principle in managing all forests;

4. Ecosystem-based forest management should be adopted; *and*

5. Autonomous principle should be ensured.

Simon (2004) further suggested that planning of forest rehabilitation programs in the various regions of Indonesia should be based on the following guidelines:

Sumatra

- Using indigenous species for productive areas;

- Forest timber plantation establishment on unproductive areas and in young secondary forests;

- Agroforestry models should be adopted (Examples: rubber with dipterocarps; oil palm with dipterocarps as demonstrated by the Gadjah Mada University and by London Sumatra Private Limited (PT Lonsum));

- Conservation activities in protection forests and restoration in the National Park to restore the forest to its original structure;

- Mangroves and swamp rehabilitation especially in Northern parts of Aceh and the Eastern parts of Sumatra Island;

- Develop downstream wood industries to supply timber for both export and domestic use;

- Involvement of many organizations and stakeholders such as the National Forestry Department, Provincial Forestry Department, District Forestry Department, National Companies, and also NGOs; *and*

- Strengthening of the organization, planning and also professionalism.

Java

- Increase teak production in order to attain at least 6 m^3/ha/year so that teak production at national level can attain 4.8 million m^3/ha/year;

- Promotion of teak as national wood for construction and export;

- Production of non-teak timber should reach at least 5 m^3/ha/year. Harvesting from productive forest should not exceed 0.2 m^3/ha/year for construction wood;

- Production of fuel wood should be about 5.2 m^3/ha/year;

- About 85,000 ha/year of forest land should be utilized for agroforestry using several models such as mixed food crops and teak;

- Develop cattle feed production, protect water resources, erosion control, flora and fauna conservation, and ecotourism;

- Production area to be managed by the sustainable forest resources management approach and the non-productive areas to be managed by the forest ecosystem management approach;

- Develop forest communities, introduce forest tree planting along the streets in urban areas, along the rivers, drainage areas and also in residential areas;

- Better forest management will assist at least 2 million families and will benefit more than 4 million people;

- Some other requirements for the success of forest management in Java should involve:

    - Train professional workers especially for sustainable forest management to be organized by the state companies under the supervision of the Forestry Department;

    - Introduce social forestry paradigm to reduce socio-economic pressure.

Kalimantan

Simon (2004) suggested that for Kalimantan, which has 36,7 million ha land area, and of which about 25,6 million ha is production area with low population, the utilization of its forest could be managed as follows:

- 5 million ha could be used for timber plantation, 5 million ha for community forests and estates and the remaining 15.6 million ha should be restored and maintained as natural forests;

- Kalimantan should be managed using the forest ecosystem based management system for about 11.1 million ha. As most of these areas would be returned to and maintained as tropical rain forest. The restored state of this ecosystem will be beneficial and important for Malaysia and Singapore to avoid any haze issues in future;

- Indigenous species such as Dipterocarp, Ramin, *Eusideroxylon zwageri* and also several kinds of food and fruit species should be introduced into the forest;

- Forest timber plantation should be introduced into unproductive areas and secondary forests;

- Forest and estate communities should be established both in the forest and also outside the forest;

- Agroforestry could be established especially using not only several important timber and estate species but also food crops under a forest canopy;

- Establishment of a National Park and Protection forest through the forest ecosystem management approach;

- Rehabilitation of watershed areas such as Mahakam, Barito and Kapuas;

- Promote the development of wood industries for domestic use and export;

- Involve a majority of the stakeholders such as, state and private companies, forestry departments, local people and their local institutions;

- Mangrove rehabilitation along the coastal areas;

- Reclamation of mining areas using the forest ecosystem management approach; *and*

- Rehabilitation of conservation and protection forests by returning them to a close-to primary state.

Sulawesi

In 1997, data showed that Sulawesi had about 12 million ha of forests consisting of 6,188,000 ha production area and 5,870,000 ha conservation area. Ebony (*Dyospiros celebica*) should be one of the very important timbers to be replanted. The reforestation activities should be concentrated in Central Sulawesi where the population is lowest. Simon (2004) then suggested that rehabilitation of Sulawesi should be based on the following principles:

- Rehabilitation with indigenous species such as *Dyospiros celebica*;
- About 1.5 million hectares should be under short rotation forest timber plantations;
- Another 1.5 million hectares under agroforestry management systems;
- Manage conservation forest by the forest ecosystem management approach;
- Mangrove rehabilitation to be reverted to their natural state;
- Promote the wood industry for domestic and export purposes;
- Involve several stakeholders such as national and district forestry departments, state and private companies, and local communities; *and*
- Develop conservation and protection forests.

Nusa Tenggara

The total area of these islands is about 2.7 million ha. About 1.134.000 ha are production areas while 1.533.000 ha is conservation and protection forests. The rehabilitation strategies suggested for Nusa Tenggara are as follows:

- Agroforestry should be the first priority for these islands;
- Planting of indigenous species such as duabanga, durian, kenari etc. should be carried out;
- The islands of Sumbawa and Flores as the main areas for timber production for domestic and export markets;
- Replanting to enrich the natural habitat of mangroves;
- Planting of economic timber trees that are suitable for semi arid areas such as teak, mahagony, *Dalbergia latifolia* should be carried out. Planting of local species is preferred especially due to their pest and disease resistance and their adaptation to water deficient areas;
- Planting along the road sides with species such as kenari is very beneficial not only for urban forest but their fruits can also be utilized as food;

- Involve more local communities, state and private companies, forestry department in forest ecosystem management; *and*

- Manage conservation and protection forests for water resources conservation.

Maluku

The total forest area in Maluku is about 7.2 million ha or about 65 % of the total land of Maluku. The regions of Halmahera, Ceram, Buru and the Southeast of Maluku should be designated for wood production.

- Rehabilitate the area back to its natural ecosystem state;

- Rehabilitation should be carried out based on local wisdom;

- Promote industries for export and domestic wood;

- Involve the organization of department of forestry, private and state companies and local communities; *and*

- Restoration of conservation and protection forests.

2. Building Research and Education Capacities

In 1970 a Research and Development Unit (Litbang Kehutanan) was formed within the Forestry Department to provide technical support related to suitable species for planting and other silvicultural practices needed for the success of the rehabilitation programs. At about the same time, the Government also created about 6000 vacancies for recruiting suitable extension professionals to carry out the duties.

While research on forest rehabilitation was enhanced, however, the interest in rehabilitation decreased throughout the country. This resulted in a decrease in students enrolling in the faculty of forestry at the universities in the recent years. Furthermore, forestry and faculties of forestry also became unpopular especially after the financial crisis in 1997 that escalated the bankruptcy of many of the forest concession companies.

Research in forest rehabilitation also needs to be expanded as very little research has been done in this field. Education capacity also needs to be expanded since most of extension workers appointed in the early eighties have retired, and at the same time there are not many student candidates who would like to enter programs such as in the faculty of agriculture, the faculty of forestry, the faculty of animal sciences and into agriculture technology. Most qualified students are only interested in civil engineering, medicine and economics. To recreate back interest in these fields, the government is now creating a new act to put in place new bodies or to renew the commitments of the existing bodies to seriously get involved into the program of rehabilitation of the country. Efforts are also being made to commit sufficient funds for such programs.

3. Reconciling Global and National Policies

There are several programs under the national policies such as the National Movement on Forest and Land Rehabilitation (GNRHL-Gerakan Nasional Rehabilitasi Hutan dan Lahan) which will rehabilitate about 3 million ha within 5 years. However, the total degraded forest land is about 58 million ha so. Hence, the target of 3 million hectares over 5 years is still too small.

Indonesia has ratified the Kyoto Protocol but to date the availability of funds through the CDM program is still difficult to mobilise. Most of the rehabilitation work done by NGOs either locally or from abroad focus only on fast growing species. Not much has been done in using indigenous species for planting in both water and biodiversity conservation. The Government is serious in the protection of the environment and hence it is a party to several of the international agreements and protocols. These include the following: Biodiversity, Climate Change, Endangered Species, Hazardous Wastes, Law of the Sea, Nuclear Test Ban, Ozone Layer Protection, Ship Pollution, Tropical Timber 83, Wetlands; signed, but not ratified - Desertification, Marine Life Conservation, and Tropical Timber 94.

4. Partnership and Collaboration with Private Sectors

Industrial Plantations (HTI-Hutan Tanaman Industri) became one of the main programs, of the previous President Suharto, to rehabilitate large areas of degraded land. Several companies such as PT Barito Pacific in South Sumatra, PT WKS in Jambi Province, and PT Andalan Pulp in Riau have successfully carried out such industrial plantations but mostly for pulp and paper production.

At the level of the involvement of communities, the Government's program named as the National Movement for Forest Rehabilitation (Gerhan/GNRHL) has created facilities for small, medium and even large scale community involvement in the production of quality seedlings in cooperation with the government. This too resulted in problems because the communities were not experienced in the techniques of seedling production.

Several private companies have been working on rehabilitation especially using indigenous species. One such company is Sari Bumi Kusuma that decided to rehabilitate areas with Dipterocarpaceae using line planting (tebang jalur) in existing degraded areas with the support and advice of the Gajah Mada University team. This program showed good results. Now Inhutani I, II, III also IV, which are companies belonging to the Government, are teaming up with the Gadjah Mada University to also carry out forest rehabilitation using dipterocarps.

5. Creating Public Awareness and Support

In the early 1970s, a program called Greening (penghijauan) was initiated. To make this greening of the country a success, the Government recruited about 6000 extension officers (Petugas Penyuluh Pertanian). Unfortunately, following the reformation era, most of these extension officers lost their role of creating public awareness on greening; instead they became administrative assistants in the respective districts.

In the early 1980s President Suharto started a campaign of "Planting a Million Trees" (Penanaman Satu Juta Pohon) to create public awareness of the importance of greening through the Youth Movements. One of the shortcomings of all these greening programs was that in most cases fast

growing species which were mostly exotics were used at the expense of the indigenous species. During the period from 1980-1990, species like *Acacia* sp., *Leucaena* sp. and *Paraserianthes falcataria* were extensively planted. The program was, however, quite successful but from the biodiversity point of view, local species lost out to these exotics.

President Abdurrahaman Wahid during his term as President started a campaign “No Forest No Future”. During all his visits around the country, he made it a point to plant trees as a mark of his visit to a specific location.

.

President Megawati during her era inaugurated a program termed as the National Movement for the Rehabilitation of Forest and Watershed areas (Gerakan Nasional Rehabilitasi Hutan dan Lahan). This was to be a 5 year program involving three ministries. The total area to be rehabilitated was 3 million ha. The program clearly outlined the rehabilitation of 300,000 ha in 2003; 500,000 ha in 2004, 600,000 ha in 2005; 700,000 ha in 2006; and 900,000 ha in 2007 (dirjen RLPS, 2004).

The new Indonesian Government under President Susilo Bambang Yudoyono also has initiated several campaigns through the mass media such as newspapers and televisions for getting the support of the people to become more involved in the forest and environment rehabilitation movements. The campaign on the use of dipterocarp species for rehabilitation has now taken roots and the people at large know of their importance. The new Government is using the participatory approach by the communities to produce planting material from community nurseries for the rehabilitation program. Furthermore the Government is able to cover more areas of planting through this approach. Areas of rehabilitation includes degraded forests, mangroves, urban areas, road side planting and in community forest areas.

6. Community Involvement

Real GDP growth in 1985-94 averaged an impressive growth of about 6%, but not sufficient to both reduce unemployment and to absorb the 2.3 million workers annually entering the labor force. Agriculture, including forestry and fishing, are important sectors accounting for 21% of GDP and over 50% of the employed labor force. The staple crop of the country is rice. Once the world's largest rice importer, Indonesia is now nearly self-sufficient. Plantation crops - rubber and palm oil - and textiles and plywood are being encouraged for both export and job generation. Industrial output now accounts for almost 40% of GDP and is based on a supply of diverse natural resources, including crude oil, natural gas, timber, metals, and coal. Foreign investment has also boosted manufacturing output and exports in recent years. Indeed, the economy's growth is highly dependent on the continuing expansion of non-oil exports. Japan remains Indonesia's most important customer and supplier of aid. Rapid growth in the money supply in 1989-90 prompted Jakarta to implement a tight monetary policy in 1991, forcing the private sector to go to foreign banks for financing their investments. Real interest rates remained above 10% and off-shore commercial debt grew. The growth in off-shore debt prompted Jakarta to limit foreign borrowing beginning in late 1991. Despite the continued problems in moving toward a more open financial system and the persistence of a fairly tight credit situation, GDP growth in 1992-94 has matched the government target of 6-7% annual growth.

In the year 2006, the government faced the problems of 10 million unemployed workers while in early 1990 the figure was only 2.3 million workers. With the serious environmental damage caused the capacity of making available job opportunities to the communities was also reduced. In the

early 1990s the deforestation was between 700,000 ha to 1 million ha annually, while in 2005 deforestation reached about 2.9 million ha per year. To combat this worrisome rate, the Government instituted the Social Forestry Program to increase agriculture productivity and at the same time combining such agricultural activities with the conservation of natural resources on land. To obtain more support from the communities and to allow for more involvement at the same time, the government introduced another regulation to empower the communities around and inside the social forestry program to ensure sustainable forest management of the areas.

7. Monitoring and Evaluation for More Effective Rehabilitation/Restoration

Monitoring and evaluation has been done in the past. Most of the projects have been reported as successful work. However, in some cases when ground inspection was done, the projects were not implemented correctly and hence must be considered as unsuccessful. There is a need to put in place a more stringent monitoring system to ensure that all the rehabilitation programs undertaken are successful. Monitoring is imperative to ensure that the efforts put in for rehabilitation are indeed successful. The need is urgent as currently the area recognized as degraded forest stands at 59 million ha. Some of the universities have been charged to oversee and monitor rehabilitation acti-vities in their vicinity.

8. Effective and Practical Applications

Indonesia has been ranked as the 3rd mega diverse rich centre in the world. In principle therefore, the country should be rich in resources that should provide for the basic needs of its citizens. However, it can be noted that today this country depends on imports for its food needs. The import includes items like rice, wheat, corn, meat, milk, fruits, vegetables etc. The reason for this is the land productivity; availability of good quality water has reduced drastically due to the deforestation activities. Data until 1995 showed that the annual deforestation was about 600,000 ha. However, from recently collected data it was noted that the annual destruction was about 2,900,000 ha. Some NGOs on the other hand claim that the annual destruction could reach as much as 3,500,000 ha.

The tropical forest, home gardens and estates ecologically and originally could produce in huge quantities food such as, arrow root, cassava, sweet potato, yam, sukun (*Artocarpus communis*). Such food is a good source of vitamins and has many calories, not only in its fruits, but also in its leaves. Indigenous knowledge about food diversification (or agroforestry) in fact has a long history and has supported the sustainability of Indonesian society for thousands of years. These traditional foods could be produced throughout the year not only in the wet season but also during dry seasons unlike for example rice which needs a lot of water to grow and hence only cultivated once during the rainy season.

If this old food diversification method (or agroforestry system) is continued in the forest under the forest canopy, in estates, in home gardens or in marginal land areas, a large quantity of food can be produced that could eliminate the food scarcity in the country. However, the increase in monoculture systems of the food production industry which is more beneficial from the business point of view may not be suitable for most of the Indonesian situation because such practices reduce land optimization, deplete the water resources, and can aggravate a water shortage situation in the country. Taking an agroforestry approach, which has been tested over thousands of years in the country, would be the best way for the country, thus ensuring food security for the country and at

the same time ensuring the conservation of the forest and the water resources. In addition, it will also reduce the hefty bill on food imports.

The media can play a significant role in promoting good agricultural practices and food diversification programs. Special programs can be drawn up to explain to the public about the importance of optimal land utilization for food production which will reduce the pressure to clear more land for food production using monoculture systems.

Education is another important means to effectively promote the concept of food diversification, the importance of locally produced food for consumption and importance of attaining self sufficiency in food production and locally made products. If this is adopted, Indonesia can enhance and advance the science at the local universities towards agriculture, livestock, forestry, agroforestry and food science.

9. Financing for Forest Restoration

Forest rehabilitation in Indonesia started in the early 1980s as “penghijauan” or afforestation. These programs involved planting of trees on areas outside of the forests. Under the “Proyek Penghijauan” (Regreening project) forest rehabilitation is financed through the fund for reforestation (DJR: Dana Jaminan Reboisasi). As explained in the section on rehabilitation history, this fund has been created by the Presidential Regulation No. 35 1980, obliging forest concession holders to pay into the fund a fee for each cubic meter timber extracted. Forest concession companies replant or regenerate the logged-over forest areas. Once the replanting has proven successful the companies will be compensated by the Government using DJR funds.

In 1989, a new Presidential Regulation No 31 1989 called Reforestation Fund (DR: Dana Reboisasi) was launched. Under this regulation the forest concession company had to pay the DR for each cubic meter timber extracted being also responsible for the rehabilitation of logged forest area. The Government was responsible for the rehabilitation of areas outside the forest concession company such as Industrial Plantation Forest (HTI: Hutan Tanaman Industri) through a loan without interest and a governmental fund share. The DR funds were to be deposited in the accounts of the Ministry of Forestry. The use of the money had to be coordinated by the Ministry of Forestry and the Ministry of Finance and was additionally approved by the President.
Later on, problems arose when most of the rehabilitation projects faced difficulties to meet the time requirements. Since the rehabilitation work depended on the rainy season, in many cases seedling production commenced late and thus produced seedlings of low quality. Frequently, seedlings were planted in the field outside the preferred rainy season. As a consequence, survival rates and growth performance was poor, thus the entire project lead failed.

After 1999, another President Decree called “Penerimaan Negara Bukan Pajak” was implemented. Under this regulation, funds for rehabilitation have to be deposited in the Ministry of Finance (as non tax national revenue). Later on, this budget was not only used for forest rehabilitation but also for other government projects. In 2002, the Government revised the reforestation fund (DR: Dana Reboisasi) and transformed it to a loan scheme with focus on forest rehabilitation outside the production areas.

10. Home Garden/Indigenous Systems

The home garden model in Indonesia is a model that has evolved over thousands of years especially in Java. This model emulates the structure of tropical rain forests in home gardens and supplies most of the basic needs of the farmer's family. Food is produced under a canopy of fruit and timber trees while at the same time cattle and goats are reared as well.

11. Enhancement of Human Well-being and Natural Environment

Forest restoration usually succeeds when it contributes to the increase of benefits, daily income, and cultural life of local people. It must also be compatible with the ecology of the area. Numerous examples show that successful rehabilitation building diverse forests with many different layers and species provides a wide array of benefits to society. A combined rubber tree and dipterocarp management provides cash income through gum and timber production and improved the water resources. Gum production in Lampung, South Sumatra, for example, could be increased by improved maintenance of the trees without cutting them.

Research conducted by Mutiara and Irfan (1999) compares the efficiency of several management models. The first model represents present land use by planting several crops in an open area. The second model is a mix of crops and tress in gardens and the third model is a conversion from pine forest to a ginger plantation. The results show that mix gardens is the best model to protect the area from soil erosion and the decrease of the farmer's income is only 0.5 %/year. The second model reduces erosion by about 26%, while using the open area increases soil erosion by 3 %. However, the income only increases by about 2.3 %. The first model causes 22.53 tons of soil erosion/year.

The second model on mixed gardens therefore is the best scenario because the farmer's income is not significantly reduced. Although soil erosion in the second model is still above the tolerable value it can be reduced by soil conservation practices, especially in steep areas. The model was tested in the area of the Toba Lake catchment with a total area of 259.594 ha (FAO, 1987). Forest cover is around 65.100 ha or 25% of the total area; the remaining land belongs to local people. Almost 93% the land of the local people has steep slope and it is used for seasonal agricultural production without any soil conservations practices. Therefore, soil erosion is above the tolerable value. If this condition continues, soil fertility will decrease rapidly.
Based on the above-described background, another study was conducted at one of the sub-catchments of the Toba Lake, in order to evaluate the effect of land use on soil erosion and farmer's income. This study is also seeking the best land use model that can by applied in the Program of Forest, Land and Water Sustainability, without loosing farmer's income.

PART D
MISCELLANEOUS

1. Forest Fires

Forest fires are caused by land clearing activities for oil palm plantations, arson linked to land tenure conflicts (e.g. financial compensation for forest gardens), other types of arson and accidental fires. Drought seasons and the effects of uncontrolled fires increase the pressure on the

local population through destroyed forest gardens, temporary loss of many plant resources, reduced protein and vitamin supply causing an increase in health problems.
One of the main factors effecting forest degradation is forest fires and uncontrolled burning. ASEAN countries especially Malaysia and Indonesia were most affected by forest fires during July-November, 1997. The worst haze occurred in Sarawak, Malaysia when an emergency was declared based on the Air Pollution Index (API) indicating a danger level of 800, 300 above the allowable danger level. Observations and studies based on data from the Meteorological Department Service showed that the haze was caused by fires and burning in large parts of Indonesia. This paper also assessed the burned forest area and the relationship between the number of "hot spots" and the severity of haze occurrence in affected areas, particularly Borneo. The causes of forest fires were highlighted and a management plan of forest fire control was proposed (Kamaruzaman and Aswarti, 1999).
Nyoman and Irwansyah (1999) describe the impact of forest fire on the biodiversity and water quality in Berbak National Park studied during March to October 1998. The study covered three swampy areas: Simpang Palas, Simpang Datuk and Air Hitam Dalam. The first two areas had been burnt twice (1994 and 1997) and the Air Hitam Dalam area only once (1997). The results include the impact of fire on the water quality, vegetation and fauna.

- *Impact on water quality:* The survey indicated that forest fire had caused acidification and increased ion concentration in the water of the areas studied. The pH of these areas was very low (3.3-3.5), with the acidity ranging from 120 to 760 ppm, compared to the adjacent area which received no direct impact from forest fire (i.e. the Batanghari river: pH 5.8-7.1, no acidity values detected). The acidification of these swampy areas is thought to have resulted from the release of sulfate (through drought and fire) from soils containing sulfides or free sulfur, which then oxidized in the presence of water to form sulfuric acid. The survey recorded that the sulfate (136-695 ppm) and iron (1.7-6.4 ppm) content of these swampy areas was very high compared to the Batanghari river (sulphate: 14-29 ppm, total iron 0.30-0.62 ppm). Physical degradation of organic matter during the forest fire in Berbak had also significantly increased the ion (Ca, Na, Mg, K, SO_4, CO_3) concentration in the water. This effect has been demonstrated in the laboratory using a simulation model.

- *Impact on vegetation:* Forest fire has destroyed 75-98% (24-48 species) of plant species in the study areas. The highest loss was recorded in Air Hitam Dalam (98% or 48sp from a total of 49 species found in unburned areas), followed by Simpang Palas (96 % or 25sp from total 26 species) and Simpang Datuk (75% or 8sp from total 32 species). Although significant numbers of plant species were destroyed during the fire, the loss of thick canopies has enabled several dormant plant species to emerge from the ex-forest fire floors.

- *Impact of fauna:* Forest fire has created many patches of open areas in Berbak. This implies loss of living habitat, feeding grounds and nesting habitat and certain creatures (e.g.: sun bear). During the October 1998 survey, crowds of predator birds (e.g. Lesser adjutant and Brahminy kite) were observed searching for food in these open areas and villagers' crops (e.g. coconut trees). Villagers reported finding many freshwater fishes dead in Berbak NP during the 1997 dry season, due to the disappearance of water from swamps, and also in the 1998 early rainy season. The 1998 fish death toll is suspected to be due to water acidification. A number of these fish species (e.g. the climbing perch *Anabas testudineus*),

snakeheads (*Channa striata*), sepat rawa (*Trichogaster leeri*) and seluang (*Rasbora agyrotaenia*)) have since reappeared in these ex-forest fire swampy areas. A minimum of between 20-21 adult individuals and 15 ducklings of WWD (White Winged Duck, *Cairina scutulata*) were found in Desa Sei Rambut and Air Hitam Dalam. (These areas have now become new records for WWD populations found in Sumatra). In the short term, forest fire has had no significant impact on the occurrence of WWD in these areas, but in the long term due to the loss of suitable habitats.

2. Regional Collaboration

Collaboration for forest rehabilitation has been developed with JICA of Japan, KEEC/Kanso Sumitomo Japan, the South Korea Government and privates companies, as well as with the European Union and other organizations such as ICRAF, ITTO, KOICA, IUFRO-SPDC, GTZ and CIDA.
JICA for example has developed a model for rehabilitation of tropical rain forest in cooperation with the University of Mulawarman and many other universities through the Indonesian Ministry of Education.
ICRAF also formed a network for agroforestry education (INAFE: Indonesian Network Agroforestry Education) and worked with 23 universities to promote education in agroforestry also as a means for ecosystem rehabilitation.

3. Pests and Diseases, Invasive Species, Exotics

The introduction of *Leucaena leucocephala* (lamtoro gung) in Indonesia has caused serious forest health problems, particularly the introduction of pests such as kutu loncat. In addition, the exotic leucaena species is a strong competitor to the local species of leucaena (lamtoro/kemlandingan) which is in danger to be eliminated. Exotic species, such as *Acacia mangium*, *Acacia pellita* etc., are preferably planted in fast-growing tree plantations for the production of pulp and paper causing great problems to Indonesia's rich biodiversity. Similarly, the conversion of tropical forests to oil-palm and rubber plantations has also a negative effect on biodiversity.

4. Biodiversity

Indonesia ranks number three of the list of biological diversity. Although its land area is only about 1.3 percent of the world, Indonesia has about 17 percent of all species. Due to past and ongoing land conversion to monocultures biodiversity faces a critical era in the years to come. According to Rivai (1993) there are about 28,000 plant species in Indonesia, but only about 6,000 have been utilized for various purposes such as:

- Ornaments about 1100 species;
- Medicinal plants about 940 species;
- Fruits about 400 species;

- Vegetables about 340 species;
- Tannin about 228 species;
- Timbers 267 species; *and*
- Spices about 54 species.

If marine diversity was also included Indonesia would be regarded as the most significant mega-diversity region in the world. The 47 ecosystem types in Indonesia can be divided into seven bio-geographic regions which are located on the major groups of island as follows:

- *Java and Bali*: rain forests, natural monsoon forests;montane forests, temperate herbaceous formation, limestone karst, fresh water swamp forests and mangroves;
- *Kalimantan including the Natuna and Anambas islands*: lowland evergreen forests; montane forest; extensive mangroves, peat and fresh water swamp forests and large heath forests;
- *Sumatra and offshore islands:* dipterocarp forest; peat swamp forests, mangroves, montane rain forests; natural pine forests;
- *Sulawesi and offshores islands including Sulu:* montane rain forests; lowland rain forests, karst lime stone, swamp forests and mangroves;
- *Nusa Tenggara:* monsoon forests and extensive grass lands, natural sandalwood forests and some montane rain forests;
- *Maluku:* low land and montane forests, mangroves and fresh water swamps;
- *Papua:* monsoon forests; savanna woodlands, tropical rain forest including lower mountain forests; mangrove forests; upper montane forests; alpine heath forests, fresh water swamp forests; limestone; grassland and beach forests.

Rapid deforestation mainly due to land conversion is the major cause of loss of biodiversity. Therefore, maintenance of biodiversity is one of the most demanding tasks for the new century (Gonner 1999). A good example of sustainable management and biodiversity conservation can be reported from Kalimantan. During at least 300-400 years of swidden agriculture and forest management, Dayak Benuaq farmers have created a mosaic of vegetation on an area of 9,200 ha, consisting of more than 1,700 forest gardens (rattan, fruit, rubber) and hundreds of swidden fallows in different succession stages (Gonner, 1999). More than 740 taxa are used by the locals, including at least 398 extracted plant species, 246 cultivated crop varieties and 99 hunted animal species. Out of this diversity about 10-15 species are regularly used as traded commodities. This example shows that only approaches to forest restoration will work that seek to balance human needs with those of biodiversity and aim to restore a range of forest functions and accepting and negotiating the trade-offs between them.

REFERENCES

Anonymous, UU 41 RI 1999. The Library of Congress Country Studies, CIA World Factbook.

Anonymous 2000. Lokakarya reforestasi dan kapasitas industri, dephut.

Anonymous 2001. Growing Population Stamps Heavy Ecological Footprints. Environment News Service (ENS) New York, July 11, 2001.

Anonymous 2001. Walhi Calls for logging Moratorium," The Jakarta Post, Indonesia, June 9, 2001

Anonymous 2006. Proposal Seminar Nasional Arahan Pembentukan Unit Manajemen Kelembagaan Kawasan Kelola dan Pengembangan Sumber Daya Manusia dalam Program Gerakan Rehabilitasi Hutan dan Lahan. Fak Kehutanan UGM.

Dirjen RLPS (Rehabilitasi Lahan dan Perhutanan Sosia) l Departemen Kehutanan 2004. Kebijakan Gerakan Nasional Rehabilitasi Hutan dan Lahan (GN RHL). Departemen Kehutanan. Dalam Sarasehan Membangung Multipihak dalam Mendukung Gerakan Nasional Rehabilitasi Hutan dan Lahan (GN RHL) tanggal 15 Maret 2004.

Fakultas Kehutanan UGM. 1998. Pengaruh Hutan Pinus Terhadap Tata Air dan Tanah di KPH Surakarta. Laporan Penelitian Kerjasama antara Fakultas. Kehutanan UGM dengan Perum Perhutani Unit I Jawa Tengah. Yogyakarta. Sub Fakultas Kehutanan UGM. 1998.

Gesang Setyadi, Hadi S`Alikodra, Dwi L Rahayu, Rudi Pribadi and Deky Lala 2006. Mangrove Management and Monitoring in PT Freeport Indonesia Contract of Work in Prosiding Lokakarya Pengembangan Kelembagaan Mangrove Jakarta 17-18 Juli 2006 Dephut Dirjen RLPS.

Gonner Christian 1999. Causes and effects of forest fire: A case study from district in East Kalimantan, Indonesia in Research Abstracts and Key Policy Questions. Environmental Services and Land Use Change. Bridging between Policy and Research in Southeast Asia. International Centre For Research in Agroforestry. Methodology Workshop.

Gonner Christian 1999. Resource Diversification and Avian Diversity in a Traditional Agroforest System: A Case Study from East Kalimantan, Indonesia, in Research Abstracts and Key Policy Questions. Environmental Services and Land Use Change. Bridging between Policy and Research in Southeast Asia. International Centre for Research in Agroforestry. Methodology Workshop.

Gunawan, Memed. 1998. Konsep dan Arah Pengembangan Agribisnis dan Agroindustri Berbasis Ketela Pohon di Pedesaan. Prosiding Seminar Nasional Pengembangan Agroindustri Ketela Pohon Berbasis Pedesaan Dalam Menunjang Peningkatan Ketahanan Pangan. Kerjasama Fakultas Pertanian dan Kantor Menteri Negara Urusan Pangan.

Hehanusa, P. E., 1999. Ketersediaan Air Dalam Perspektif Abad 21 Kaitannya Dengan Hak Asasi Manusia. Masyarakat Hidrologi Indonesia Bersama Himpunan Ahli Teknik Hidraulika Indonesia. Di Bogor.

Indonesia Economy Library of Congress Country Studies; CIA World Factbook.

Kamaruzaman Jusoff and Aswarti Batang bengkok Surep 1999. Monitoring and Assessing Forest Fire in Borneo using NOAA-AVHRR Data in: Methodology Workshop Research Abstracts and Key Policy Questions Environmental Service and Land Use Change, International Centre for Research In Agroforestry.

Kompas 2006. Ratusan telaga karst rusak berat, 10 Sept. 2006

KR 2006. Lahan pertanian di daguran kekeringan, 7 Okt. 2006

Muhshi, M. A. 2004. Tinjauan GN-RHL Dari Aspek Kemasyarakatan. Sarasehan Nasional Membangun Komitmen Bersama Multipihak dalam Mendukung GN-RHL

Mutiara Tyas and Irfan Budi Pramono 1999. Effect of Land Use Change on Soil Erosion and Farmer's Income at Naborosahon Sub Catchment, Toba Lake Catchment-North Sumatra Indonesia in Methodology Workshop Research Abstracts and Key Policy Questions Environmental Service and Land Use Change, International Centre for Research in Agroforestry.

Nyoman Ngurah Suryadhi Putra and Irwansyah Reza Lubis 1999. Impact of Forest Fire on Berbak National Park's Biodiversity and Water Quality in Jambi-Sumatera in: Methodology Workshop Research Abstracts and Key Policy Questions Environmental Service and Land Use Change, International Centre for Research in Agroforestry.

Rivai MA 1993. Plasma nutfah. Erosi genetika dan usaha pelestarian tumbuhan obat Indonesia. Bio Indonesia 9: 15-28.

Sekretariat Tim Koordinasi Perbaikan Lingkungan Melalui Rehabilitasi dan Reboisasi Nasional 2003. Gerakan Nasional Rehabilitasi Hutan dan Lahan: Pedoman Penyelenggaraan.

Sekretariat Tim Koordinasi Perbaikan Lingkungan Melalui Rehabilitasi dan Reboisasi Nasional 2003 Gerakan Nasional Rehabilitasi Hutan dan Lahan (GN-RHL). Rencana Lokasi GN-RHL Tahun 2003.

Setyono, A dan Soeharmadi. 1991. Aspek Penanganan Pascapanen Ubikayu. Seminar Hasil Penelitian Pascapanen Labolatorium Pascapanen Karawang. 10 Februari 1990.

Simon 2004. Membangun Kembali Hutan Indonesia. Pustaka Pelajar. Yogyakarta 169p.

Soemarwoto, O. 2001. Atur diri sendiri: Paradigma baru Pengelolaan Lingkungan Hidup. Pembangunan Ramah Lingkungan, berpihak pada rakyat,ekonomis, berkelanjutan. Gadjah Mada University Press. Yogyakarta.

Sugandhy A 1999. Pencegahan dan pemulihan Kerusakan Sumber Daya Lahan. Proseding Seminar Penyusunan Kriteria Kerusakan Tanah. Kerjasama Direktorat Kerusakan Lahan Bapedal dengan Pusat Penelitian Lingkungan Hidup UGM dan CEPI. Yogyakarta.

Suhardi, Sri Astuti, K Ambar, Eny Faridah dan Anwar Bale 1998. Pengaruh Campuran Tanaman Jati (*Tectona grandis*), Pinus Merkusii dengan Ubikayu (*Monihot esculenta*) Terhadap Pertumbuhan Tanaman Pokok, Mikorisa dan Kondisi Hara. Kerjasama penelitian Fak Kehutanan UGM dan Perum Perhutani th 1998.

Suhardi, SN Sambas, Sri Astuti, HD Dwidjono, Minarningsih dan Widodo 2002. Hutan dan Kebun Sebagai Sumber Pangan Nasional. Yayasan Kanisius Yogyakarta.

Forest Restoration and Rehabilitation in Lao PDR

by

Chanhsamone Phongoudome[1] and Khamfeua Sirivong[1]

1. General Information

1.1 *Geographic Information*

The Lao People's Democratic Republic (Lao PDR) is located in Central Indochina between latitude 13º 54'-22º 30' North and longitude 100º 05'-107º 59' East. The total land area is 236,800 km^2. Borders are shared with the Republic of China, Union of Myanmar, Kingdom of Thailand, Kingdom of Cambodia and the Socialist Republic of Vietnam. Elevation ranges from 80 m above sea level in the South to 2,820 m at Phou Bia Mountain in Xiengkhouang Province in the far Northeast. About 80 % of the country is mountainous. The Mekong River enters Lao PDR from China in the Northwest where the borders with Myanmar and Thailand meet and then flows East to Luang Prabang Province and South to the region bordering Thailand, Vietnam and Cambodia. The climate is dominated by the monsoon with annual pronounced wet and dry seasons, respectively. The rainy season lasts from May to September when the prevailing winds blow from the Southwest. The dry season which runs between October and April, is characterized by winds from the Northeast. Average annual rainfall varies from 1,000 mm in the North to 3,000 mm in the South. Daily mean temperatures range from 10º C in January to 38º C in July whereas the North of the country is generally cooler than the South. Lowland areas are classified as tropical, whilst the higher elevations and mountainous areas in the centre and the North are considered sub-tropical.

1.2 *Population*

In 1950, the population of Laos was about 1.76 million and until 2005 had increased to 5.7 million representing an annual growth of 2.4 percent and a population density of 22 people per km^2. Approximately 76.1 % of the total population are farmers managing about 2 million ha of agricultural land or 9% of the total land area (MAF, 2006).

1.3 *Natural Resources*

Laos is endowed with rich natural resources including forest and agricultural land, biodiversity, minerals and water resources. There are more than 10 million ha of forest land representing the habitat of a diverse array of plant and animal species. Many areas have potential for the tourism industry, particularly eco-tourism activities. The water resources of Laos are of regional significance because 35 % of the total water flow of the Mekong river are generated in the river catchments of the country.

[1] Forestry Research Centre (FRC), National Agriculture and Forestry Research Institute (NAFRI), Ministry of Agriculture and Forestry (MAF), Vientiane, Lao P.D.R.

1.4 *Environmental Management*

Lao P.D.R. faces a number of environmental problems ranging from deforestation and poor management of agricultural land to inadequate urban waste water treatment, industrial pollution, and low water supply and rural sanitation. Major reasons for this situation include lack of appropriate technology and investments, unresolved land tenure issues as well as insufficient enforcement and control mechanisms by public institutions.

1.5 *Economic Situation*

Over the past 10 years the country experienced a slow economic growth with a GDP per capita in 1995 of 377 $/head/year, increasing to 468 $/head/year in year 2004, and 500 $ in 2005. The economy is largely natural resources-based making up 52% of GDP (i.e., agriculture crop 27%, animal husbandry 19%, and forestry 6%). This is followed by industry, particularly handicrafts (27%), and the services sector such as trade, tourism and communication, transport, post and construction with 21% of GDP. (Source: GoL, 2006).

PART A
STATUS OF LAND USE AND FOREST (AND LAND) DEGRADATION

1. Forest Land Use and Land Use Change

According to three national forest inventories carried out in 1982, 1992 and 2002, forest and other land uses have changed significantly, as shown in Table 1. While the current forest area decreased from 11.6 million ha in 1982 to 9.8 million ha in 2002, there was an increase in area for potential forest from 8.6 million to 11.1 million ha in the same period. Expansion of agricultural land was significant and almost doubled from 708,700 ha in 1982 to 1,200,000 ha in 2002. This was accompanied by a decreasing area of other wooded land from 1.5 million ha to 287,000 ha.

2. Nature Conservation

Terrestrial ecosystems in Laos contain a rich diversity of plants and animal species. Floral diversity is estimated at 8,000 - 11,000 plant species *(Xu Zai Fu, 1994, Latiff pers. Comm., 2000)* with 333 species of orchids, 93 species of bamboo, 51 species of rattan and 757 species known for their non-timber uses. Animal species include 700 bird species, 100 species of large mammals, 166 species of amphibians and reptiles, 555 species of butterflies, 100 species of bats, and 481 species of fish *(National Biodiversity Country Report, 2003)*. In order to preserve this rich natural heritage significant areas of forests have been set aside for conservation purposes, namely 20 National Biodiversity Conservation Areas (NBCA) covering 3.1 million ha (GoL, 1993); 188 provincial forest conservation areas with 2.9 million ha; and 494 protection forests with a total area of 2.1 million ha.

Table 1. ***National land use and vegetation type distribution in Lao PDR between 1982 and 2002 (000' ha)***

Land uses and vegetation types	Code	1982 (ha)	1992 (ha)	2002 (ha)
1. Current Forest	***CF***	***11,636.9***	***11,168.0***	***9,824.7***
Dry Dipterocarp Forest	DDF	1,235.1	1,206.4	1,317.2
Lower Dry Evergreen Forest	LDEF	88.6	85.5	56.0
Upper Dry Evergreen Forest	UDEF	1,105.8	1,061.0	1,387.9
Lower Mixed Deciduous Forest	LMDF	893.0	864.5	881.1
Upper Mixed Deciduous Forest	UMDF	7,792,2	7,405.5	5,499.5
Gallery Forest	GE	90.7	87.5	28.2
Coniferous	S	138.3	132.2	89.1
Mixed Coniferous and Broadleaves	MS	293.2	280.4	525.8
Wood Plantation	P	0.0	0.0	40.0
2. Potential Forest	***PF***	***8,554.1***	***8,949.0***	***11,152.2***
Bamboo	B	1,475.0	1,531.9	539.0
Un-stocked*	T	6,499.7	6,791.4	10,096.3
Ray (Shifting Cultivation Area)	RA	597.4	625.7	516.9
3. Other Wooded Areas	***OW***	***1,545.4***	***1,444.2***	***286.5***
Savannah/Open Woodlands	SH	974.0	912.5	94.4
Heath, Scrub Forest	SR	571.4	531.7	192.1
4. Permanent Agricultural Land	***PA***	***708.7***	***894.4***	***1,200.0***
Rice Paddy	RP	658.3	798.4	963.7
Agriculture Plantation	AP	14.9	17.7	216.8
Other Agricultural Land	OA	35.5	42.3	19.5
5. Other Non-Forest Area	***NF***	***1,234.9***	***1,269.4***	***1,216.6***
Barren Land, Rock	R	109.8	116.1	231.0
Grassland	G	804.4	822.8	579.3
Urban Area	U	82.2	84.2	135.3
Swamp	SW	34.1	35.3	51.0
Water	W	204.4	211.0	220.0
TOTAL		***23,680.0***	***23,680.0***	***23,680.0***

Source: Department of Forestry, 2005

3. Status of Forest and Land Degradation

As shown in the previous section current forest vegetation types gradually decreased over time. However, inventory results before 1982 showed that the forest rapidly decreased from 70% of total land area in the 1940s to only 49.1% in 1982. Thus, there was a much higher deforestation

rate compared to the recent two decades (Maurand, French-Indochina Report, 1943; National Forest Inventory and Planning Centre, cited by DoF, 1982; no original report).
Forest loss during 62 years from 1940-2002 was identified as 28.5 % with an average of 0.44% per annum, while in 2002 forest cover amounted to 9,824,700 ha *(Department of Forestry, 2002)*. The forest resources assessment by FAO in 2005 resulted in a total forest area of 16.1 million ha. In this survey, a 10% canopy cover limit of all areas larger than 0.5 ha has been applied, while in the 2002 inventory which showed only 9.8 million ha, a 20% canopy cover limit of all areas larger than 0.5 ha had been used. Based on these results, it is concluded that about 11 million ha of forests to date are understocked (i.e. below 20% of canopy cover) and considered heavily degraded.

According to the Tropical Forestry Action Plan 1990-1995 (GoL, 2001), the forest in Laos was classified into three categories such as: production forest (5.0 million ha), conservation forest (9.5 million ha) and protection forest (2.5 million ha) with a total 17.0 million ha (Table 2). However, after ten years, the latest status showed that over 50 % of forest was under management plan, and about 10 million were considered as degraded forest.

Table 2. ***Current forest category in Laos***

Types	Level	Number	Area(ha)	Remarks
Production	National	106	3,207,000	
	Total	106	3,207,000	
Protection	National	23	461,000	
	Province	52	56,000	
	Total	75	517,000	
Conservation	National	20	3,391,000	
	Province	57	932,000	
	District	144	504,000	
	Total	221	4,827,000	
Natural Regeneration	National	164	181,920	Natural Rehabilitation
Grand total			**17,283,920**	

Source: Department of Forestry, 2005

Overall growing stock of the forests declined over time from an estimated level of total volume of 1,026,000,000 m^3 in 1990 and 980,000,000 m^3 in 2000, to 957, 000,000 m^3 in 2005 *(FAO, 2005).*

4. Causes of Forest and Land Degradation

Loss of forests in Laos took place due to a combination of several factors such as slash-and-burn agriculture, uncontrolled fire, frequently caused by shifting cultivators, infrastructure development such as dams, roads, urban, industry, and mining as well as clearing of land for permanent agriculture, and logging. The causes responsible for deforestation include the increase in population, the second Indochina War from 1954 to 1974 (1/4 of the country was affected by American bombardments), as well as external factors such as the high demand for wood and NTFP in the inter-

national markets. The lack of clear regulations and enforcement mechanisms, the absence of land use planning and land management systems including sustainable forest manage-ment and planning also contributed to forest degradation (Sayyasouk, 1999; Gilmour, 1999; Xong and Gilmour, 2000; Lang, 2001; Gilmour *et. al*, 2000; Duangsavanh *et al.*, 2003; Morris *et al*., 2004; ADB, 2005; GoL, 2006; Lee, 2006).

5. Impacts of Forest and Land Degradation

Major consequences of deforestation in Lao P.D.R. have been the decline in environmental services to rural communities because of the increasing frequency of both drought and flood events as well as land slides (DOF, 2007). Moreover, forest and land degradation negatively affect the goals of the Ministry of Agriculture and Forestry related to agricultural production and poverty alleviation. As the economy of Laos is based on agriculture and natural resources continued deforestation will significantly slow down the path towards poverty reduction and economic development.

PART B
IMPLEMENTATION OF FOREST RESTORATION AND REHABILITATION

1. History of Restoration/Rehabilitation

Concern over the rapid loss of forest cover in Laos between the 1940s and 1982 resulted in repeated efforts to increase the forest area in the country. Over the years, the Government of Laos, in collaboration with international organizations and local NGOs, has undertaken a number of programmes to rehabilitate existing forests through various means. Most of these programmes aimed not only at building new forests, but also at contributing to improve and sustain the lively-hoods of millions of rural people.
Some of the major forest restoration and rehabilitation activities are summarized in Table 3.

2. Current Policies Governing Land Use and Restoration/Rehabilitation

- There are many policies and strategies in Lao PDR in relation to land use and restoration / rehabilitation programmes. The most important ones are listed.
- Master Plan Study on Agricultural Development in Laos
- National Growth and Poverty Eradication Strategy (NGPES)
- The Government's Strategic Vision for the Agricultural Sector
- National Land Use Planning Programme
- Forestry Strategy to the year 2020 (FS 2020)
- National Strategy on Environment to the years 2020 and Action Plan for the years 2006-2010

- National Biodiversity Strategy to 2020 and Action Plan to 2010 (NBSAP)
- National Agricultural Biodiversity Programme (NABP)

The most recent national forest strategy prescribes an increase in the country's forest cover of 70% in the year 2020 through the natural rehabilitation of 6 million ha of degraded forest and 0.5 million of plantation (GoL, 2005) , In order to achieve this, 9 programmes and 146 action plans are outlined. These 9 programmes include:

1) Land and forest use;

2) Production forest;

3) Non-timber forest products;

4) Tree plantation development;

5) Harvesting/logging plans and royalties;

6) Biodiversity conservation;

7) Wood processing industry;

8) Protection forest and watershed management; *and*

9) Village land use and forest management.

Table 3. ***Forest restoration/rehabilitation activities in Lao PDR***

1932 - 2006	Forest plantation (for protection, production and genetic conservation) 186,000 ha (DoF, 2005) 220,000 ha (FRA, 2005)
1986 - present	Logged over areas (natural rehabilitation) 181,920 ha (DoF, 2005)
1989 - 2006	Forest and Forest Land Allocation Programs (FFLAP)
1993 - 2006	National Biodiversity and Conservation Areas (NBCAs) 4, 827,000 ha
1995 - 2000	Forest Management and Conservation Project (FORMACOP)
1995 - 2005	Forest rehabilitation and afforestation project (FORCAP) (benefit sharing between local communities and local government)
1998 - 2001	Asia-Pacific Forest Rehabilitation Network (APFReN) (lowland mixed deciduous forest enrichment planting)
2000 - 2005	Nam Ngum Watershed Conservation Project (NAWACOP) (direct sowing with local involvement)
2001 - 2005	Asian-Korea Environmental Cooperation Project (AKECOP) (Restoration in logged over, fallows and degraded forest land restoration by enrichment planting and agro-forestry)
2004 - 2008	Sustainable Forest and Rural Development (SUFORD)

3. Case Studies on Forest Restoration/Rehabilitation Initiatives

The need for forest restoration/rehabilitation has been recognised by the government since 1932. However, only over the past 25 years or so larger forestry programmes were undertaken. In the following, four major projects are briefly described.

3.1 *Forest Management and Conservation Programme (FOMACOP)*

This project supported by the Finnish Government and the World Bank was carried out between 1995 and 2001 and assisted in the establishment of community-based forest management in two production forests (Dong Sithouane, Savannakhet and Dong Phouxoy, Khammouane), with a total area of about 145,000 ha of natural forests involving 51 villages. More specifically, the programme aimed to achieve the following objectives:

- Develop schemes to improve sustainable forest management implementation and biodiversity conservation systems,
- Strengthen capacity to implement the systems,
- Improve policy and legal framework for village forestry and sustainable forest management.

The main project activities included the formation of forest management units (FMU), the development of guidelines for sustainable forest and non-timber forest management, and the implementation of best forest management practices on a pilot scale.
Overall, the project produced very useful results. At the end of the project period a workable benefit sharing system between the government and local people was established, greatly paving the way for long-term sustainable forest management. In addition, the project was expanded beyond the original project area and established forest management plans in 8 target state production forests in 8 districts covering a total forest area of 659,000 ha.
The project significantly contributed to developing and testing the guidelines for forest management planning as a guide for implementation. On that basis, 18 forest management units were established for implementation involving 400 village forest organizations. The forest certification scheme established by the project also proved to be a successful mechanism to guarantee the villagers' rights and responsibilities in managing forests on a sustainable basis.

3.2 *Sustainable Forestry and Rural Development Project (SUFORD)*

This is an ongoing initiative, which started in 2003 with an expected 5-year project period. The project covers 8 districts of Khammouane, Savannakhet, Champasack; and Salavanh provinces with 413 villages and is in the process of establishing 8 production forests, covering a total area of about 655.000 ha.
The objectives particularly focus on

- Strengthening the policy, legal and incentive framework for sustainable participatory forest management, *and*
- Improving rural well-being and livelihood through sustainable forestry and community development.

Similar to the FOMACOP project, also here the project promotes the application of best practices in line with sustainable forest management principles and the involvement of local village groups. Major results include a benefit sharing system for sustainable forest management and the successful certification of 3500 ha of production forests during 2004-2005. Actual forest management operations started in 2006 following the approved and certified forest management plan.

3.3 *Forest Conservation and Afforestation Project (FORCAP)*

The FORCAP project, implemented in the period 1998 – 2003, focused on 15 target villages in Hinheup district of Vientiane province. The initiative aimed at:

- Enhancing the participation of local people in the forest management cycle including planning, implementation and monitoring & evaluation;
- Promoting forest conservation and afforestation activities and thus contribute to human well-being;
- Strengthening individual and institutional capacity of rural communities; *and*
- Improving cross-sector coordination in the area.

The activities of the project are centred on the development of technical and managerial methods for forest conservation and afforestation. Major results included an action plan for forest management and stabilisation of shifting cultivation based on participatory village land use planning; a 15-year management contract between farmers and district authorities 213 ha of plantation and 7 ha of agro-forestry areas were established during 1998-2002 by 300 families in 15 villages, and 60 ha reforestation demonstration plots and 6.5 ha enrichment planting plots were established. The success of the project is based on cross-sector coordination providing for incentive mechanisms such as clean water supply systems, aquaculture, other alternative income generation activities, agro-forestry, and thus encouraged local involvement in forest conservation and protection. A system of 15-year rotation for forest plantations was also developed and implementation initiated.

3.4 *ASEAN-Korea Environmental Cooperation Project (AKECOP)*

AKECOP aims at the restoration of logged over forests, fallows and other degraded forest land in selected countries in the ASEAN region. The project was implemented in Laos in four target villages in Oudomxay, Luang Prabang and Borlikhamxay Provinces in the period July 2001 – June 2005. The activities focused on the application of suitable techniques for forest rehabilitation, particularly on species selection, planting techniques and organisational aspects. Particular emphasis was placed on agro-forestry systems with enrichment plantings using lines and gaps as principal planting areas within existing vegetation.
Results obtained included successful selection of timber species (e.g. *Hopea odorata*) for line and gap planting as well as suitable species for agro-forestry systems using fruit crops such as litchi and pineapple.
Constraints to large-scale application were identified and include limited attractiveness to poor farming communities except for some short-rotation crops and overall lack of funding support.

The experiences made with the four projects presented here will assist in the future design of forest rehabilitation initiatives in the country. Major lessons learned include (Phongoudome, C. 2005 and Manivong, K and Sophathilath, P. 2006):

- Level of local participation in planning and decision-making influences their contribution to forest management and is a key to sustainable management of the forest resources;
- There is a need to consider improved short- and long-term incentive mechanisms to encourage and maintain local participation;
- Expanding project results to other areas has frequently been hampered by inappropriate legal instruments and weak enforcement;
- Due to the rather small scale of the projects no clear effects on expansion to larger areas could be observed.
- Inadequately trained personnel and insufficient funding hinder larger-scale application.
- In addition, the period for project implementation needs to be expanded, so that sufficient time is available for bringing about the necessary organisational and institutional changes.
- As most of the projects have confirmed, access to markets can encourage forest-dependent income generation activities.

4. Assessment of Existing Capacities of Stakeholder Involvement

Basically, there are four main players in Lao P.D.R. active in the management, restoration and rehabilitation of forests. These key players are the government sector, private companies, NGOs and farmers. Comparing these organisations in respect of their capacity to manage forests, it is noticed that NGOs in Lao P.D.R. have by far the most extensive experience in terms of technical skills as well as managerial and organisational capacity. The government sector is the second experienced one followed by private sector companies. Skills and knowledge in establishing and managing forests are least developed among the farming communities, making them an important target group for capacity development and training programmes.
Over the past 10 years efforts have been undertaken to improve the forestry profession through upgrading programmes at master's, bachelor's and diploma's levels as well as technical schools. With regard to organisation and management at the national level, initiatives have been undertaken to enhance systems for information dissemination and sharing between major forestry agencies and local communities. A decentralisation process has also been initiated providing more authority to local governments in enforcing national forestry policies and regulations. In addition, the Ministry of Industry and Trade and the National Chamber of Trade and Industry have played key roles in enhancing the value of products for local consumption and exports.

PART C
FUTURE ACTIONS FOR ENHANCING RESTORATION/REHABILITATION

1. Reconciling Global and National Policies

The Government of Lao PDR has given high priority to the poverty issue and formulated targets on poverty eradication to be achieved in the year 2020. In order to reach these targets, several laws and regulations have been revised. The revision of legal documents started with the Lao Constitution passed in 1991 and was amended in 2003. Most of the documents revised and improved until today are laws and associated legal regulations. Some of the laws relevant to forest restoration and rehabilitation are presented in Table 4:

Table 4. Revised laws and regulations

Name of the laws	Passed in (year)	Revised in (year)
National constitution	1991	2003
Forestry law	1996	2005
Land law	1997	2003
Water and Water Resources law	1996	2005
Industrial Processing Law	1997	2005
Agricultural Law	1998	2005
Environmental protection law	1999	Under consideration for revision

National forest policy development before 1989 aimed at the following key issues:

- To utilize forest resources for the welfare and development of the population and to increase capital;
- To ensure that harvesting of forest is followed by plantation; *and*
- To invest the capital generated from forests in industries based on forest and agricultural products.

In May 1989, at the National Forestry Conference concern over deforestation and land degradation led to important decisions and overall direction of a revised forest policy. Three main policy directions were defined:

- To preserve and to enhance the biological diversity of the present forest, especially by improved systems of management and protection;
- To rationally use forests and take advantage of its associated benefits, especially to improve economic benefits from forest resources; *and*
- To link rehabilitation, preservation and expansion of forests with requirements for food, commodities and creation of permanent economic activities for uplands populations.

The conference agreed on steps to be taken to deal with deforestation and recommended that the country's forest cover should return to 70 percent by the year 2020.

In 1990, the government prepared a national Tropical Forest Action Plan (TFAP) which was officially adopted in 1991; the plan identified six major programmes:

1) Development process support (follow TFAP, advisory support to MAF);

2) Human resources development;

3) Alternatives to shifting cultivation;

4) Water catchments area protection/conservation forest;

5) Sustainable use of forests; *and*

6) Plantation forest development.

More recently, a strategic socio-economic development plan set development targets for the years 2005, 2010 and 2020, respectively:

- By 2005 shifting cultivation is to be basically stabilized and by 2010 completely eradicated;
- Tree plantation for commodity production is to be strongly promoted;
- Classification and delineation of forest for protection, conservation and production are to be completed.

Amongst others, the following ministry regulations related to forests and trees were issued:

- Village Forest Management was issued in June 2001;
- The Prime Minister Decree No. 59 on Sustainable Management of Production Forest was issued in May 2002; *and*
- The Ordinance of Prime Minister's Office No. 18 / 2002 on Forest Management Policy requiring the Ministry of Agriculture and Forestry to reassess national forest cover, forest categories, wood processing, and tree planting according to factory sizes, and regulate the use of wood energy source.

These policies and regulations are currently being implemented and – from time to time – revised, based on the changing socio-economic requirements.

2. Building Research and Education Capacities

In the early days of forestry education in Lao PDR, foresters obtained their certificates and degrees from abroad, mainly from Thailand, India, Papua New Guinea and Australia. In the early 1970s, the School of Agriculture and Forestry started with a vocational training programme. In 1986, the College of Agriculture and Forestry was established offering diploma courses. The new Bachelor

of Science programme in forestry started in 1996. Since then a curriculum for a Master of Science in forest management has been developed with the first intake of students, starting in October 2006. During the time of developing the forestry curricula in Laos, forestry staff was upgraded abroad, mainly in the Soviet Union, Vietnam, Germany and Malaysia. The history of forest education development in Laos is provided in Table 5.

Table 5. ***History of forestry education development in Laos***

Year	Diploma	Higher diploma	B.Sc.	M. Sc.	Ph. D.
Before 1970	Phrae Forestry School Thailand, India Forestry School,		Papua New Guinea, Australia, and Canada		
1970-1982	Phrae Forestry School Thailand, India Forestry School, Lao Agriculture and Forestry School		Canada, Soviet Union, Vietnam	Soviet Union	Soviet Union
1975-1982	Lao Agriculture and Forestry school		Soviet Union, Vietnam, Germany, Hungary	Soviet Union	Soviet Union
1982-1985	Three Forestry School, two forestry training centres		Soviet Union, Vietnam, Germany, Hungary, Czechoslovakia India, Sweden	Soviet Union, Germany.	Soviet Union
1986-1996	Three Forestry Schools, one forestry training centre	Forestry College, Ministry of Agriculture and Forestry	Soviet Union, Vietnam, Germany, Hungary, India	Sweden, Malaysia, Thailand, Philippines.	Russian, Germany, Malaysia.
1997-date	Agriculture and Forestry School (Ministry of Agriculture and Forestry)	National University of Laos (Ministry of Education)	National University of Laos (Ministry of Education)	Sweden, Malaysia, Thailand, Philippines, Japan, Netherlands, Germany, Vietnam.	USA, Japan, Malaysia, Thailand, Korea, Vietnam, Sweden.

2.1 *Forestry Research Trends in Lao PDR*

The first national Forest Research Centre was established in March 1996 and evolved from its predecessors such as the former forest restoration unit and national centre of forest nursery and logging unit in the Namsouang reservoir area in 1980. The unit was named Silviculture Division between 1985 and 1990, Silviculture Research Centre between 1991 and 1995. Currently it is called Forest Research Centre (FRC). The FRC was established under the supervision of the Department of Forestry (DoF), and has been under the umbrella of the National Agriculture and Forestry Research Institute (NAFRI), Ministry of Agriculture and Forestry (MAF) from April 1999 until to date. Since its establishment the institute has struggled with serious problems related to research capacity and permanent funding. This situation has not changed until today and significantly hampers the implementation of medium- and long-term experiments. Research at FRC is carried out in three research programmes, as shown in the summary below.

Research Programmes 2001-2010 in Forestry Research Centre

1) *Silviculture Research Programmes:*

- Tree plantation zoning and species suitability for different zones,
- Productivity improvement and cost effective tree planting,
- Rehabilitation techniques of degraded forest and fallow lands,
- Growth and yield studies in natural forest managed under the selection system,
- Village forestry model development,
- Livelihood and production systems in the uplands including marketing constraints and potential for agroforestry products,
- Testing promising agroforestry systems,
- Interaction between agroforestry components, *and*
- Adaptability and adoption of agroforestry systems.

2) *Non-Timber Forest Products Research Programmes:*

- Domestication for commercial NTFP host species,
- Sustainable NTFP management and harvesting,
- Plant taxonomy studies and botanical survey,
- NTFPs inventory and NTFP resources assessment techniques,

- NTFP marketing; *and*
- Processing studies

3) *Tree Seed and Tree Improvement Research Programs:*

- Species and provenance trialsm,
- Seed demand and marketing,
- Regulatory framework,
- In-situ and ex-situ genetic resources conservation,
- Technical standards and guidelines for indigenous tree species seeds handling and procurement,
- Gene ecological zoning,
- Seed sources management and development, *and*
- Propagation techniques.

To date, a total number of 86 professionals are employed in forestry institutions of Laos such as the Ministry of Agriculture and Forestry, the Forestry Department, the Forest Research Centre, Forestry Extension Division, and the Faculty of Forestry. Not included are the levels of higher diploma, diploma, contract staff, and those working in other sectors. The details of specialisations of staff are provided in Table 6.

2.2 *Research, Education, Extension and Policy Linkages*

- Research on forest rehabilitation and its results will
  - facilitate the improvement of the educational quality,
  - provide a framework for participatory technology development and information for extension *and*
  - generate information to be provided to the policy making processes related to natural resources management and rehabilitation.
- Research is an important tool for educational framework development (e.g. curriculum, tracer studies) and for the improvement of the teaching and learning process (e.g. syllabi and manual development).
- On-station and on-farm trials are valuable opportunities for teachers and students to experience linkages between local development activities and adaptive research. Results of participatory development will be provided for relevant institutions.

Table 6. ***Current staff employed in the forestry sector of Laos***

Field	Ph. D.	M. Sc.	B. Sc.	Remark
Agroforestry		1		
Environment Management		2		
Forest Botany	1	1	1	
Forest Ecology		1		
Forest Economics		1	1	
Forest Engineering	1	6		
Forest Entomology		1		
Forest Inventory		1		
Forest Policy	1	1		
Forest Products		2		
Forest Recreation	1	1		
Forest Resources Management	1			
Forest Rural Development	1	4		
Forest Silviculture	1	3		
Forest Watershed	1	1		
Forest Watershed Management	1	1		
Gender		1		
General Biology			4	
General Forestry			20	
GIS	1			
Land Use Planning	1	3		
Natural Resources Management		12		
Tree Propagation		1		
Wildlife Management		1		
Forestry Education Management		1		
Wood Science	1	3		
Total	**12**	**48**	**26**	**86**

3. Partnership and Collaboration with Private Sectors

The government currently has a strong collaboration with international institutes and organizations, NGOs and private sector companies in managing forest and land resources. Currently, there are about 60 private companies involved in forestry plantations established on degraded forest land. These include BGA, Oji (Japan), KASIM, China, Vietnam, Thailand, and local companies assisting Laos to increase the forest cover in the country. In addition, recognition on the importance of forest resources is highly appreciated by NGO's. Currently, there are more than 50 NGOs working in Laos, of which 29 are involved in projects related to agriculture, forestry, fisheries, natural resources and/or ecosystems management and conservation.

4. Creating Public Awareness and Support

Many public awareness activities related to and in support of the environment are carried out throughout the country. The most important one is the annual National Arbor Day (June 1) that promotes planting of trees involving the government sector, private companies, NGOs and educational institutes. The event is celebrated country-wide in conjunction with the international children day, thus raising awareness among children on the importance of forests for the improvement of the environment and human well-being.

Moreover, public awareness is further raised through radio broadcasting, television programmes and monk speeches reminding the public on the importance of trees and forest resources.

Environmental awareness groups operating in Laos further promote awareness-raising on environmental issues in the country. Most of them are supported by international organizations, NGOs, the government, and private sector companies. The Dong Dok Nature Society, for example, is an environmental awareness raising group proposed by the first batch of Bachelor of Science in Forestry in the Faculty of Forestry, National University of Lao in 1996. This is a student-led organization on environmental campaigning supported by various organizations such as the IUCN and the National Tourism Administration. This organization has been running well until now bringing together many students from the forestry faculty, other faculties as well as people from outside the university willing to being involved in campaigns.

Ecotourism activity is another tool in promoting awareness on forest and forest resources. The Nam Ha National Biodiversity Conservation Area (NBCA) ecotourism project, for example, is a good example of forest conservation and management that can promote rural livelihoods. This project was awarded by UNESCO.

5. Community Involvement

Community involvement in forest and land management in Lao PDR has become an essential strategy towards sustainable forest resources management. Starting in 1986, the government promoted a new approach (i.e. New Economic Mechanism Strategy) to focus on market economy as well as the decentralization of forest management. This approach delegates duties and responsibilities to local authorities and rural communities for managing land and forest resources. The decentralization approach promoting forest management with communities' involvement is supported by international organizations, NGOs and the government. Major projects include:

- Joint Forest management (JFM) of production forests (Savannakhet Province): focussing on benefit sharing mechanisms, in which most of the revenue generated goes to the village development fund and is also used for re-investment into forest management and operations.

- Forest conservation (Nam Ha NBCA, Luang Namtha Province): emphasis is on the involvement of local people in servicing tourists in the area as well as selling local products and souvenirs.

- Forest conservation and afforestation project (Vientiane Province): offers benefit sharing mechanisms such as provision of seedlings to farmers and the distribution of final products among the farmer communities.

- Lao-Swedish Upland Agriculture and Forestry Research Programme (Luang Prabang and Oudomxay Provinces): on-farm research on local needs of rural people participating in the project with the purpose of poverty alleviation and sustainable forest and forest land use.

6. Monitoring and Evaluation for More Effective Rehabilitation/Restoration

The main mechanism for monitoring and evaluation of forest restoration and rehabilitation is based on 10 year re-inventories such as those conducted in 1982, 1992 and 2002, respectively. This regular assessment assists in the development of policies, strategies, and further actions for the improvement of forest rehabilitation works. In addition, the extent of shifting cultivation in Lao PDR was also assessed especially from 1990 to 2006. As a result of new policies being in place, the number of families practicing shifting cultivation decreased from 210,000 (with a cultivated area of 249,000 ha) in 1990 to 32,790 families (with a cultivated area of 14,400 ha) in 2006 (Table 7).

Table 7. ***Evaluation of shifting cultivation in Laos***

Year of assessment	Number of family	Area (ha)
1990	210,000	249,000
2001	134,000	93,900
2005	43,039	29,400
2006	32,790	14,400

Source: Forestry strategy to the year 2020, July 2005

7. Financing of Forest Restoration/Rehabilitation

The main sources of funding for forest restoration in Lao PDR are the government (currently the forest development fund and the environmental conservation fund), international donors, NGOs as well as the private sector. The Lao government is now implementing some of the major projects by using resources of the forest development fund that aim to sustain forest resources as well as to improve rural livelihood. In addition, the environmental conservation fund created in early 2006 will provide also components for environmental research (including research on forests) in the near future.

International funding sources are currently still the main financial support for forest research, development, management and restoration/rehabilitation of forests in the country. Table 8 provides information on the financial sources from international organizations practicing forest conservation activities in the country. In addition, there is still some support for forest conservation activities including research from national and international private sector companies.

Table 8. ***International funding sources for forest rehabilitation in Lao PDR***

No	Country	Long-term training	Short-term training	Facility	Government contribution	Remark
1	Sweden	x	x	x		Grant
2	Denmark	x	x	x		Grant
3	Germany	x	x	x		Grant
4	R. Korea	x	x		x	Grant
5	Japan	x	x	x		Grant
6	China		x		x	Grant
7	Vietnam	x	x		x	Grant
8	ADB					Loan
9	Thailand	x	x			Grant
10	FAO		x			Grant
11	India		x			Grant
12	UK		x			Grant
13	Netherlands		x			Grant
14	LAO/WB/Finnida		x	x	x	Loan/Grant
15	Government of Laos					Forest Development Fund
16	APAFRI		x		x	Grant

PART D
MISCELLANEOUS

1. Forest Fires

Forest fire is not really a concern in the country because Lao PDR is a sub-tropical to humid country. However, due to shifting cultivation and hunting activities, uncontrolled fires sometimes result in the destruction of wildlife habitats involving the loss of wild insects and animals.

2. Regional and International Collaboration in Forestry

Over many years, the forest sector of Laos has received significant support from the international donor community. Projects range from forest resources inventories and forestry operations to scientific studies and capacity development. More detailed information about these cooperation projects are provided in Annex 1.

3. Pests and Diseases, Invasive Species, Exotics, etc.

3.1 *Pests and Diseases*

Lack of assessment, but also found in Pine forest in the North of Laos.

3.2 *Invasive Species*

Mimosa invisa, M. pigra, is not only found in agricultural land but also in secondary forests and open areas (Nhoybouakong and Khamphoukeo, 2003). Others are *Imperata cylindrical* (grass) and *Leucaena leucocephala* (infesting small to medium trees) (The Global Invasive Species Database, n.d).

3.3 *Exotic Species*

Acacia mangium, Acacia crassicarpa, Acacia auracuriformis, Anacardium occidentale, Eucalyptus camaldurensis, Sweitenia macrophylla, Samanea saman, Casuarina equisetifloria, Heavea brasilensis, Leucaena leucocephala, Asoka longfolia. (Phongoudome and Mounlamai, 2003).

REFERENCES

ADB. 2005. Sector assistance program evaluation for agriculture and natural resources sector in Lao PDR.

ADB. 2005. Ethnic minority development framework for forest plantation development project.

AKECOP. 2001, 2002, 2003, 2004, 2005. Project document, Restoration of Degraded Forest Ecosystem in Southeast Asian Tropical Region. Annual Report of AKECU, NICEM, SNU.

AKECOP. 2002. Restoration of Degraded Forest Ecosystem in Southeast Asian Tropical Region. Annual Report of AKECU, NICEM, SNU.

DoF. 2005. Forest statistics 1975-2005. Vientiane, Lao PDR.

DoF. 2007. Report on current status of forest management for timber products industry in Lao PDR. National Workshop, 14-15 February, 2007. Vientiane

Duangsavanh, L., B. Bouahom and J. Raintree. 2003. Ethnic diversity and biodiversity in the Lao PDR uplands. *In*: Xu Jianchu and Stephen Mekesell (eds.) Landscape diversity: Indigenous knowledge, sustainable livelihoods and resource governance in Montane mainland Southeast Asia. Proceeding of III Symposium on MMSEA 25-28 August 2002. Lijiang P. R. China. Pp.79-99. Kunming, Yunnan Sciences and Technology Press.

FAO. 2005. Global Forest Resources Assessments 2005. Lao PDR Country Report 182, Rome.

FAO. 2005. State of the World's Forest. FAO, Rome.

FRC. 2001. Report on Demonstration of Rehabilitation Plot in Logged over forest in Pakkading, Bolikhamsay Province Laos. FRC-FORSPA Project. Vientiane, Laos.

FRC. 2005. The National Forestry Research Agenda for the year 2000-2010. Vientiane, Lao PDR.

Gilmour, D.A. 1999. Rehabilitation of Degraded Forest Ecosystems in Vietnam, Lao PDR, and Cambodia. Regional Overview. Final report. IUCN – The World Conservation Union.

Gilmour, D.A, Nguyen Van San and X. Tsichalicha. 2000. Rehabilitation of Degraded Forest Ecosystems in Cambodia, Lao PDR, Thailand and Vietnam. Conservation Issues in Asia. IUCN-WWF-GTZ.

GoL. 1993. Prime Minister Decree No.164/PM on Establish National Biodiversity Conservation Areas. Vientiane, Lao PDR.

GoL. 2001. The Tropical Forest Action Plan 2001-2004. Vientiane, Lao PDR.

GoL. 2005. National Export Strategy for Laos: Wood sectors. Ministry of Commerce. Vientiane, Lao PDR.

GoL. 2006. Eight National Party Congress. Vientiane, Lao PDR.

Hirsch, P. 2000. Underlying cause of deforestation in the Mekong region. Australian Mekong Resources Centre, School of Geosciences, Univ. of Sydney. Pp.157-168.

Lang, C. R. 2001. Deforestation in Vietnam, Laos, and Cambodia. *In*: Vajpeyi, D. K. (ed). Deforestation, Environment, and Sustainable Development: A Comparative Analysis. Praeger. Pp. 111-138.

Latiff, A. M. 2000. Professor of Botany, Department of Biology, Faculty of Sciences and Technology, National University of Malaysia (UKM).

Lee, D. K. 2006. Regional Forest Policy in Asia. Special Papers, Department of Forest Sciences, CALS, SNU.

MAF. 2006. National Agriculture and Forestry Conference. Vientiane, Lao PDR.

Manivong, K and P. Sophathilath. 2006. *Status of Community Based Forest Management in Lao PDR: Final Draft*, a Status Report for the submission to the Regional Community Forestry Training Center for Asia and the Pacific (RECOFTC), National Agriculture and Forestry Research Institute (NAFRI), Ministry of Agriculture and Forestry (MAF), Vientiane, Lao PDR.

Morris, J., A. Ingles S. Ketphanh. 2004. Linking Poverty Reduction with Forest Conservation Case Studies from Lao PDR. IUCN. http://www.iucn.org/themes/fcp/publications/files/poverty/lao-pdr-povertyreductionboook.pdf.

NAFRI. 2004. The National Agriculture and Forestry Research Strategic for the year 2005-2010. Vientiane, Lao PDR.

Nhoybouakong, M. and K. Khamphoukeo. 2003. Invasive alien species in South-Southeast Asia: national reports and directory of resources. *In:* Pallewatta, N., J. K. Reaser and A. T. Gutierrez. http://www.gisp.org/downloadpubs/SOUTH_AN.PDF.

Phongoudome, C. 2005. Report on Forest Policy on Non-Timber Forest Product (Draft). Forestry Research Centre, NAFRI.

Phongoudome, C. and K. Mounlamai. 2003. Status of Forest Genetic and Management in Lao PDR. *In*: Proceedings of Asia-Pacific Forest Genetic and Conservation 13-17 July, 2003, FRIM.

Sayyasouk, B. 1999. Forest Fire in Lao PDR. FAO Report.

Xu Zai Fu. 1994. Feasibility Study of Flora of Lao PDR. Chinese Academy of Forestry. Kunming, China.

Xong, T. and A. Gilmour. 2000. Forest Rehabilitation in Lao PDR: Issues and Constraints. IUCN-Vientiane, Lao PDR.

LITERATURE USED

AKECOP. 2006. Proceeding of planning workshop of Second phase of AKECOP, Jakarta, Indonesia 11-15 January 2006.

Anon. 2001. Teak in the Lao People's Democratic Republic - Department of Forests Ministry of Agriculture and Forestry, Lao PDR. http://www.fao.org/DOCREP/005/AC773E/ac773e0e.htm.

Anon. 2005. Villager centred Forest Conservation/Promotion of Sustainable Agriculture and Livelihood Improvement / Rural Development. http://www.ngo-jvc.net/en/laos.html.

Anon. Annamite Range Moist Forest. http://assets.panda.org/downloads/annamiteflrfactsheet.pdf

Baskaran, D. K. Regional update for South and East Asia. http://www.fao.org/DOCREP/005/AC646E/ac646e0a.htm.

Chanhthirath, K. 1998. Participatory forest conservation and afforestation in degraded forestland for sustainable forest management in the Vang Vieng District (case study). http://www.iges.or.jp/en/fc/phase1/3ws-21-khampha.pdf.

Chanhthirath, K. 1998. Study on participatory forest conservation and Forest Rehabilitation in Degraded forestland in the Vang Vieng District (Lao P.D.R.). http://www.iges.or.jp/en/fc/phase1/ir99/2-7-Chanthirath.pdf.

Chanthirath, K. 1998. Forestry Resources and the underlying causes of Deforestation and forest degradation in Lao PDR. Pp. 534-532. www.iges.or.jp/en/fc/phase1/ir98-5-10.pdf.

Chanthavong, S. 2003. Participatory forest management: a research study in Savannakhet province, Laos. Institute for global environment strategies, Japan.

Cleetus, R. 2005. Case study Lao PDR: Using strategic environmental vulnerabilities assessment (SEVA) for evaluating threats to Forests. WWF-Macroeconomics Program Office.

DoF. (unknown date). Teak in the Lao PDR: small scale teak planting work by farmers in Luang Prabang Province, Lao PDR. http://www.fao.org/doccrep/005/ac773e/ac773e0e.htm.

FAO. 2001. State of the World's Forest. FAO, Rome.

FAO. 2006. Global Forest Resources Assessments 2005. FAO, Forestry Paper No. 147. Rome.

Foppes, J. and S. Ketphanh. 2000. Forest extraction or cultivation? Local solution from Lao PDR. Paper presented at the workshop on the evolution and sustainability of "Intermediate systems" of forest management, FOREASIA, June 2000, Lofoten Norway.

Forestry Research Centre. 2000. Report on National Workshop on Priority Tree Species for Plantation in Laos. Vientiane, Laos.

Geijmans, M.G. and C. Phongoudome. 2002. Assessment of tree Species for genetic conservation in Lao PDR. *In*: Journal of Agriculture and Forestry No. 5.

Gilmour, D.A. and X. Tsichalicha. 2000. Forest Rehabilitation in Lao PDR: *Issues and Constraints*. IUCN-Vientiane, Lao PDR.

Global Invasive Species Database, n.d. '100 of the Worst Invasive Alien Species', http://www.invasivespecies.net/database/species;search.asp?st=100ss&fr=1&str=#SpeciesList (15/12/2006)

GoL 2005. Forestry Strategy to the year 2020 of the Lao PDR. Vientiane, Lao PDR.

GoL. 1989. The first National Forestry Conference. Vientiane, Lao PDR

GoL. 2003. National Biodiversity Country Report. Vientiane, Lao PDR.

GoL. 2004. The National Biodiversity to 2020 and Action Plan 2010.

GoL. 2006. Third national report on implementation of united nation convention to combat desertification. PMO-STEA, Vientiane May, 2006.

http://cdiac.oml.gov/ftp/trends/emissions/lao.dat, (August 31, 2005).

http://cdiac.ornl.gov/trends/emis/lao.htm, (2006).

http://www.adb.org/documents/caps/LAO.

http://www.arcbc.org, 2006.

http://www.aseansec.org, 2006.

http://www.directoryofngos.org/ngoindex2.cfm 2006.

http://www.earthtrends.wri.org 2003.

http://www.fao.org, 2006.

http://www.kpl.net.la/english/30years/.

http://www.rrcap.unep.org/country/cp/seasia/cp_LaoPDR.cfm.

http://www.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICCEXT/.

Inman, F. Predicting Primary Forest Recovery in a Fragmented Landscape: a Restoration Roadmap. Botany Department, North Carolina State University North Carolina, USA. http://www.seasite.niu.edu/Lao/LaoStudies/finma.htm.

IUCN. 2004. Red list of threatened species. http://www.iucnredlist.org/.

Jullien, F. 2005. Forest conversion in Lao PDR: Assessment of threats and opportunities. WWF Lao Program Indochina Program. http://www.wwfindochina.org/resources/publications/LaoPDR_Forest%20Conversion.pdf.

Lamb, D. 1999. Rehabilitation of Degraded Forest Ecosystems. (Draft manuscript).

Lamb, D. and D. A. Gilmour. 2003. Rehabilitation and Restoration of Degraded Forests: Issues in Forest Conservation. WWF-IUCN.

Lamb, D., P. Evskine and J. Parrotta. 2005. Restoration of degraded tropical forest landscapes. Science 310, 1268 or www.sciencemag.org.cgi.

MAF. 1990. Tropical Forest Action Plan. DoF, Vientiane, Lao PDR.

MAF. 2005. Forestry Strategy year 2020. Vientiane, Lao PDR.

Manivong, P. 2005. Final Report on Forest restoration of logged over and fallows in Laos. AKECOP Regional Research 2001, July-2005, June.

Marland, G., T. Boden and R. J. Andes. 2005. National CO_2 emissions from fossil-fuel burning, cement manufacture, and gas flaring: Country Study for Laos.

Ministry of Agriculture and Forestry. 2005. Agriculture and Forestry Statistics Year Book 2004. Department of Planning, Vientiane, Lao PDR.

Ministry of Agriculture and Forestry. 2005. Agriculture and Forestry Statistics Year Book 2004. Department of Planning, Vientiane, Lao PDR.

Ministry of Agriculture and Forestry. 2005. Report on the assessment of forest cover and land use during 1982, 1992, 2002. Department of Forestry, Vientiane, Lao PDR.

Phongoudome, C. 2005. Final Report on Forest Restoration using Agroforestry Technique in Degraded Forest and Forest Land Northern Lao PDR. AKECOP Regional Research 2002-2005.

Phongoudome, C. 2006. Seminar Papers on Forest, Forestry Research, Education and Extension in Lao PDR. Department of Forest Sciences, College of Agriculture and Life Sciences, Seoul National University, Korea.

Phongoudome, C., P. Philakone, T. Inthavong, K. Phakchomphone and K. Homesavad. 2005. Draft Report on Feasibility Study on Suitable Tree Species and Planting Zones in Northern Lao PDR. NAFRI/LSUAFRP. (un-published)

Samountry, X. 2000. Country Update No. 13 Lao PDR. FAO Report.

Sandewall, M., B. Ohlsson and S. Sawathvong. 2001. Assessment of historical land use changes for purposes of strategic planning - A case study in Laos. Ambio Vol. 30 No. 1 (55-61). Royal Academy of Science.

Sanonty, S. 2002. Forest Policy Review in Lao PDR. FAO.

Sanonty, S. 2002. National forest products statistics, Lao PDR. FAO: An overview of forest products statistics in South and Southeast Asia.

Sigaty, T. 2003. Report on Legal Framework in Forestry Sector for Forestry strategy 2020. Vientiane, Laos.

Sirivongs, K. 2004. Environment Protection and the Law: Hydropower Projects in Lao PDR. Australian National University.

Sirivongs, K. 2006. Lao PDR APFORGEN report. Dedradun, India.

Sodarak, H., C. Ditsaphon, V. Thammavong, N. Ounthammasith and O. Forshed. 2004. Indigenous agroforestry pratices in two districts in the Northern part of Lao PDR. *In*: Proceedings of the workshop on shifting cultivation and poverty eradication in the uplands of the Lao PDR. January 2004, Luangprabang, Laos.

Theilade, I., T. Luoma-aho, A. Rimbawanto, H.N.Nguyen, M. Greijmans, Z.N.A Nashatul, A. Sloth, So Thea and S. Burgess. 2005. An over view of conservation status of potential plantation and restoration species in Southeast Asia. http://www.APFORGEN.org.

Tsechalicha, X. and D. A. Gilmour. 2000. Forest Rehabilitation in Lao PDR: Issues and Constraints. IUCN-WWF-GTZ.

Vongxai, M. 2003. Current energy situation and the future role of oil and gas for petroleum security in Lao PDR. Foreign Trade Department, Ministry of Commerce Lao PDR.

Wayakone, S. 2004. Status of Biodiversity Researches in Lao PDR. Special Reports, ASEAN Biodiversity. Pp.19-21.

Wayakone, S. 2005. Biodiversity Research for development in Lao PDR. In: Biodiversity Research for Development in Southeast Asia. Proceedings of conference workshop towards a regional cooperation on Biodiversity research for development. Pp.35-40.

Yamane, M. and K. Chanhthirath. 2000. Lao Cypress Forest: Causes of Conservation in Lao PDR. International Review for Environmental Strategies. Vol. 1 No. 1 (119-133). IGES.

Yayoi Fujita, T. Vongvisouk, H. Chantavong and S. Chanthaleunnavong. Dong Phou Xoy and Dong Sithouane Production Forests: paving the way for village forestry. http://www.fao.org/docrep/007/ae542e/ae542e08.htm.

ANNEX 1
Regional and International Collaboration in Forestry

Regional Collaboration

Name	Project Title	Duration	Funding	Remarks
ASEAN Korea Environmental Cooperation Project (AKECOP)	Restoration of Degraded Forest Ecosystem in Southeast Asian Tropical Regions	Phase I: July 2001 – June 2005, and Phase II: July 2005~June 2008	Grant	Capacity building; agro-forestry in degraded forest land, and rehabilitation in logged-over forests and fallows
ARCBC	Rattan Shoot Product, and Cardamoms Trial	2001-2003	Grant	
Asia Pacific Forest Genetic Resources and Conservation (APFORGEN)	Network	July 2003~date		1st Inception Workshop July 2003, Second Workshop November 2004 (absent), Third Workshop April 2006
Asia Pacific Forestry Research Association (APAFRI)	Network	1999, member 2003~date		
Brunei				Discussion on Aquilaria plantation 2005
Cambodia	Conservation Project			
China	Training on Tropical Plantation	2004, 2005 (2 staff/year)	Grant + Government of Laos	Yunnan Academic of Forestry Visit FRC
Indonesia-JICA		2004 (1 staff), 2005 (1 staff), 2006 (1 staff)	Grant	Capacity building on forest tree improvement
Japan				National Agro-Environment Sciences of Japan-NAFRI MOU; Forestry and Forest Products Research Institute of Japan (Draft MOU)
Malaysia				Information sharing
Myanmar				Teak seed support
Philippines				
Singapore		1999/2000	Grant	Training on orchid propagation
Thailand	Agriculture and Forestry			
Vietnam				NAFRI-FSIV (MOU)

International Collaboration

Name	Project Title	Duration	Funding	Remarks
Denmark (DANIDA)	Indochina Tree Seed Programs (Lao Tree Seed Project)	1998-2004	Grant	Capacity building
Denmark (DANIDA)	Forest Watershed Management	1998-2003	Grant	Ministry of Agri-culture and Forestry
Sweden	Lao Swedish Forestry Programs	Phase IV: 1996-2001	Grant	Capacity building, growth and yield studies, rehabilitation in fallow and dry dipterocarp forest
Sweden	Lao Swedish Upland Agriculture and Forestry Research Project	Phase I: 2002-2006	Grant	Capacity building and research-development
FORSPA	Forest Rehabilitation and Biodiversity in Logged Over Forest	1998-2001	Grant	Demonstration plot 100 ha
LAO-ADB	Forestry Plantation	Phase I: 1993-2005; Phase II: 2006-2010	Loan	Industrial plantation
LAO-WB-FINNIDA	Phase I: Forest Management and Conservation Project (FORMACOP); Phase II: Sustainable Forest Management and Rural Development Project (SUFORD)	Phase I: 1995-2000; Phase II: 2004-2008	Grant + Loan + Laos Government	200 permanent sample plots on growth and yield
JICA	Forest Conservation and Afforestation (FORCAP)	1995-2005	Grant	Reforestation in Lower Namngum Reservoir
CARE	Non-Timber Forest Products Information Centre	1997~2001	Grant	
IDRC	Bamboo Inventory	1992-1994	Grant	
Darwin-RBGE-K	Rattan	1998-2001	Grant	
Darwin-IUCN	Botanical Training	Phase I: 2001-2003; Phase II: 2004-2006; Phase III: 2007-2009?	Grant	FRC, FIPC, FoF, FoS-NUoL
Darwin-FORRU	Forest Rehabilitation	2005	Grant	Provided training for FRC, DoF, FoF
IUCN	NTFPs	1995-2001	Grant	
NC-IUCN	Botanical Survey	1998-2001	Grant	
FAO	(1) Forestry Library; (2) Marketing Analysis Development		Grant	
FAO	Styrax benzoin Project	1997-2000	Grant	
Neem-Network	International Neem Provenances Trial (*Azadirachta indica*)	1997-2001	Grant	
ACIAR	Chukrasia tabularis, Toona ciliate)	1997-2002	Grant	

Table "International collaboration" continued

SNV	Technical Advisor on NTFPs	Phase I: 2003-2006	Grant	Free service
ACIAR	Processing of Timber from Plantation			Project document
WWF	Rattan Studies (Lao-Cambodia)			Project Document 2006
IUFRO-SPDC	Keep Asia Green	January-December 2006		1st Workshop June 2006
CIFOR	1st Workshop on the Role of Forest Permanent Samples Plot in Asia and Pacific			2005 joint workshop
GTZ	Forest Cover and Monitoring Project	1992-1997	Grant	
GTZ	Forestry Curriculum	2000-2005	Grant	FoF, NUoL
GTZ	NAVACOP	1995-2005		
ICRAF-SENAFES	Agroforestry Curriculum		Grant	FRC as National Partners
VASI-NAFRI-Sida-ICRAF-CGIAR	Agroforestry Support Project for Vietnam and Lao PDR	1998-2001	Grant	

Forest Rehabilitation – The Malaysian Experience

by

Daniel B. Krishnapillay, Mohamed A. A. Razak and Simmathiri Appanah

PART A
STATUS OF LAND USE AND FOREST (AND LAND) DEGRADATION

1. Historical Perspective of Forest Land Use and Land Use Change in Malaysia

In former times, natural forests were extensive in Malaysia. Contrary to events in other regions of the world, European colonization of Malaya, which began in 1511 with the capture of Malacca by the Portuguese, did not result in exploitation and removal of the forest. In those days, the foreign demand was for spices, gum Arabic, gutta percha and what were subsequently termed "minor forest products". Exploitation for timber began in earnest only towards the end of the 19th century. The logged timber was entirely used for development within Malaya, in construction work, the building of the railway lines and for tin mining and smelting. This period also saw an unprecedented demand for gutta percha, an exudate that resembles latex from gutta taban (*Palaquim gutta*). This substance was needed for the insulation of the sea cables used in pre-wireless days. This resulted in heavy exploitation of the taban trees from the forests. Another development of the time that affected forests was the introduction of rubber (*Hevea*) plantations.

Export of timber did not really take place until the Empire Trade Fair Exhibition of 1925. Samples of Malayan forest produce and timber samples were sent to London. This was when interest for Malayan timber was shown and a market for it began to be established. In those days sustainable forest management was never heard of and uncontrolled logging and heavy exploitation was the rule. In 1947, post-war examination from selective felling of forest was done and it showed that many areas contained adequate or even abundant regeneration of timber species (Walton, 1948) and that these areas on the whole would recover by themselves. This observation led to the development of the Malaysian Uniform System (MUS) for managing the lowland Dipterocarp forests in Malaya.

However, in 1960, the Malayanisation process began and by 1963, based on the Ford Foundation report, plans for agricultural diversification and rural development were initiated in P. Malaysia. Before the decade was over, sweeping changes to land-use policies were made and most of the timber-rich lowland forests were set aside for agriculture. Forestry was third priority after mining and agriculture for land-use. Forestry was forced up to the hills and those areas with soils too poor for agriculture, and where the forest composition and its merchantable value did not measure up to that in the lowland Dipterocarp rich forests. In Sabah and Sarawak, too, apart from uncontrolled logging, forest had been lost due to shifting cultivation using the slash and burn method by the natives.

Hence, beginning in the early 1960s, large tracts of lowland forest were cleared for the planting of paddy and rubber under the country's agricultural development program. Millions of hectares of rubber plantations have been established since then. Around the same time or earlier, tin mining became big business and large areas of lowland forest concessions were also given out for this purpose. After mining, these areas were laid bare with almost no vegetation. Around the early 1970s oil palm was also introduced into commercial planting and again vast tracts of lowland for-

est were taken up for this plantation crop. Today, it can be seen that we hardly have any lowland forest left in the country and most of our forests in Malaysia are confined to the hills.

Then again in and around the nineties, the country experienced the Industrialization and slump eradication era. Here again large tracts were cleared for building low cost housing for the mass and for other mixed developments. Land areas were also allocated for industrial buildings.

Today the status of the available forest is summarized in Table 1. In the category of Permanent Forest Estates (PFE) in Peninsular Malaysia, the very notable and recognized area worldwide is the Matang Mangrove Forest. It has been touted as the best sustainably managed mangrove estate in the world. Located in Perak (5°8'N; 100°35'E) it covers a total area of about 40,500 ha. A total of 19 forest reserves were gazetted beginning with the islands followed by the mainland beginning in 1902. In the category of the National and Wildlife Park, the notable reserve in Peninsular Malaysia is the Taman Negara. This is touted as the oldest rainforest in the world. It stretches over three states (namely Pahang, Trengganu and Kelantan) and covers a total area of about 500,000 hectares. It was established in 1939. In Sabah, the notable forest reserve is the Maliau Basin which covers an area of 39,000 hectares of pristine forest and was established in 1983.

Table 1. ***Existing forest types in Malaysia based on a usage classification***

Types	Peninsular Malaysia	Sabah	Sarawak	Total
PFE	4.73	3.59	6.00	14.32
• Productive	2.83	3.00	4.97	10.80
• Protective	1.90	0.59	1.03	3.52
National and wildlife parks	0.74	0.38	1.00	2.12
State land forest	0.46	0.49	2.89	3.84
Total	***5.93****	***4.46****	***9.89****	***20.28****
Total land area of Malaysia: 32.86 million hectares				

* In millions of hectares

2. Current Status of Forest (and Land) Degradation

2.1. Extent of Degraded Lands in Malaysia

Degradation is used here to refer to former forest land that has had the trees removed and is being farmed in a manner unlikely to be sustainable into the future or to forest land that has been disturbed and has been abandoned since. The degraded terrestrial ecosystems that are grouped according to the definition are abandoned agriculture land, ex-mining land, poorly stock logged over forests and ex-shifting cultivation areas. The extent of degraded lands in Malaysia is as shown in Table 2.

3. Causes and Impact of Forest (and Land) Degradation

In Malaysia, causes of degradation may be due to a consequence of a variety of processes or activities. Sometimes it is possible to identify a single cause but often it is a number of factors

that cause the degradation.The following are the leading factors behind deforestation (Panayotou & Ashton 1992).

Table 2. ***The extent of various degraded lands in Malaysia***

Type of degraded land	Acreage (ha)	Source
Poorly stock logged-over forests that had been converted to forest plantations in Peninsular Malaysia.	56,260	Thai *et al.* (1995)
Shifting cultivated areas	4,800,000	FAO/UNEP (1981)
Degraded secondary forests i. Peninsular Malaysia ii. Sabah iii. Sarawak	(4,604,000) 174,000 1,100,000 3,330,000	Ahmad ainal bin Mat Isa (1992)
Ex-mining land	114,000	Chan (1990)
Abandoned Agricultural land Rice field Others	(700,000) 260,000 440.000	Berita Harian (1989)

3.1 *Poorly Stock Logged-Over Forests and Shifting Cultivated Areas*

Degraded logged-over forests in Malaysia are only from the productive forests. The distribution of the productive forest is as shown in Table 1. The cause of degradation is mainly due to uncontrolled logging and followed by shifting cultivation. As the forests are opened out, the logging roads become highways for the illegal shifting cultivators and hunters to exploit the logged-over forests. The control of this illegal degradation of biodiversity is very difficult due to the lack of manpower in the forestry departments. The problem has made the effort on conservation of biodiversity in the productive forests a formidable task.

The Selective Management System employed to manage the productive forests is a fairly sound system. However, some uncontrolled loggings may result in poorly stock logged-over forests and in Peninsular Malaysia alone, it has been estimated to be about 56,200 ha (Table 2). These poorly stock logged-over forests have slow regeneration rates as a result of damages to their growth during logging activities. In addition, the removal of plus mother trees virtually stripes the genetic pool of commercially exploited species. Thus, the poorly stock logged-over forests need human intervention to improve the regeneration of the forests. In the past, enrichment planting was carried out after post-F inventory but it proved to be costly and ineffective.

The degraded secondary forests may come from productive forests, state land, natural greenbelts in the city which are normally characterized by secondary forests and shifting cultivated areas. The causes of the formation of secondary forests are shifting cultivation, abandoned plantation projects, and illegal clearing of the forests that are under state ownership. However, the secondary forests at undeveloped slopes in the city and river reserve are normally conserved as green belts and often act as environmental buffer zones.

Ex-mining land is a poor fertility site caused by tin mining activities and only a small number of plant species has successfully colonized the sites. The poor fertility of the ex-mining land is main-

ly due to its changing physical properties where water was used to separate the sand from the silt and clay particles, forming sand and slime tailings. This resulted in the large area of infertile sand, and slightly better fertility waterlogged slime (Ang, 1994). Thus, the colonization process is normally very slow which results in low diversity, especially on sites which are located far from the seed sources of natural forests. Table 3 shows the species diversity of the tin tailings. Slime tailing has the highest number of species probably due to its more fertile soils than sand. Hence, exmining land is usually very poor in diversity and needs enrichment of plant species. A classical successful story of the complete rehabilitation of a tin tailing site is located in Bidor, Perak. The area is about 130 hectares. Rehabilitation work started in 1997 and from the year 2000 onwards AKECOP provided funds to continue this work. The area currently is completely rehabilitated and stands out as a green belt against the vast area that continues to remain barren. The Perak State is now studying this model to extend this work to the other tin tailing areas in the State.

Table 3. ***Number of species at selected sites of tin tailings***

	Pond	Sand	Sandy slime	Slime
Shrub/small tree species	0	9	7	19
Creeper, grass, etc	24	38	54	56
Total	24	47	61	75

Source: adapted from Ang, 1994

Abandoned agricultural land derived mainly from the conversion of the state land forests or degazetted permanent forest estate (Table 2). The main cause of abandoned agricultural land lies mainly primarily the success of the industrialization process and the New Economic Policy, which has changed the social economic status of the villagers. Many of the villagers would prefer to work in air-conditioned factories with stable incomes, especially the new generations of villagers. This shift of economic balance in development prompts a new pattern of migration from village to the city or industrial zone and this has been taking place since the early 1990s. This migration pattern has caused a considerable setback in the rice production of the nation and resulted in an extensive area of abandoned rice fields (Table 2). The idle land is commonly covered with grasses and economically unimportant tree species.

3.2 *Conversion to Other Economic Uses*

Large tracts of easily accessible natural forests have been converted to other forms of land use such as agriculture, mining, timber plantations, pasture land, urban development, hydroelectric dams, etc. Conversion of natural forest to perennial tree-crop agriculture such as rubber, oil palm, cacao, fruit trees, spices, coffee, sugar cane, etc. have been important economic developments in the region. The pressure to convert more forested land for such development has not ceased, considering the apparently high profits from such activities. These activities result in definite loss of tree cover from the area.

The government sponsored settlement programs whereby people were relocated is another cause for forest degradation. The FELDA (Federal Land Development Authority) scheme in Malaysia was introduced to raise the economic standards of the settlers. Under the schemes, in the region in excess of 10 million ha of natural forests were converted to rubber and oil palm and other tree crops for the settlers to work on.

3.3 *Uncontrolled Exploitation*

Although statistics are not available, effects of over-harvesting, overgrazing and fire damage, all of which lead to forest degradation, has also to be taken into account. The incidences of fire are increasing in the region, with three major episodes of fires in the region in the last two decades. In each instance, about 1 million ha, mainly the peat swamps, were burned (e.g. Leighton & Wirawan 1986).

3.4 *Shifting Agriculture*

The problem of shifting agriculture has been highlighted extensively. Easily more than half of deforestation in the country can be attributed to unsustainable shifting agricultural practices (Spencer 1966). The rapid growth of the populations and shrinking of the existing forested areas are the main reasons behind the failure of this age-old system of agriculture. Besides shifting agriculture, encroachment by landless populations into newly logged forests is also taking its toll.

3.5 *Logging*

Prior to the introduction of Sustainable Forest Management guidelines, commercial extraction of timber in the country had been shown to be largely destructive. An ITTO study concluded that a very small percentage (less than 1%) of the natural forests in the country had been managed on a sustainable basis (Poore et al. 1989). In all cases, over-harvesting had been the usual practice. The growth figures obtained from studies rarely support the rate of harvesting, and the cutting cycles of 25-40 years are believed to be on the short side. The harvesting using heavy skidder-tractor machinery usually resulted in damage of over 60% to the residual vegetation (Appanah & Weinland 1990). The loss of potential tree crops as a result of logging damage had not been clearly recognized, but it has shown up to be considerable, and extensively depletes the stock left behind for the second cut (Appanah & Harun 1999). Logging is carried out with maximum speed, and rarely skidding tracks are pre-planned and controlled, very little road maintenance is carried out, directional felling is rarely employed, pre-felling climber cuttings are not conducted, and little silvicultural tending is done to improve the commercial regeneration. Besides damage to vegetation, the poor construction of roads, low maintenance, and the use of heavy machinery result in excessive soil erosion. If such conditions continue to prevail, many of the logged forests will be poorly stocked, and natural regeneration will be scarce.

PART B
IMPLEMENTATION OF FOREST RESTORATION AND REHABILITATION

1. History of Reforestation/Rehabilitation in Malaysia

Forest plantations are not a new concept and practice for Malaysia. However, interest in forest plantations lacked the required impetus in the distant past. It has vacillated quite a bit, influenced on the one side from fear of impending timber deficits in the future and poor results from planting trials on the other. Up until the 1970s, Malaysia was endowed with vast areas of natural forest. Under such superfluity, it was considered unnecessary and unnatural to convert natural forest into unstable monocultures.

A brief history of forest plantation trials can be found elsewhere (Appanah & Weinland, 1993; Wyatt-Smith, 1963). Here it will suffice to present the most notable events in the history of plantation forestry in the country, especially with Peninsular Malaysia (Table 4). The situation in Sabah and Sarawak is more straightforward, and less illustrative to the changing tides in forest management that Malaysia underwent. Therefore, in Table 4, the principal events in plantation development in Peninsular Malaysia, Sabah and Sarawak are highlighted.

Like with the management of natural forests, plantation trials were first begun in Peninsular Malaysia, and then subsequently in Sabah and Sarawak. Records of planting forest species date back as far as 1880, when concern for loss of desired species was expressed (Hill 1900). There was concern over the rapid destruction of the taban forests and it was also becoming increasingly difficult to obtain railway sleepers. This was the gutta percha era when the nyatoh taban (*Palaquium gutta*) trees were heavily felled for gutta percha, which fetched a very high price. Interest in plantations of gutta taban caught on. Wildings were collected and planted in regular plantations. At Ayer Kroh, Malacca, 500 gutta percha plants were planted (Hill 1900). A scheme for planting hardwood trees in Sungai Buloh Forest Reserve was also initiated. They removed all mature timber, and line planted the hardwood species. About this time, rubber production became the new excitement. In 1901, 180 acres of regular plantations of rambong (*Ficus elastica*) and para rubber (*Hevea brasiliensis*) were started in Pondok Tanjong, Perak.

Besides planting of heavy hardwoods, afforesting mining land and BRIS soils and reforesting forest lands were also of high priority. In 1898, the areas around Pekeliling (Circular Road), Kuala Lumpur, were planted with species such as *Casuarina equisetifolia*, *Eugenia grandis*, *Dryobalanops aromatica*, *Swietenia macrophylla*, *Hevea brasiliensis* and *Fagraea fragrans*. For example, the clumps of trees of *C. equisetifolia* and *Fagraea fragrans* found on the Selangor Golf Course in Kuala Lumpur are remnants of plantings done between 1896 and 1901. Forest planting was limited to trials of extremely valuable exotics such as *Eusideroxylon zwageri* and *Hevea brasiliensis*, and local timber species such as *Casuarina equisetifolia*, *Fagraea fragrans*, *Intsia palembanica* and *Palaquium gutta*.

After a while, all these planting fell out of favor. Plastics replaced gutta percha. Rubber planting was taken up increasingly by private planters. The reforestation work, experimental in nature, did not perform well and the results were considered not commensurate with the expenditure. Nevertheless, some planting trials persisted here and there. Plantings of *Intsia palembanica* and *Neobalonocarpus hemeii* were continued. Besides these, species trial with teak was also reported. They were first planted by rubber planter in Langkawi Island (1903 Annual Report).
These were the main developments, and by the end of 1912, there were 922 acres of regular plantations and 4,828 acres were line planted under shade. By that stage, results from improvement felling in natural forests were available. These suggested that it is still better to improve the crop in the natural forest than plantings in regular plantations (Annual Report 1912). As a result, no further increase in plantations occurred, and in the 1920 Annual Report, it was noted that the area of regular plantations stood at 869 acres.

The Forest Department did most of the plantings but the records were meager. Initially, exotics were tried, but subsequently local species were tested in the belief that they gave better growth. Foxworthy (1930) records that some 130 species were tested in all, but a high proportion of them yielded poor results. Overall, the plantings were haphazard, initiated by individuals, and scattered throughout the country. Many of the trials were lost when the officers got transferred. This was dubbed the "plant and forget" era (Oliphant 1932).

These disappointing results led to a major development in forestry in Malaya. It was decided that a central permanent experimental station should be set up, in Kepong. It was recommended that further planting should be initiated only after the species and methods would have been tested in Kepong. The experimental plantations were started in Kepong in 1927. While more species were added to the trials in Kepong, much of it remained experimental. The emphasis was mainly on high quality timber species that have a long rotation. These would yield definitive results only in the decades after 1970. In the early 1930s, the position on planting did not shift as the researchers were not in favor of planting.

Despite the reservation on planting, occasional experimental trials were conducted.In 1931, high elevation plantations were begun in Mentiga, Cameron Highlands, to test exotics (Annual Report 1933). In 1936, large-scale planting experiments were carried out in Rantau Panjang and Bukit Sungai Puteh Forest Reserves, Selangor. In 1937, trials were begun to establish commercial pole crops on denuded areas in Selangor and on the poor BRIS land in Kelantan. The latter were totally unsuccessful. During the Japanese Occupation, (1942-1945) many areas in Forest Reserves were cleared for farming due to food shortage and after the war, there were some efforts to line-plant these areas.

Taungya system was also tried. Progress was made, but the survival rate was very poor. In the early 1950s, extensive plantations were established in devastated areas in Malacca, Selangor and Perak. The experimental teak plantations in Northwest Malaysia were stepped up to test provenances from Java and Thailand (Wyatt-Smith 1961). This was also the period when many exotics were tried on an experimental plantation scale to gauge the costs. The species included some of the fast growing species like pines, yemane, and eucalypts. The pines and eucalypts were planted in the hills and lowlands. The pines were also tried on lalang (alang-alang) infested areas and tin tailings.

In the early 1960s, work still continued on trials of more pine species, especially the ones from Central America. Selection of elite trees of pines and their vegetative propagation were initiated. Another significant development then was a plan to set up a pulp and paper mill in Peninsular Malaysia. This lead to the “Pilot Plantation of Quick Growing Industrial Species” program, carried out with UNDP assistance. Several species of pines and other conifers were grown on a pilot scale for pulp production. Plantations were started in several states, including the setting up of seed orchards. The early results appeared promising with *Pinus caribaea* and *P. merkusii*, which had increments of above 21 m^3/ha. Their pulping properties were found to be suitable for paper manufacture. But before the viability of such plantations could be ascertained, the planned paper mill was scuttled. Thereafter, interest in raising plantations for pulp production diminished as well.

In the early 1960s, following sweeping changes to land-use policy, forestry became confined to poorer soils and to the hills. With these poorer forests, the old management systems were revised and planting was taken as an option to remedy logged sites that were poor in regeneration. The Forestry Departments embarked on Enrichment Planting under the Intensive Forest Management Scheme (Ismail 1964). Planting with potted seedlings and wildings of mainly indigenous species was carried out in several states, especially Selangor, Perak and Kedah. Such plantings dominated the Departments' activities for most of the 1970s. The results, however, were dismal, despite the high costs (Tang & Wadley 1976). Survival was moderate to low. Growth was good. Provided the canopy was kept open for a relatively long period. The species used were not necessarily the best for the purpose. Thereafter, enthusiasm for expensive enrichment planting faded, and is now employed to a minor degree only, to improve highly degraded sites.

Table 4. ***Summary of the most notable events in the history of plantation forestry in Peninsular Malaysia***

Year	Events
1877	Rubber (*Hevea brasiliensis*) planted in Kuala Kangsar
1884 - 1900	Small trials of exotics started
1900 - 1913	Regular plantations of gutta percha (*Palaquium gutta*) and rubber (*Hevea brasiliensis)*; Line planting of chengal (*Neobalanocarpus heimii*) in forest reserves; Experimental planting in abandoned mining land
1927 - 1941	Forest Research Institute set up in Kepong, and experimental plantations in lowlands were started; Plantation experiments in Cameron Highlands (ca. 1,500 masl); Teak planted in Langkawi Island
1945 - 1950	Experimental teak plantations in Northwest Malaya; Plantings in forest clearings resulting from disturbances during the war.
1952	FAO *Eucalyptus* study tour in Australia, and extensive species trials with *Eucalyptus* spp.
1954 - 1958	Species trials with *Pinus* spp. With potential pulp value were initiated; Experimental plantations were started on tin tailings; Taungya system tried using *Gmelina arborea* in tobacco farms; Line plantings of kapur (*Dryobalanops aromatica*) were established in Kanching.
1959 - 1962	Large scale experimental planting with *Pinus caribaea* and *P. insularis* in the lowlands. *Pinus* spp. From Central America and *Populus* spp. From Kenya were also tested; Experimental plantings in shifting cultivation areas; Line planting and small-scale plantings of secondary growth of *Dryobalanops aromatica, Eusideroxylon zwageri, Flindersia brayleyana, Fragraea fragrans, Khaya* spp., *Pentaspadon officinalis*, and *Shorea macrophylla.*
1963 - 1965	Bigger trials of *Pinus* spp. conducted in Selangor.
1966 - 1970	Under the UNDP assistance, pilot plantations of quick growing industrial tree species were initiated, mainly for production of pulp. Plantations of pine were expanded in Selangor, Johore, Pahang, Negeri Sembilan and Kedah; *Shorea* and *Dryobalanops* spp. planted under the Taungya system in Negeri Sembilan. Jelutong (*Dyera costulata*) plantations were expanded in Sungei Buloh F.R.
1971 - 1976	Mixed plantations of *Pinus* and *Araucaria* were tested on poor soils in Bahau; Enrichment planting using indigenous species became an important forestry practice.
1981 - 1992	The Compensatory Forestry Plantation Project through ADB loan was initiated. Quick growing tropical hardwoods like *Acacia mangiurn*, *Gmelina arborea* and *Paraserianthes falcataria* were chosen for producing general utility timber. The Compensatory plantations came under review and the planting for sawlog production has been put on hold. Planting for pulp production continues.
1992 - 1996	Planting of teak began earnestly event in wetter sites; Sentang (*Azadirachta excelsa*) is also given importance as a plantation species.

Source: Appanah & Weinland, 1993

As the 1980s approached, most of the State Lands Forests were converted, and forest resources were limited to the Permanent Reserves only. These are much poorer in stocking. But meanwhile, the industries have been developed for a much higher capacity than the natural forests would be able to sustain. This led to speculations that there will be a timber shortage in the future (Chong 1979). This led the Forestry Department to consider planting general utility timber under the 'Compensatory Plantation Project'. The compensatory plantation was to cover 188,200 ha by the year 1995, and was supported by an Asian Development Bank loan. The plantations were planned to produce general utility timber of small saw log dimensions for the domestic market in 15 year rotations. For the purpose, quick growing tropical hardwoods such as *Acacia mangium*, *Gmelina*

arborea, *Paraserianthes falcataria* and *Eucalyptus camaldulensis* were identified. However, due to difficulty in procuring planting material, the majority of the areas were planted with *Acacia mangium*, as seed was easily available. However, the species has not fulfilled the initial expectations, with relatively poor volume growth and trees have been susceptible to heart-rot damage in some sites (Hashim *et al*. 1991). Overall, its performance for sawlog production has remained dismal (Weinland and Zuhaidi 1990). As a consequence, additional planting of the species for sawlog production has been halted since 1992. But plans for planting the species for pulp production are being pursued on a big scale with development of one pulp and paper mill in Sabah and additional ones in Sarawak and Peninsular Malaysia.

At present, the Forest Department is looking for alternative species for forest plantations. Since the mid-1980s, rubber wood has become an important source of timber for furniture production. At present the source of rubber wood is mainly from replanting schemes. But the species has also been planted on a trial basis exclusively for timber production only.

Besides rubberwood, other promising candidates are also being tried out on a larger scale. This includes teak (*Tectona grandis*) and sentang (*Azadirachta excelsa*).Teak had been confined to the drier Northwest of Peninsular Malaysia before. But nowadays, it is being planted on a small scale in the wetter southern sites as well. The tree seems to grow just as well, the only drawback being the absence of close growth rings and therefore veneer quality may not be obtainable. The other species that has brought some excitement in the plantation scenery is sentang. This, too, has shown good growth rates in the early years, and is mostly free of pests. The plantings have to mature somewhat before their true value can be ascertained. A few other species that are also being considered for planting at the moment include *Khaya ivorensis* and *Khaya senegalensis*, and to a lesser extent *Swietenia macrophylla*. Some of the dipterocarp species also appear to be good and are being investigated as potential candidates. The reason for the new spate of interest in plan-ting timber species is partly because of the rising labor costs in the country. As a consequence many rubber and other cash crop plantation owners are looking for alternative and less labor-demanding crops. Timber trees fit that label neatly.

For Sabah and Sarawak, the gestation period between research to policy and implementation was usually shorter, taking off from experiences in Peninsular Malaysia. The path to implementation is therefore less convoluted and more or less direct. In Sabah, plantations were not considered important in its early forestry history, although there were some attempts to test out a few species on an experimental basis. In the 1970s the planners concluded that more should be done for forestry development. Unlike with Peninsular Malaysia, Sabah still lacks the momentum to develop its economy based on the industrial sector. Forestry remains in the forefront of its economic activity, and the planners realized something must be done if the State is to maintain its timber productivity. Moreover, forestry appealed to the State, as it provides the kind of rural development which is more appealing to the people, considering their lifestyle. The Sabah Forest Development Authority (SAFODA), a State statutory body, spearheaded the reforestation program. Thereafter, relatively rapid progress was made, and by 1995 almost a 100,000 ha of plantations had been developed, mostly through some of the statutory bodies responsible for rural development and reforestation (Anuar 1996). Both fast growing hardwoods and high quality timbers are being planted. Rattan has also been planted as an additional crop. Besides these developments, a paper mill was set up in the 1980s, and large areas are being planted up with fast growing pulp species.

In Sarawak, too, there never was an urgency to go into plantations, considering the large areas of natural productive forest in the State. Nonetheless, there was some concern regarding the large

areas of forest land that have become degraded as a result of shifting agriculture. In this regard, some experimental trials were started in the early part of the century, especially with species that had agroforestry potential (Fahlman 1975, Lee and Lai 1981). In the mid-1960s there were some attempts to test the potential of pines for reforestation purposes. In the 1970s, fast growing exotics were investigated. Also included were some long-rotation species which yield high quality timber. But all said, there have been relatively few plantations in Sarawak, although the position is likely to change very rapidly from now on.

2. Need for Rehabilitation of Degraded Lands

Rehabilitation is used here to refer to all those processes that help reverse the state or processes of degradation and return the land to a stable and more productive condition dominated by trees. Each type of degraded land has to be rehabilitated using different approaches and technologies. The aims of the reforestation efforts must be well defined. Generally, the selection of a suitable approach would encompass these objectives.

2.1 *Increasing Site Productivity*

Low productivity is one of the consequences of degradation. This will have to be considered along with cost-effectiveness of replanting and the acceptability of the social-economic component of the system.The purpose of increasing the productivity of a site is to ensure that the income for the illegal settlers is stable and that they are kept within the agroforestry sites. This will prevent further clearing of the forests. In Sarawak, shifting cultivators were invited to participate in the agroforestry projects initiated by the Forest Department. The shifting cultivators were issued permits for their cultivation practices but in return they have to assist the department in tree planting projects or the establishment of wood-lots (Leo & Lee, 1992).

2.2 *Increasing the Species Richness*

The rehabilitation processes to increase the species diversity of the site will only be applied in exmining land and patches of green belts in the city and river reserves. These degraded sites can be green with high diversity of plants and eventually turn into a conservation area for biodiversity and later can also be used as a green lung, park or botanical garden. These degraded sites will not be opened up for development anymore if they are gazetted as a green lung belt. The effort of enriching the species and thus increasing the biodiversity is necessary, as Malaysia would like to protect the endangered species despite the existence of the protected forests where no logging is allowed. Table 5 shows the species – mainly plant species – which are classified as endangered species requiring some kind of conservation or preservation measure. Any restoration or conservation activity must then include the planting of these endangered tree species (Table 5).

2.3 *Increasing Site Quality*

The planting of tree species will improve the site quality of the degraded lands including soil properties and microclimates. The general functions of the trees to improve the poor site such as tin tailings and other degraded sites in the productive forests are well established. In some decking sites and skid trails the soil properties are not conducive for the growth of plants. Rehabilitation of the degraded sites can only be successful if the right species is selected, followed by intensive site preparations with a high input of fertilizers.

Table 5. ***The status of some biodiversity in Malaysia***

Biodiversity	Total number of species	Number of endemic, and/or, vulnerable species	Number of endangered species	Number of extinct species
Mammals	675	126	60	0
Birds	1,200	118	16	1
Amphibians	147	134	127	0
Tree species	2,398	654	343	0

Adapted from Kiew, 1982; Kiew & Davison, 1982; Soepadmo 1983

While deforestation is required in order to develop sustained agriculture and viable cash crop plantations, beyond certain limits such forest openings would cease to be economically beneficial. Some of the countries are already beginning to reach such threshold levels. But agriculture on poor or ill-suited soils has proven to be disastrous and wasteful. The harvests have declined, and farmers have become impoverished as a consequence.

Deforestation, besides loss of valuable wood, which was often burned, has resulted in other serious problems. Heavy and unplanned encroachments have resulted in loss of major watersheds, which are facing severe de-vegetation and erosion (Hamilton & King 1983). This disrupts the water cycle, rivers and lakes become sedimented, and they finally affect agricultural development, hydroelectric dams, and silt-up ports. In many cases, the economic gains from logging are heavily offset by costs to society from the environmental damage ensuing. The cost of repairing flood damage has not been estimated in the region, but in the example of the Himalayas, it was estimated at USD 250 million per year (Spears 1982).

Logging often comes at the loss of environmental services whose values may even exceed the gains from timber (Repetto & Gillis 1988). Forests are the major source of potable water for large segments of the populations in the tropics. Many countries in recent times have experienced acute water shortages during unusual drought periods. The impact was most severe in areas which have lost their forests. In Malaysia such a situation has already been felt in some states like Malacca and Negeri Sembilan. It is indeed ironic that Southeast Asian countries, which are some of the wettest in the world, suffer from water shortages. A whole lot of other economic activities can be disrupted as a result of deforestation. They include river transport and ecotourism benefits. Climatic changes are also beginning to become apparent as a result of large-scale logging activeties (Sagan et al. 1979). Scientists speculate that large-scale clearing of tropical forests may affect the reflectivity of the surface of the earth, which could alter global climatic patterns and shift rainfall distribution. Another deep concern is the release of carbon into the atmosphere as a result of burning of tropical forests. This additional carbon dioxide in the atmosphere can cause global warming as a result of the green house effect.

The loss of forests has been considered to have affected the livelihood of the indigenous and forest-dependent population. Large-scale logging has resulted in loss of non-timber goods and environmental services, impoverishing the local people dependent on them. People who subsist on hunting, gathering fruits, nuts, cane, bamboo, medicinal plants, etc. have been affected (Caldecott 1987). Increasingly, non-governmental organizations have been vociferously campaigning against large-scale commercial loggings.

An additional facet to deforestation and forest degradation is the loss of biodiversity (Myers 1984). The rainforests of insular Southeast Asia fall among the richest zones for plant and animal biodiversity known in terrestrial ecosystems (Whitmore 1974). The loss has not been quantified, but considering some countries have already lost about 60% of the forest, the loss in biodiversity should have been substantial. Since not all the countries have done adequate surveys of the plants and animals, the losses may never be even recognized. The loss of biodiversity is not one of scientific curiosity. Biodiversity is necessary:

- To sustain and improve agriculture and animal husbandry;
- To provide opportunities for medical discoveries and industrial innovations; *and*
- To preserve the choices for future generations (OTA 1987).

The rare discovery of an important drug can revolutionize medicine, and that option should not be lost to future generations which may face new and unknown life-threatening diseases. Well-known drugs derived from tropical forests include the rosy periwinkle (*Cantharanthus roseus*), steroids from Mexican yams (*Dioscorea composita*), and antihypertensive drugs from serpentwood (*Rauwolfia serpentina*). One of the economic success stories of the pase was the discovery of rubber tree in the Amazon. Within the last century, the crop has grown into a USD 6 billion industry, and many countries are quite dependent on rubber exports for their foreign exchange. There still are economically important plants in tropical forests waiting to be discovered.

3. Current Government Policy Governing Land Use and Rehabilitation

Forest plantations have long been recognized as an essential part of the strategic development plan for the suitable management of forest resources in Malaysia. This strategy dates back to the beginning of the century, when efforts were made to test out both indigenous and exotic species in the country.
The Government is cognizant of the international debate on tropical rainforests, and the concerns over their rapid degradation and loss. Malaysia's rainforests are among the most biodiverse forests worldwide, and therefore their management is critical for the conservation of a vast number of plant and animal species. Hence, sustainable forest management has become the 'buzz' word for forest management. Under the Seventh Malaysia Plan, the Government has clearly expressed its commitment to protect the environment and ecological services by adhering to the principles of sustainable management. This would require that the annual felling rate be reduced by at least 12% over the five-year period.

3.1 *Forest Legislation*

Forest legislation in Peninsular Malaysia has been in practice since 1930 when the various forestry enactments and rules were formulated by the respective state authorities. These were found to be deficient and weak in areas of forest management planning and forest renewal operations which are vital to sustained yield management. In order to overcome these short-comings, the NFC agreed to review, up-date and uniformise the existing State Forest Enactments so as to streamline forest administration, management, conservation and forestry sector development in the country. Hence the National Forestry Act and the Wood-Based Industries Act were formulated. These were passed by an Act of Parliament in October 1984.

Apart from the National Forestry Policy and other forestry legislations, the federal government has enacted laws pertaining to timber trade, research and development, land conservation and environment quality.

Forest activities in Sabah are regulated by a Forest Enactment (1968). Forestry practices in Sarawak involve not only the regulation and management of the forest resources but also the protection and management of National Parks and Wildlife Sanctuaries. Thus, in Sarawak, the Forest Department has jurisdiction over all the permanent forests, national parks and wildlife sanctuaries. These activities are regulated by the following legislative documents:

- Forest Ordinance (Sarawak Chap. 126)
- National Parks Ordinance (Chap. 127)
- Wildlife Protection Ordinance (Chap. 128)

3.2 *The National Forestry Policy*

Malaysia has a National Forestry Policy (NFC), which was approved for implementation in 1978. The objectives of this policy are being strictly adhered to by the state authorities and the NFC is kept informed of all forestry development activities implemented in the various states. The National Forestry Policy ensures uniformity in the implementation of all forest management, conservation and development strategies towards achieving common objectives.

The objectives of the National Forestry Policy are as follows:

- To dedicate as Permanent Forest Estate sufficient areas of land strategically located throughout the country in accordance with the concept of rational land use in order to ensure:
    - Sound climatic and physical conditions of the country, the safeguarding of water supplies, soil fertility and environmental quality and the minimization of damage by flood sand erosion to river sand agricultural lands, such forest land being known as "*protective forests*";
    - The supply in perpetuity at reasonable rates of all forms of forest produce which can be economically produced within the country and are required for agricultural, domestic and industrial purposes, such lands being known as "*productive forests";*
    - The conservation of adequate forest areas for recreation, education, research and the protection of the country's unique flora and fauna, such forest lands being known as "*amenity forests"*.
- To manage the Permanent Forest Estate with the objective of maximizing social, economic and environmental benefits for the Nation and its people in accordance with the principles of sound forest management.
- To pursue a sound programme of forest development through regeneration and rehabilitation operations in accordance with approved silvicultural practices in order to achieve maximum productivity from the Permanent Forest Estate.

- To ensure thorough and efficient utilization of forest resources on land not included in the Permanent Forest Estate, prior to the alienation of such land, by means of proper coordinated planning by land development agencies in order to obtain maximum benefits for the people through complete harvesting and processing of such resources, adhering strictly to the optimum need of local processing industries.

- To promote efficient harvesting and utilization of all forms of forest produce and to stimulate the development of appropriate wood-based industries with determined capacities commensurate with the resource flow in order to achieve maximum resource utilization, create employment opportunities and earn foreign exchange.

- To ensure the sound development of trade and commerce in and to promote the exportation of forest products.

- To promote effective Bumiputera participation in the forest and wood-based industries consistent with government policy.

- To undertake and support an intensive research program in forest development aimed at achieving maximum yield from the Permanent Forest Estate, maximum direct and indirect benefits from harvesting and utilization and, above all, maximum financial return on investment in forest development activities.

- To undertake and support a comprehensive program of forestry training at all levels in the public sector in order to ensure an adequate supply of trained manpower to meet the requirements of forestry and wood-based industries.

- To encourage private sector involvement in forestry research and training at all levels with a view to accelerate industrial development and enhance the quality of professionalism in forestry and forest industrial practices.

- To foster, by education and publicity, a better understanding among the community of the multiple values of forests to them and their descendants.

- To foster close co-operation among all in order to achieve optimum utilization of the valuable natural resources of the country.

The Forest Policy of Sarawak, approved by the Governor-in-Council in 1954, remained the basis for forestry practices in that state. The main points of the Sarawak Forest Policy are:

- To reserve permanently for the benefit of the present and future inhabitants, forest land sufficient

    - for the assurance of the sound climatic and physical condition of the country; the safe-guarding of soil fertility, and of supplies of water for domestic and industrial use, irrigation and general agricultural purposes; and the prevention of damage of flooding and erosion to rivers and to agricultural land;

    - for the supply in perpetuity and at moderate prices, of all forms of forest produce that can be economically produced within the country, and that are required by the people for agricultural, domestic and industrial purposes under a fully developed national economy.

- To manage the productive forests of the Permanent Forest Estate with the objective of obtaining the highest possible revenue compatible with the principle of sustained yield and with the primary objectives set out above.

- To promote, as far as may be practical, the thorough and economical utilization of forest products on land not included in the Permanent Forest Estate, prior to the alienation of such land.

To foster, as far as may be compatible with the prior claims of local demands, a profitable export trade in forest produce.

3.3 *Salient Features of the National Forestry Policy, 1978 (Revised in 1992)*

- To dedicate as "permanent forest estate" sufficient areas strategically located throughout the country in accordance with the concept of rational land use, which will be managed and classified under four major functions, namely:

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

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

    - "Amenity forest" for the conservation of adequate forest areas for recreation, ecotourism and in enhancing public awareness in forestry; *and*

    - "Research and education forest" for the conduct of research and education.

- To implement a planned program of forest development through forest regeneration and rehabilitation operations in accordance with prescribed silvicultural practices.
- To promote efficient harvesting and utilization within the production forest for maximum economic benefits from all forms of forest produce and to stimulate the development of appropriate forest industries commensurate with the resource flow, as well as to create employment opportunities.
- To increase the production of non-wood forest produces through scientific and sustainable management practices to meet local demands and related industries.
- To provide for the conservation of biological diversity and areas with unique species of flora and fauna.
- To encourage private sector investment in forest development through the establishment of forest plantation.
- To undertake and support intensive research programs in forestry and forest products aimed at enhancing maximum benefits from the forest.

- To undertake and support a comprehensive program of forestry training at all levels for the public and private sectors in order to ensure an adequate supply of trained manpower to meet the requirements of the forest sector and the forest-based Industries.
- To promote education in forestry and undertake publicity and extension services in order to generate a better understanding among the community of the multiple values of forest.
- To set aside specific areas for the purpose of forestry education and other scientific studies.
- To promote active local community participation in various forestry development projects and to enhance their involvement in an agroforestry program.
- To develop a comprehensive program in community forestry to cater for the needs of the rural and urban communities.

4. Formulation of Criteria, Indicators, Activities and Management Specifications for Sustainable Forest Management (SFM) in Malaysia

4.1 *Definition of SFM*

In accordance with the ITTO definition, sustainable forest management is defined as a process of managing permanently forest land to achieve one or more clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services without undue reduction of its inherent values and future productivity, and without undue undesirable effects on the physical and social environment.

In this regard, a criterion can be defined as a discrete and definable or distinguishable characteristic that must be considered in setting objectives and policy and by which a correct judgement may be made, while an indicator is a measurable variable, designed to provide quantitative evaluation of the progress in meeting policy objectives against specific criterion or criteria.

However, to ensure that the indicator is implemented, a set of activities or actions would have to be taken and hence, activities can be defined as tasks that have to be performed to realize the indicator or indicators, while management specifications provide further detailed quantification of the standards by providing exact information on measurement procedures, quantities, material, thresholds, etc., that is, something established for use as a rule or basis of comparison in quantifying the indicators or judging capacity, quantity, value and quality.

4.2 *National Level*

Malaysia as a producing member country of the International Tropical Timber Organization (ITTO) is fully committed to achieve sustainable forest management in the overall context of sustainable development. In this regard, Malaysia has taken action to elaborate and operationalize *the ITTO Guidelines for the Sustainable Management of Natural Tropical Forests* and its *Criteria for the Measurement of Sustainable Tropical Forest Management* in managing its natural forest and to ensure it is sustainably managed by the year 2000.

In this connection, a *National Committee on Sustainable Forest Management in Malaysia* comprising representatives from the then Ministry of Primary Industries, Malaysia, now comprising two ministries, namely the Ministry of Plantation and Commodities and the Ministry of Natural

Resources and Environment; the Forestry Department of Peninsular Malaysia, Sabah and Sarawak; the Forest Research Institute, Malaysia; the Malaysian Timber Industry Board; the Malaysian Timber Council and the Faculty of Forestry, University of Agriculture, elaborated ITTO's *Criteria for the Measurement of Sustainable Tropical Forest Management* in the Malaysian context. To further support the Committee's work, the ten State Forestry Department in Peninsular Malaysia had also formed a *Working Party on Sustainable Natural Forest Management, Peninsular Malaysia,* at the Forestry Department Headquarters, Peninsular Malaysia, also in February, 1994.

After a series of meetings the Committee had formulated a total of 92 activities to operationalize the ITTO's 5 criteria and 27 indicators on sustainable forest management at the national level. In the process, the Committee had added two additional indicators, while omitting two of the proposed ITTO's indicators. The two additional indicators were the indicator for Plantation Establishment of Non-wood Forest Produce and Annual Planting Targets under the ITTO's criterion on the Forest Resource Base and the indicator on Expenditure Budgets for Forest Administration under the ITTO's criterion on Socio-Economic Effects. The reason for omitting the ITTO's indicator on Availability of Environmental Assessment Procedures under the ITTO's criterion Socio-Economic Effects was that this indicator has already been included under the criterion on the Level of Environmental Control which the Committee deemed to be more appropriate, while the omission of the indicator on the Institutional Frameworks was that the National Forestry Policy of Malaysia had adequately met the objectives of the ITTO guidelines in terms of sustainable forest management.

4.3 *Forest Management Unit Level*

Currently, each individual state in Malaysia is defined as the forest management unit in view of the following legal and administrative requirements:

- Under Article 74 (2) of the Malaysian Constitution, forestry comes under the jurisdiction of the respective State Governments. As such, each state is empowered to enact laws on forestry and to formulate forestry policy independently. The executive authority of the Federal Government only extends to the provision of advice and technical assistance to the states, training, the conduct of research and maintenance of experimental and demonstration stations;
- The implementation of Criteria, Indicators and Activities, as well as Management Specifications are monitored and evaluated at the state level by the Federal agencies and bodies, such as the National Forestry Council;
- All the decisions made with regard to the implementation of forest management, conservation and development activities in the state are carried out at the state level by the respective State Authorities;
- The allocation of Annual Allowable Cuts (AACs) for the production forests of the PFE by the National Forestry Council is determined on a state by state basis; *and*
- Under section 4 of the National Forestry Act, 1984 (Amended 1993), each Director of the State Forestry Department is responsible to the State Authority for the preparation and implementation of the State forest management plan, reforestation plan and programs relating to amenity forests.

In this regard, the National Committee on Sustainable Forest Management in Malaysia had identified a total of 84 activities to be implemented at the forest management unit level under the 6

criteria of the ITTO and its 23 indicators. In its development, the Committee had added to the indicators at the forest management level 7 additional indicators from those identified at the national level, which are as follows:

- the length of cutting cycle,
- areas of Protection Forests and Production Forests within the PFE,
- establishment of forest plantations for wood production,
- establishment of forest plantations for non-wood production,
- availability of environmental assessment procedures,
- expenditure budgets for forest management; *and*
- expenditure budgets for forest administration.

Of the 84 activities that have been implemented on a State basis, a total of 70 activities, or 83%, are identical to those identified at the national level. This level of management will be continued to be refined when improved silvicultural management systems are further developed for application at a lower management level, perhaps at the forest district level, forest reserve level or even at the compartment level. In this connection, the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) Project on Sustainable Forest Management and Conservation in Peninsular Malaysia which was involved in the refinement of the existing forest management systems, the improvement of silvicultural practices and the development of a cost-effective forest planning system for application at the operational level have greatly enhanced this process.

4.4 *Management Specifications*

In Peninsular Malaysia, against each of the activities identified at the national and forest management unit levels, the respective Forestry Departments had also formulated management specifications (benchmarks) for their effective monitoring and evaluation. Currently, a total of 201 and 190 management specifications have been formulated at the national and forest management unit levels respectively. Of the 190 management specifications formulated at the forest management unit level, a total of 160, or 84%, of these specifications are identical to those formulated at the national level. In this context, management specifications have also been formulated by the respective Forestry Departments of Sabah and Sarawak which are now in place.

Furthermore, in formulating the 92 activities for implementation at the national level and the 84 activities for implementation at the forest management unit level, the National Committee on Sustainable Forest Management in Malaysia had reviewed the Principles and Criteria for Natural Forest Management of the Forest Stewardship Council and those of the Tropenwald Initiative, and had also taken into account the Principles and Recommendations as enshrined in the ITTO Guidelines on the Conservation of Biological Diversity in Tropical Production Forests.

Targets for the achievement of the 92 activities at the national and the 84 activities at the forest management unit levels respectively had also been set by the respective State Forestry Department in Malaysia, as well as the cost that would be incurred to fully implement them. As of 2000 in accordance with Malaysia's commitment to the ITTO's Year 2000 Objective, the preliminary

estimates indicated that a sum of RM 2911.5 million would be required to fully implement these activities, including the need for research.

4.5 *Formulation of Criteria, Indicators, Activities and Management Specifications for Forest Management Certification*

For the purpose of forest management certification, which is undertaken at the forest management unit level, Peninsular Malaysia had taken a sub-set of the activities and management specifications formulated for sustainable forest management at the forest management unit level on a state basis. It encompasses 71 activities under a total of 6 criteria and 28 indicators.

The rationale for this is that forest management certification only involves the sustainability of the PFE, especially its production forests. Hence, the activities that had been omitted from those formulated for measuring sustainable forest management at the forest management unit level are as follows:

- Identify areas for forest plantation of wood and non-wood forest produce outside the PFE;
- Determine the optimum concession length;
- Harvest and replant the forest plantation;
- Project the level of wood production from conversion forests, plantation forests and perennial agricultural tree crops (rubber wood);
- Establish forest plantation outside the PFE for wood and non-wood productions; *and*
- Report on the contributions in terms of forest revenue to the State Governments.

4.6 *Monitoring and Evaluation*

In order to ensure that the agreed activities are implemented in the field by the respective State Forestry Departments in Malaysia, a *Task Force* comprising representatives from the then Ministry of Primary Industries, Malaysia, now comprising two ministries, namely the Ministry of Plantation and Commodities and the Ministry of Natural Resources and Environment; the Forestry Departments of Peninsular Malaysia, Sabah and Sarawak; the Forest Research Institute, Malaysia; the Malaysian Timber Industry Board; the Malaysian Timber Council and the Faculty of Forestry, University of Agriculture, Malaysia was established in May, 1995. To complement this effort, Peninsular Malaysia had also formed a *Technical Monitoring Committee* at the Forestry Department Headquarters, Peninsular Malaysia in October, 1995 to monitor the implementation of all the activities undertaken by the respective State Forestry Departments in Peninsular Malaysia.

The Task Force has developed an effective mechanism and procedure for the periodic monitoring of the implementation of all the activities, and has submitted reports on their progress to the higher authorities in Malaysia for their information and further action. The implementation of the European Union project, at the Forestry Department Headquarters, on the *Development of Mapping and Geographic Information Systems for the Effective Planning, Management, Conservation and Sustainable Development of Forest Resources in Peninsular Malaysia* has further strengthened the

monitoring capacity of the implementation of the criteria, indicators, activities and management specifications in Peninsular Malaysia.

As of 1996, an internal assessment on the implementation of each of the activities at the forest management unit level was also conducted in Peninsular Malaysia and it was revealed that a total of 64 activities, or 76%, had been fully implemented, while 9 activities, or 11%, had only been partially implemented. These partially implemented activities together with the balance of the 11 activities, or 13%, which were yet to be implemented, were fully implemented as at the end of year 2000.

Malaysia and the Netherlands through its Foundation Keurhout had undertaken a Pilot Study to identify the requirements for timber labeling, developing an operational system for forest certification and in tracking timber/timber products through the chain of custody, as well as quantify the cost involved. This covered sawn timber, plywood and mouldings and had used a phased approach in accordance with the Malaysia's criteria, indicators, activities and management specifications, which had been elaborated from the ITTO guidelines. A third party, SGS (Societe Generale de Surveillance) Malaysia, Sdn. Bhd., was appointed to undertake this study and this was completed well before the year 2000.

5. Assessment of Existing Capacity of Stakeholders Involvement

5.1 *Anticipated Deficit in Timber Production*

Malaysia currently is producing about 27 million m^3 of sawlogs. With the implementation of sustainable practices, the sawlog production is expected to decline to about 23 million m^3 by the year 2010. This is much below the total installed processing capacity. As the timber industry is already having difficulty in sourcing timber, the decline in production would affect the down-stream timber industry considerably. New sources of wood like rubber plantations would assist marginally, but most of its wood would be used for furniture production, and the need for pulp, utility timber and high quality timber would always remain unfulfilled unless appropriate measures are taken.
To make up for the impending deficit in timber production, plantations are to be developed. Besides plantations, degraded forest land would be reforested, and under-stocked forests would be line planted. There is an estimated 153,900 ha of degraded forest land in the country. The Government's inspiration and desire are that such plantations should be private-sector driven.

5.2 *Recent Developments*

There is now a direct order from the Government to plant about 375, 000 ha as forest plantations in the next fifteen years. To kick-start the program, the Ministry of Finance has allocated a sum of RM 200 million to develop a pilot plot of 36,000 ha over a period of 3 years (2006-2008). A special purpose vehicle called Forest Plantation Development Sdn. Bhd under the aegis of Malaysian Timber Industry Board (MTIB) has been set up. This entity will undertake the program commercially. Under this program, landowners and plantation companies farming on state-leased forest land are expected to plant their land with valuable timber species in an effort to sustain the growth of the timber industry. It has been reported that to date a total of 36 applications have been received from the private and government linked companies to plant about 495,000 ha comprising Rubberwood, Acacia, Kelampayan and Teak (MTIB, 2006). The whole forest plantation program is estimated to cost about RM 2.2 billion (MTIB, 2006). The money allocated by the Government is in a

form of soft loan to MTIB at an interest rate of 2.5% per annum. The loan will be disbursed over a period of 3 years and is repayable after 15 years. To ensure the continuance of the program there are plans by the Plantation Ministry to issue 'green bonds' besides seeking additional funds from MOF when the RM 200 million fund has been fully utilized.

With this initiative by the Government, now put in place, there is currently a serious pressure to come out with good planting stock that can be made available to nurseries and companies that are carrying out the planting programs.

5.3 *Species Identified for the Forest Plantation Program in Malaysia*

For plantations, although indigenous species are available, a greater preference is given to the selection of exotic species. The reasons for this are:

- There is generally a lack of adequate knowledge in the propagation and silvicultural management of indigenous species;
- There is generally plentiful supply of seeds of the exotic species;
- The exotic species are easy for handling; *and*
- The exotics are fast-growing and high-yielding.

There is a great challenge ahead to carry out adequate studies on the indigenous species to see their viability for forest plantations.

Since the mid 1980s, rubber wood has become an important source of timber for the furniture industry. At present the main source of rubber wood for the industry is from replanting schemes and from large plantations. But the species has now been planted on a trial basis exclusively for timber production. While the demand for rubber wood is high, supply is decreasing, as fewer people are interested in planting it due to a low price.

Besides rubberwood, teak (*Tectona grandis*), Sentang (*Azadirachta excelsa*), *Khaya ivorensis*, *Dyera costulata* and to a lesser extent *Swietenia macrophylla*, some of the dipterocarp species such as *Shorea leprosula, S. parvifolia,* and *Hopea odorata* were also found to be good and are being investigated as potential candidates. In Sabah and Sarawak other species like *Octomeles sumatrana, Paraserianthes falcataria* and *Neolamarkia cadamba* have been grown and found to be suitable.

Early in 2006, after serious discussions and with the available data on growth and performance according to regions, tree species have been identified for the plantation forestry program. The species have been classified as main and additional species (Table 6). In all the regions the emphasis has been placed on *Hevea* and *Acacia.*

Table 6. ***List of species identified for the Plantation Program***

Region	Main Species	Additional Species
Peninsular Malaysia	*Acacia mangium*/hybrid *Hevea brasiliensis*	*Tectona grandis* *Khaya ivorensis* *Azadirachta excelsa*
Sabah	*Acacia mangium*/hybrid *Hevea brasiliensis*	*Tectona grandis* *Octomeles sumatrana* *Neolamarkia cadamba*
Sarawak	*Acacia mangium*/hybrid *Hevea brasiliensis*	*Neolamarkia cadamba* *Paraserianthes falcataria* *Octomeles sumatrana*

5.4 *Short Rotation Forest Tree Species in Malaysia*

In about the year 1900, rubber production became the new excitement. In 1901, the first 180 acres of regular plantations of Para rubber (*Hevea brasiliensis*) were planted in Peninsular Malaysia. For almost 100 years Hevea has been planted in Malaysia for latex and now over the last 20 years its timber has been highly sought after for the furniture industry. Extensive research on Hevea has been carried out by the Rubber Research Institute Malaysia, now known as the Malaysian Rubber Board, and they now have excellent clones both for latex and timber for their numerous breeding trials carried out over the years.

For the other selected timber species, tree improvement trials were started in the mid 19th century, mainly on an *ad-hoc* basis. Serious improvement programs (involving a sustained concerted effort to improve the genetic stock) started only in the last 10 years. Hence for many of these selected species we do not really have improved seeds or clones except for some clones of teak and Acacia hybrid that we had started evaluating in the early years.

5.5 *Strategies to Produce Improved Planting Material for the Immediate Needs*

In general, high levels of productivity are achieved, when genetic and physiological potential of the species are well matched with management practices which promote rapid growth. Valuable improvements can be made in important properties such as stem form and wood density through selection and breeding. One major constraint, that is currently perceived, is the shortage of good planting material for the various plantation programs. Quality seeds and plus trees that have been selected and reproduced vegetatively are inadequate to meet current and projected needs. While efforts are being stepped up to overcome this problem, middlemen and overnight nurseries are providing planting material whose genetic sources are unknown.

FRIM has now signed MOUs with four private nurseries to step up production of quality planting materials of the required species under license while the Forest Department of Peninsular Malaysia is in the process of setting up the National Seed and Planting Material Procurement Centre at Lentang, Pahang, to address this need also. In Sabah and Sarawak similar efforts are underway.

Work that has been done for *Hevea brasiliensis*, *Acacia* hybrid and *Tectona grandis,* for which planting materials have been evaluated, *albeit* not all the clones have been vigorously tested to ensure their versatility on a wide range of soil types particularly for *Acacia* hybrid and *Tectona* is elaborated below:

Hevea brasiliensis

For Hevea, extensive work had already been done by the Malaysian Rubber Board with regard to breeding. In the early past, the focus was only on latex yield, but in the last 15 years they started to breed for both latex and timber yield. Recently, they have released a list of 15 clones that could serve a dual purpose for both latex and timber yield. The proposed clones with details on yield are given in Table 7.

Large-scale production of these clones is carried out by bud grafting of the desired clones on compatible root stocks raised from seeds. This procedure is well established and planting material in large quantities is raised in this manner.

Table 7. ***Timber latex clones released for the Forest Plantation Program***

Clone	Latex yield (kg/ha/yr)	Clear bole volume (m^3/tree)	Canopy wood volume (m^3/tree)	Total wood volume (m^3/tree)
RRIM 929	3,148	0.60	0.60	1.20
RRIM 2001	2,850	0.41	0.82	1.23
RRIM 2002	2,348	0.44	0.66	1.10
RRIM 2008	2,686	0.33	0.99	1.32
RRIM 2009	2,277	0.34	0.34	0.68
RRIM 2015	2,760	0.43	0.87	1.30
RRIM 2016	2,582	0.43	0.85	1.28
RRIM 2020	2,232	0.36	0.64	1.00
RRIM 2023	2,822	0.35	0.46	0.81
RRIM 2024	2,685	0.52	0.74	1.26
RRIM 2025	2,700	0.63	1.24	1.87
RRIM 2026	2,204	0.66	0.45	1.11
RRIM 2027	3,036	0.60	0.70	1.30
PB 260	1,633	0.37	0.93	1.29
PB 355	1,397	0.53	1.06	1.59

Source: MRB, 2003

Acacia hybrid

Currently there are around 40 ortet selected from various locations all over the country, where the natural Acacia hybrid occur. This hybrid is a cross between *Acacia mangium* and *Acacia auriculiformis* and they have characteristics that are far superior than their parents in relation to susceptibility to heart rot and bole straightness. The selection criteria used is in relation to height,

stem diameter, volume, straightness, branch frequency and angle, branch diameter and health. Currently 5 of these clones (namely M2, M4, M5, F29 and F30) have been tested extensively and have been found to be suitable in multi location trials. Recent observations of these 5 Acacia hybrid clones provided to the Kosinar Plantations in Keningau, Sabah, for field trials have shown superior performance in terms of height growth and diameter increase on Sabah soils over clones procured from other sources. The other clones are currently being bulked up for trial. In addition, we have now initiated a control crossing program to develop clones with desirable wood density and fire length.

***Tectona grandis* (Teak)**

Teak is also not a native species but was introduced into the country a few hundred years ago. Today, this species has become a landrace and has adapted itself to some regions of the country. Particularly in the Northern region of the country, where the climate is somewhat pronounced monsoonal in nature, this species has adapted well. Close to 50 ortets based on phenotypic characteristics similar to the criteria used for selecting the teak ortets have been identified and selected. These parents have been used to initiate the cultures. Field data on about 10 of these clones are now available and out of these, one clone (Clone T16), initially for forest plantation establishment in the new program for the Northern Peninsular Malaysia, has been released.

5.6 *Selected Timbers Species and Their Proposed Uses*

- *Wood for Pulp and Paper Production*
  One pulp and paper mill is already in operation in Sabah (Sabah Forest Industries, SFI), but it hardly meets the local demand for paper, and none for newsprint. Additional mills are being planned. For pulp production, *Acacia mangium* has been identified as the principal species. Another species would be *Paraserianthes falcataria*. These would be planted in large-sized plantations, so that a sufficient amount of pulp would be produced in one site in short rotations of about 6-8 years. Such schemes would be developed in State lands.

- *General Utility Timber*
  There is a huge demand for general utility timber for industrial purposes. They go into cores of plywood, and make up the major constituent of fibreboard, particleboard, interior construction wood, and other low-grade use. Several species have been identified for this purpose, and include *Shorea* spp. (Light Red Meranti group), *Hopea* spp., *Dryobalanops* spp., *Ocotomeles sumatrana*, *Neolamarkia cadamba*, *Endospermum malaccense* and *Hevea brasiliensis*.
  Many of these species would be included in reforestation and enrichment planting schemes within the Permanent Forest Estate. The species would have rotations of about 15 to 20 years.

- *High Quality Timber*
  High quality timbers are in strong demand for veneers, paneling and furniture. The species identified for such needs include principally *Tectona grandis* (teak) and *Azadirachta excelsa* (sentang). Additional species include *Araucaria* spp., *Dyera costulata*, *Swietenia* spp., and *Khaya* spp. These would be grown both in small holdings and larger estates under full plantation conditions. Although some of the plantings would be located within the Permanent Forest Estate (PFE), most will

be in the State lands and in private holdings. This is to ensure the PFEs are not converted. The rotations, under full plantation conditions, would be kept short, at around 15 to 20 years.

5.7 Labor Situation in the Country

Since the country moved into rapid industrialization in the nineties, this has created a serious labor shortage which has resulted in some agricultural sectors like the runner plantations, becoming less viable. Many small holders have neglected these plantations not only due to labor shortage but also because of the low prices of latex. Under these circumstances, low-labor demanding forest plantations are being explored as a potential alternative to rubber tapping and other labor-demanding forms of agriculture. There are trials to plant timber-latex clones through replanting activities. These clones will be latex producers that will also maximize timber production.

In Sabah and Sarawak, timber plantations are being promoted for social development as well. Large tracts of forest lands have become degraded as a result of poor shifting cultivation practices. In these remote sites, traditional agricultural cash crops like oil palm and rubber are not attractive to the lifestyles of these people. In contrast timber plantations provide a more attractive option.

Besides the above, fuller utilization of timber products is being promoted, so there will be less pressure on the forests. Towards that, downstream processing of wood wastes into valuable products such as flakeboards, particle boards and charcoal briquettes are being developed. Reduced forestry wastage and increased efficiency during processing would help ameliorate timber shortage, and also be environmentally less damaging. R & D efforts are also being directed towards putting more efficiency into reducing wastage.

Overall, Malaysia aims to maintain a forest cover of at least 50% of the land area. In addition, it is committed to managing the permanent Forest Estate on a sustainable basis. For achieving sustainability, several policy options have been identified.They include Environmental Impact Assessments (EIAs) for forestry activities, subsidies for setting up forest plantations, rehabilitation of forests, and expanding the network of protected areas to include more ecosystems and thereby protecting the huge biodiversity of the Malaysian forests.

The plantation program initiated in the country, in a nutshell, then has the following objectives:

- To supplement the increasing timber requirement in Malaysia.
- To increase productivity of degraded forest lands.
- To alleviate rural poverty through implementation of social forest plantation programmes.
- To reduce excessive loss of foreign exchange by increasing production of raw material for the timber industry.
- With the increasing shortage of labour in the country, there is a need to diversify into low-labour demanding crops, and timber plantations offer an excellent opportunity *and*
- It would be appropriate and wise to introduce timber plantations, which, with their higher productivity, would reduce pressure on the PFE. The latter therefore can be managed in a sustainable way.

5.8 *Place of Forest Plantations in the Ecosystem*

Plantation development must take place within a holistic approach to land-use and ecosystem management. In the humid tropics, there is evidence that well-planned ecosystem-based plantation forestry can play a role in improving the environment. Under the Malaysian climatic conditions, tree plantations are ecologically more in harmony with the ecosystem compared to growing of annuals in agriculture. Tree plantations minimize soil erosion and do not disrupt the nutrient cycle.

5.9 *Potential of Forest Plantations*

Forest plantations are generally more efficient in producing commercial timber than natural forests. For example the increment from tropical plantations may be between 10-30 m^3 per hectare per year compared with less than 3 m^3 from managed natural forests. Furthermore, plantations are easier to manage due to the mono or double species mix only in contrast to very diverse natural forest stands. From the logistics point of view, the location of the plantations can be predetermined to reduce transportation costs. Currently available degraded and idle lands can be converted into productive forest plantations. Hence, plantation development will serve as a strategy for maintaining a sustainable supply of timber and at the same time relieve the natural forest for non-timber benefits such as water catchment areas, recreation, biodiversity and germplasm conservation.

5.10 *Agroforestry Approach*

The term ‘agroforestry’ commonly refers to a dynamic system involving the integration of agricultural crops and/or livestock with plantation tree crops for the purpose of increasing land productivity. It is a sustainable land use system and has the function of meeting the social and economic needs of both the forest and agriculture on the same piece of land. It can be introduced simultaneously or at different stages of the tree growth.

The benefits of agroforestry in forest plantation are many. Generally, for the investors it means extra income, early cash flow and better return on investment. Besides, it maximizes land use and optimizes labor use over longer periods from the onset of the establishment to the final harvest of the tree plantation. To the nation it will encourage private sector involvement in forest plantation and thereby improve utilization of idle land as well as damaged forest. The overall effect will be a sustainable or even increased timber and food production.

Agroforestry has important roles in the forest environment and social activities of the forest dwellers. It improves biodiversity; increases biomass production and provides a better microclimate where agroforestry is developed on damaged forests or land areas resulting from shifting cultivation, it will lead to the development of permanent resettlement centers. This among others will discourage collection of items such as bamboo, herbal plants and rattan over wide areas and hence leave the natural forest undisturbed. In essence agroforestry has the potential to transform ‘wasteland’ or disturbed forest into an integrated productive-protective system.

With these potential benefits mentioned above, the Government under its Third National Agricultural Policy (NAP3) has given great prominence to the development and practice of agroforestry in the country.

5.11 *Constraints of Forest Plantations*

Generally, while forest plantations are a lucrative option to supply the ever increasing demand for wood on a sustainable basis, the planting of timber trees on a plantation scale is constrained by a number of other factors that are critical. These are:

Ecology

The establishment of forest plantation involves extensive alteration of the ecosystem, particularly when heavy equipment is employed. The complex closed nutrient cycle in tropical rain forests is disrupted for a long time. This can lead to reduction of productivity unless ameliorative measures are undertaken. Furthermore, monocultures further destabilize the system, and require heavy use of fertilizers and pesticides. Next, with many slow-growing species, those grown under fast plantation conditions have poorer quality. Finally, there is the problem of species-site matching for the heterogeneous area of large plantations. The danger of fire may also increase in exotic species plantation.

Land

It is an established fact that land is the world's most valuable resource and public scrutiny of land is becoming more intense with each passing year. With the increase of the population, the competition on land for agriculture and development are ever increasing.

For a forest plantation investment to be commercially viable, a large area is required. The size of the land required will vary with the objective of the plantation. If the timber were for sawmilling and furniture manufacturing, then an area of around 15,000 to 20,000 hectares would suffice. On the other hand, if the objective is to establish a chip or pulp and paper mill, then economic-sized plantations should be in the range of 60,000 to 150,000 hectares. It would always be desirable to have a single contiguous piece of land area, or at least should the required land area just be in about two or three nearby parcels only. This is to ensure easy and efficient management of the activities. It is always preferable that the acquired land is close to basic amenities and near a relatively accessible road system and within an economic range to a processing mill or market. For example, to operate efficiently a pulp or a chip mill, the plantation should be located within a radius of 100 km. Otherwise, exorbitant cost for the transportation of logs would render the operations uneconomical.

In Malaysia, land is under the State's jurisdiction. This implies that in Peninsular Malaysia a large plantation project may stretch across state borders. Land being a state prerogative implies that commercial organizations may have to deal with different procedures adopted by individual State governments. Often, inquiries on information regarding land can become very difficult. Details for example on information regarding forest reserves are obtainable from the respective State Forest Departments while that on State land is obtainable from the Department of Land and Mines or the Department of Agriculture. The setting up of a coordinating agency is desirable to overcome this and thus encourage the easier establishment of plantation forests.

Besides sufficient land size, the location with suitable infrastructure and the premium rate for leasing are also crucial factors. Considering the long period necessary for forest plantations, many companies in Malaysia have requested that they be given the prerogative of allocating a fraction of the land leased for planting agricultural plantation crops, which can begin earning some revenue after three years of establishment. This is considered a necessary activity to

cushion the long waiting period before final harvests. However, according to the Forest Department such a request is not permissible unless the land allocated is State land and lies outside the forest reserves. Forest reserve land is strictly to be planted with forest trees. If forest reserves are ever to play a role in forest plantation establishment this issue needs to be reviewed.

The leasing period over land requested by commercial organizations varies. In order to attract their interest in forest plantations, land should be made available for leasing ranging from a period of at least four rotations to 99 years. The intention is to have tenureship long enough to assure that sufficient returns are obtained for the investments ploughed in.

Another concern that is slowing down the commercial sector's participation in forest plantation investments, either as joint venture partners or outright investments, is the issue of claims for customary rights by natives residing in affected logged-over forest lands where plantations are to be established. In Sabah for example, although these lands belong to the State and are untitled, under the provision of the Land Ordinance a native can claim customary rights on them as long as he or she has been living in it for at least 3 years. Such issues need to be resolved before if investors are to consider investing in forest plantations.

Labour and Mechanization

Labor supply is another issue of great concern. In Malaysia, the agricultural sector is experiencing a shortage of labor because of the rural to urban migration of youth to work in factories. Although the labor requirement in forest plantations is less then in agriculture, it still has to compete for labor in an expanding Malaysian economy, where the working conditions in other industries are usually more conducive.

A natural tendency in the plantation sectors is that foreign workers are engaged. The foreign labor recruitment process had never been efficient. The weaknesses have been attributed to inconsistent government policy on foreign workers' employment coupled with lack of dedication of the foreign workers resulting in extremely high turnover of manpower. One option to alleviate the labor shortage is increased mechanization. Machines developed in countries like Finland and Canada for example are environmentally friendly and highly flexible in their operation in forest plantations.

Finance and Private Involvement Issues

The planting of timbers on a plantation scale is constrained by a number of economic factors as well. These are:

- The high initial capital investment to establish the forest plantations,
- The long period between initial planting efforts and harvesting and thus the corresponding concern for the high capital cost or interest being carried until harvesting period,
- The high biological and economic risk involved in forest plantations *and*
- Unattractive and inappropriate investment incentives provided by the government for forest plantation investments in the past.

6. Government Tax Incentives and Regulations

6.1 *Incentives for Forest Plantations*

To hasten early development of forest plantations in Malaysia, incentive packages were introduced under the Promotion of Investment Act (PIA) 1986 and the Income Tax Act 1975 (Khaziah 1992). Under the PIA 1986, the two incentives offered were pioneer status and an investment tax allowance. Those planting timber, rattan, and bamboo, which were designated promoted activities under the PIA 1986, were granted pioneer status. The Income Tax Act 1975 provided an agriculture allowance to those who invested in forest plantations.

6.2 *The PIA 1986 (Malaysian Industrial Development Authority, 1986)*

Pioneer Status (PS)

Before 11 January 1991, PS provided full exemption from income and development taxes for a period of 5 years. However, since 1 November 1991, tax relief has been in the form of a 70% exemption from a company's statutory income. This means that a company-granted PS would have to pay income tax of 35% and development tax of 2% on 30% of its statutory income. Hence the company is taxed at a rate of 11% on its overall income. A company granted PS would be eligible for the 70% exemption for a period of 5 years from the date of its first sale.

Investment Tax Allowance (ITA)

The ITA is in the form of an allowance of 60% of the qualifying capital expenditure incurred within 5 years from the date of approval of the project. In the case of agriculture, the term "qualifying capital expenditure" has been expanded to include the following:

- The cleaning and preparation of land;
- The planting of crops;
- The provision of irrigation or drainage systems;
- The provision of plant and machinery used in Malaysia for the purpose of crop cultivation, animal farming, aquaculture, inland or deep-sea fishing, and other agricultural or pastoral pursuits;
- The construction of access roads, including bridges;
- The construction or purchase of buildings (including those provided for the people's welfare or as their living accommodations) and structural improvements on land or other structures that are used for the purposes of crop cultivation, animal farming, aquaculture, inland fishing, and other agricultural or pastoral pursuits; provided that the construction of roads, bridges, buildings, and structural improvements on land and other structures are on the part of the land used for the purpose of such crop cultivation, animal farming, aquaculture, inland fishing and other agricultural or pastoral pursuits.

The ITA is given as a deduction against statutory income (Khaziah, 1992). In any one year, the amount of deduction is limited to 70% of statutory income for that year. Although private investors were supported by these two incentives, the private sector's involvement in forest plantation development, especially in Peninsular Malaysia, has not been encouraging. Passive involvement by the private sector in forest plantation projects is still partially the situation today. Another option that has been proposed to attract investors was to introduce "group relief" under the ITA (Khaziah 1992). Group relief in this context refers to offsetting losses with income from other profitable ventures of a company's subsidiaries.

A revised version of the incentives has extended the PS for another 5 years for companies processing agricultural products, provided they fulfill certain criteria determined by the Ministry of Trade and Industry (Ministry of Trade and Industry 1988). Another important observation concerning the revised version of the incentives is the maximum rate of 100% for the ITA, compared to 60% when it was first introduced in 1986 (Ministry of Trade and Industry 1988). However, the 100% ITA can be granted only to companies that produce promoted products or are engaged in promoted activities.

There are three major types of risks involved in planting forest trees or commercial tree planting (CTP), namely:

a) Physical risk
b) Market risk
c) Financial risk

a) *Physical Risk*

Some of the major physical risks involved in CTP are the selection of the right species of tree to plant in certain types of soils, the growth rates of the tree, the physical properties of the timber required, the species' susceptibility to pests and diseases, the percentage of recovery from logs and the type of silvicultural regimes to follow. This list is not exhaustive and there are many more factors involved.

In general, tree plantation is exposed to a higher risk of pest and disease infections than trees in the natural forest. This risk can be associated with the homogeneity of tree plantation. Another reason could be the inadequate supply of quality seedlings during planting. As large-scale planting requires a large number of seedlings to be available within a relatively short period of time (within 2 to 3 months), quality seedlings may be hard to come by. The planting season is usually carried out just prior to the wet season to ensure higher survival rates. Up to a thousand seedlings are required for a hectare of land. At least a million seedlings would be required to plant an area of one thousand hectares. Given this scenario, it is not surprising that many CTP ended up with seedlings of poor quality and this may result in the trees being more susceptible to pests and diseases later on.

Fire is another major physical risk that is associated with CTP. Forest plantation fire outbreak is especially common during the dry season (the expected El Niño effect causing exceptionally dry weather).

b) *Market Risk*

Unlike other agricultural projects where the final products are realized within a short period of time (from a few months to one to two years), CTP can only be harvested from 15 years or more depending on the final objective of the forest plantation. For example, there is currently a high demand for rubberwood sawn timber but 15 years down the road, market preference may shift to

darker colored timber. It would be difficult for the investor to change the species mid-way through the rotation.

c) *Financial Risk*

The financial risk is perhaps the single major factor that has prevented the large-scale establishment of CTP. The high financial risk associated with CTP is due to the long gestation period and the payback period. The long gestation period means that investor has to set aside sufficient capital reserves for funding all the plantation activities from establishment to final harvest. This may span a period of 15 years or more depending on the species and the final objective. Many of those who have invested in CTP are currently facing cash flow problem.

The physical and market risks can be overcome through proper planning and implementation. However, the financial risks associated with the long gestation period and the uncertainty of the final outcome has discouraged new investments in CTP. The current sets of incentives available for CTP have not addressed the cash flow problem adequately and as a result very few CTP have been set up.

6.3 *Constraints of the Incentive Package*

The issue of incentives for the forest plantation program has been raised in many seminars and conferences. Almost everyone basically agrees that the existing incentives for forest plantation are not only unattractive but also, if applied, would place the company concerned in a difficult position to sustain its yearly cash flow.

For instance, Mohd Shahwahid and Saroni (1992) set out to find out the reasons why private investors showed no interest in becoming involved in commercial forest plantation projects. According to these researchers, there were four main reasons, inclusive of the incentives, why private investors were not interested in forest plantation projects. First was the issue of availability of land for the establishment of a forest plantation project. To make the project a profitable venture, most interested private entrepreneurs requested a sufficient land size, not to mention that the land must be suitable for planting at a low premium charge and in a suitable location in relation to infrastructure. Besides, the subject of land is a State prerogative; it is difficult to obtain information on the availability of land. Second was the issue of management of the land itself. Mohd Shahwahid and Saroni found out that the stipulations that the land is to be listed for 10 years or so and that the plantation together with the infrastructure must be established within 2 years of signing the contract might be difficult to achieve, considering other unforeseen problems that could arise. This was found to be not forthcoming. Third, the funds or loans at a subsidized interest rate must be made available for the development of the plantation. Fourth is the issue of the incentive package itself, which is focused more on crops with a shorter rotation period than on crops planted under the forest plantation program.

Norini (1994) stressed the importance of establishing forest plantations not only for timber production but also for recreational uses or as new breeding grounds for wildlife. Such multiple uses may not only help investors in forest plantations to achieve a positive cash flow but also make the project more financially viable. In other words, when issuing land, State governments must consider the multiple uses that can be derived from such man-made forests.

6.4 *Shortcomings of Current Incentives*

The current sets of incentives are not effective for CTP and do not benefit the investor as they do not address the long gestation period and cash flow problem associated with such a project.

6.5 *Weaknesses of the Pioneer Status (PS)*

The PS provides a 100% tax relief for an initial period of 5 years starting from the first harvest and an additional 5 years after expiry of the first period. In CTP the first harvest may be 15 years or more from the initial establishment stage. This means that a company will have to invest a substantial amount of money and wait for 15 years or more before it can make use of the tax relief, which is used to offset against the profits earned from tree harvesting. In many instances, CTP may involve longer rotation periods of 25 years or more. Under such circumstances, the investor would rather invest in other agricultural projects that have short payback periods and short gestation periods.

As an illustration, assuming the cost of plantation establishment is RM 2,000 per ha an investor will need to pump in RM 2 million annually if the annual target of 1,000 ha is to be reached. Over 15 years, a total investment of RM 30 million would be required and this is before taking into account the cost of maintenance and interest charges. Only then, from Year 16 onwards, income from the harvest of the first block of CTP will be realized. This is an enormous capital outlay and no company can afford to stay viable for 15 years without any returns on the capital invested. Furthermore, after discounting for time preference (say at 10% for 15 years – RM 1.00 in 15 years' time is only worth about 0.24 cents in net present value terms). This clearly illustrates the inappropriateness of the PS as an incentive for CTP.

6.6 *Weakness of the Investment Tax Allowance (ITA)*

Similarly, the existing ITA only allows qualifying expenditure to be given for the first 5 years only, whereas maintenance of planted areas goes beyond year 5 and in most cases up to year 15 or more depending on the species planted. Although the ITA allowance can be used to offset against statutory income and any unused portion can be carried forward indefinitely until all such balance is used up, it would take more than 15 years if the company does not have any other sources of income in the interim. In such a case, the ITA can only be used in the future when the company is making profits. The same reason is valid as in the case of Pioneer Status. Hence the ITA is also not useful to the investor during the establishment and tending phase of the plantation.

6.7 *Agricultural Allowance under Schedule 4A*

In the Income Tax (Approved Agricultural Projects) Order 2002 forest plantation has been included as an approved agricultural project thus qualifying for tax relief effective from the year of assessment 1999. However, this incentive is not available if a company has been granted PS or ITA (to be offset against statutory income). In such a case, PS, ITA and Schedule 4A are mutually exclusive. If the company elects for Schedule 4A then it is not entitled to PS or ITA.

Unused qualifying capital expenditure can be carried forward to the next assessment year and until all of it has been fully written off. This is especially useful if the company has other businesses that are generating an income stream.

The major drawback of Schedule 4A is that to qualify, a minimum area of 50 hectares of CTP needs to be established. This conditionality effectively excludes the thousands of individual planters (mainly one to two hectares) who are interested in CTP.

The costs of preparing the Forest Management Plan and the Annual Operating Plans cost of EIA study and all costs and fees related to the procurement of timber certification (MTCC, FSC and others) are currently not classified as qualifying capital expenditures.

6.8 *New Development Regarding the Incentive Package*

The new development regarding the incentive package is that there is a possibility of extending the incentive package based on the merits of individual companies. That is, the Ministry of Finance is willing to consider extra incentives on a case-by-case basis, according to the special incentives listed in the Budget 2000. This was stated in a letter forwarded to the Secretary of the then Ministry of Primary Industries from the Secretary, Department of Treasury. Currently this has come into effect and this now has created more interest from the private investors to venture into forest plantations.

PART C
FUTURE ACTIONS FOR ENHANCING RESTORATION/REHABILITATION

1. Improving/Revising Policies

While the Sustainable Forest Management guidelines in line with those of ITTO are in place in all the states, there is now the great need to ensure that these guidelines are adhered to. To this end enforcement is essential. If our timbers were certified we would be free to export to those countries that lay stress on such labels.

In the area of Biodiversity Conservation, Malaysia is a party to the Convention on Biological Diversity. To show its commitment, Malaysia has come out with its own policy on Biodiversity Conservation. Efforts are now on the way to completely document all the flora and fauna found in our forests and at the same time taking more efforts to gazette additional areas that have conservation value. More financial resources and manpower need to be committed to this mammoth task. In Sabah and Sarawak, in addition to conservation, the forest dwellers are being taught to settle down and to till the soil for their livelihood through the concept of agroforestry, then to continue with the destructive way of ‘slash and burn’ farming. More needs to be done in this area.

In relation to forest plantation, the government realizes the importance of timber farming to offset the expected shortage of timber in the future. To this end a special purpose vehicle has been set up along with a revolving fund to attract private sector participation in this activity. Many changes have been made to the incentive packages to attract investors. The process of planting trees needs to be expedited, so that such plantations are set up soon to meet the challenges of timber shortage that is evident to come in the near future.

2. Building Research and Educational Capacities and Facilities

Before the early nineties, there was only one institution of higher learning that was training forestry students at degree level. Forestry in the past was not thought of as a real science that needed skilled staff to manage them. All this has changed since the meeting in Rio in 1992, which created the awareness of the importance of forestry in relation to the environment. Since the nineties, two more universities have been set up, one each in Sabah and in Sarawak, where forestry and conservation have been given prominence as important areas of study. While the institutions are in place, there is now a need for these institutes to provide more emphasis in their syllabus on issues related to conservation, reforestation, rehabilitation, agroforestry, and in poverty eradication among the rural poor and forest dwellers There is also an urgent need to have graduates trained to handle and manage plantation forestry as a business entity similar to the other crops like rubber and oil palm being grown in the country. Research emphasis in the various disciplines of forestry also needs to be enhanced.

3. Reconciling Global and National Policies

The Malaysian Government is a party to many of the international initiatives that have come about, which are aimed at protecting forest by generating guidelines and protocols for sustainable forest management. Issues like forest certification, C&I for SFM, Forest Principles and Agenda 21 have all been addressed by the Malaysian Government. In line with the Convention of Biological Diversity, the Malaysian Government has formulated its own Policy, which came into effect in 1998. Malaysia continues to actively participate in the different processes like COP, LULUF etc. to make its stand on issues raised. The government is serious in its effort to retain its forest in its prime state and the present trend is to move away from logging and to protect the forest for conservation and other ecosystem benefits like water, carbon cycle etc.

4. Partnership and Collaboration with Private Sectors

The government policies are all aligned for the private sector to play a major role in the economy of the country. Private sector involvement has particularly been prominent in plantation crops management, in industrial processes and the down-stream timber industry. Much more is desired for the private sector to participate in the forest plantation industry. To facilitate this, the government is providing attractive incentives and soft loans for this sector to take off. Only now some momentum is being seen, where the private sectors are venturing into forest plantation industry. Much more needs to be done to attract private sector funding for forest rehabilitation programs.

5. Forest Fires

Forest fires are a rare phenomenon in the moist tropical rainforest. However, now with the advent of forest plantations on large tracts of degraded lands, the occurrence of forest fires are a probability. It is now necessary to set up plans to have a comprehensive forest fire prevention and fire fighting units in place. There is also a need to develop infrastructure for monitoring fire outbreaks in forest plantations. Criteria to determine zones that are fire prone also need to be established.

6. Pests and Diseases and Invasive Species

Strict guidelines for the introduction of alien species should be in place. Tests should be first made to ensure that an introduced species is not invasive in its new environment. Strict guidelines on health of imported forest materials and planting materials should also be in place to avoid accidental introduction of pests or diseases into the country that could affect the local flora.

With the increase in the area under monoculture forest plantations, it is essential that trained manpower to identify and control pest and disease outbreaks in plantations are in place. Due emphasis has to be given to the above issues, because if private sector involvement is desired, the investors should be assured of their returns during the harvest of these plantations.

7. Creating Public and Community Awareness and Support for Greening

Awareness campaign at the state and community level of the importance of trees and greening of the nation is an important tool to educate the public and to evoke a positive response for the love of trees in them. Currently in Malaysia there is a “plant a tree” campaign which is held annually where the public is encouraged to buy a tree and plant it in and around their homes and in open spaces. Such campaigns should be enhanced and carried out more frequently, so that trees are planted along the road sides, around housing estates and available open spaces. If this is continued, the urban areas, too, would be green within a few years.

8. Conclusion

The review above expounds on the Malaysian experience in moving towards a Green Nation. Currently 53% of the country is still covered by forest. The National interest and trend now is to move towards sustainable forest management and conservation of the forests. The need to hasten the forest plantation project is more evident than ever, especially with the decreasing trend in timber production from the natural forest. For instance, the timber production in Peninsular Malaysia has drastically declined from more than 12 million m^3 in the early 1990s to only 5 million m^3 from 1998 onward. A similar trend can also be observed for Sabah and Sarawak, where timber production dropped from 18 million m^3 and 8 million m^3 in the early 1990s to 14 million m^3 and 3 million m^3 in the year 2000, respectively (Anonymous 2001). It is well known that the forest-based industries employed more than 300,000 workers in the year 2000; a majority of these workers were from rural communities (Anonymous 2001). Hence the yearly declines in timber production will have a negative impact not only on the development of the existing forest based industries but also on the social well-being of the workforce engaged in such industries. Establishing forest plantations are therefore best seen as tree farms with multiple values designed to provide one or more very specific services to society. Whether managed by the private sector or the government with involvement of the rural communities, timber from these plantations will play an important role in relieving the pressure on natural forests by supplementing wood supply in the future and at the same time ensuring continued employment to the displaced workers from the rural communities.

The involvement of the public in greening the Nation will come a long way if the urban settings are also greened with trees and ornamentals. Educating the public on the importance of trees will evoke the culture of love for trees and a green environment.

It is critical that the correct policies and mechanisms must be put in place at a national level for the success of such programs. Forging partnership with the private sectors to invest into such venture

will speed up the greening process and also will complement the timber supply needed by the local timber industries.

LITERATURE CITED

Anonymous, 2001. Forestry Statistics in Peninsular Malaysia. Published by the Forest Department Peninsular Malaysia. 159pp.

Ahmad Zainal bin Mat Isa. 1992. Country report: Malaysia. MAB Regional Workshop on Rehabilitation of Degraded Secondary Forests, Kuala Lumpur. February, 1992.

Ang, L.H. 1994. Problems and prospects of afforestation on sandy tin tailings in Peninsular Malaysia. Journal of Tropical Forest Science 7(1): 113-128.

Annual Report. 1903. Report of Federal Forest Administration in the Federation of Malaya, 1903. Government Printer, Kuala Lumpur.

Annual Report. 1912. Report of Federal Forest Administration in the Federation of Malaya, 1912. Government Printer, Kuala Lumpur.

Annual Report. 1933. Report of Federal Forest Administration in the Federation of Malaya, 1933. Government Printer, Kuala Lumpur.

Anuar, H.M. 1996. Forest plantation development in the context of sustainable forest resources. Seminar on Forest Plantation Development and Sustainable Forest Management, Joint Working Committee on Forestry between Malaysia and Indonesia, 26-27 August 1996, Palembang, Indonesia.

Appanah, S. & Harun, I. 1999. Some thoughts on future management and silvicultural treatment of Malaysian forests. JIRCAS-FRIM-JFES Research Meeting, 11-13 October, 1999. Kuala Lumpur.

Appanah, S. & Weinland, G. 1990. Will the management systems for hill Dipterocarp forests, stand up? Journal of Tropical Forest Science 3:140-158.

Appanah, S. & Weinland, G. 1993. Planting Quality Timber Trees in Peninsular Malaysia. Malayan Forest Records No. 38. FRIM, Malaysia.

Berita Harian, 1989. Peluang Kerja di tanah terbiar. 26. Mei, 1989.

Caldecott, J. 1987. Hunting and wildlife management in Sarawak. World Wildlife Fund, Malaysia.

Chan, Y.K. 1990. The mining land - an overview of the current situation in Peninsular Malaysia. Paper presented at National Seminar on Ex-mining land and BRIS soils: Prospect & Profit. Kuala Lumpur. 17pp.

Chong, P.W. 1979. The growing domestic demand for timber and its influence on forest management. Malaysian Forester 42:378-389

Fahlman, R. 1975. Project S.4 - Species trials. Final Report. Research Report No. S.R.7. Forest Department, Sarawak.

FAO/UNEP. 1981. Topical Forest Resources Assessment Project (GEMS): Tropical Asia. Rome.

Foxworthy, F.W. 1930. Forest planting in Malay Peninsula. Staff Conference, Forest Research Institute, Federated Malay States, Kuala Lumpur.

Hamilton, L & King, P. 1983. Tropical Forested Watersheds: Hydrologic and Soils Response to Major Uses or Conversions. Westview Press, Boulder, CO.

Hashim, M.N., Maziah, Z. and Sheik Ali, A. 1991 The incident of heart-rot in Acacia mangium Willd. Plantations: a preliminary observation. In: Proceedings of the Conference on Forestry and Forest Products Research. Eds. Appanah, S. Ng, F.S. P. and Roslan I. Forest Research Institute of Malaysia, Kuala Lumpur. 54-60

Hill, H.C. 1900. Report on the Present System of Forest Administration in the Federated Malay States, with Suggestions for Future Management of the Forest of those States. Her Majesty's Indian Forest Service. Government Printers, Selangor.

Ismail, A. 1964. Enrichment planting in Selangor with particular reference to *Dryobalanops aromatica* (kapur). Malayan Forester 27:3-17

Khaziah, A.K. 1992 Investment incentives for forest plantation. In: Proceedings of the National Seminar on Economics of Forest Plantations. Forest Department Peninsular Malaysia. Pp.24-26.

Kiew, B.H. 1982. The conservation status of the Malaysian fauna, I. Mammalia. Malay Nat. 35(3)3-19.

Kiew, B. H. & Davison G. 1982. Conservation status of the Malaysian Fauna, II Birds. Malay. Nat. 26(2):2-25.

Lee, H.S. & Lai, K.K. 1981. Reforestation in Sarawak. Paper for the 1981 Forestry Departmental Conference, Sarawak, Malaysia.

Leighton, M. & Wirawan, N. 1986. Catastrophic drought and fire in Borneo tropical rainforests associated with the 1983 El Niño Southern Oscillation Event. Pp. 75-102 in G.T. Prance (ed.), "Tropical Forests and the World Atmosphere." American Association for the Advancement of Science Symposium, Washington, D.C.

Leo Chai & Lee, H.S. 1992. Rehabilitation of logged-over forests in Sarawak. In 1-6pp, Nik Muhamad M., Ismail Adnan AM, Mohd Zaki H. & Kamaruzaman J (Eds.), Proceedings of International Symposium on Rehabilitation of Tropical Rainforest Ecosystems: Research and Development Priorities. 2-4 September 1992. Kuching, Sarawak, Malaysia.

Malaysian Rubber Board 2003. Rubber Forest Plantation. Monograph No.5. Published by the Malaysian Rubber Board, Malaysia.

Ministry of Trade and Industry Malaysia 1986. Investment in the manufacturing sector – policies, incentives and procedures.

Ministry of Trade and Industry Malaysia 1988. Investment in the manufacturing sector – policies, incentives and procedures.

Mohd Shahwahid, O & Saroni Jodi. 1992. Forest Plantation Investment, viewpoints from the commercial sector. In: Proceedings of the National Seminar on Economics of Forest Plantations, 24-26th February 1992. Forestry Department Peninsular Malaysia and Forest Research Institute Malaysia. Pp 109-126.

MTIB, 2006. Malaysia's Forest Plantation Program. Maskayu Vol. 6:14-15.

Myers, N. 1984. The Primary Source: Tropical Forests and Our Future. W.W. Norton & Co., N.Y. & London.

Norini, H. 1994. Financial Assessment of Forest Plantation Project. Paper presented at the Malaysia-German Forestry Research Project Seminar, 13-15th February, 1994. Forest Research Institute Malaysia.

Oliphant, J.N. 1932. Artificial v. Natural regeneration. Malayan Forester 1:186-192.

OTA. 1987. Technologies to Maintain Biological Diversity. Office of Technology Assessment. U.S. Government Printing Office, Washington, D.C

.

Panayotou, T. & Ashton, P.S. 1992. Not by Timber Alone: Economics and Ecology for Sustaining Tropical Forests. Island Press, Washington, D.C.

Poore, D., Burgess, P., Palmer, J., Rietbergen & Synott, T. 1989. No Timber Without Trees: Sustainability in the Tropical Forest. Earthscan Publ., London.

Repetto, R. & Gillis, M. (eds.). 1988. Public Policies and the Misuse of Forest Resources. Cambridge Univ. Press, NY.

Sagan, C. Toon, O.B. & Pollack, J.B. 1979. Anthropogenic Albedo Changes and the Earth's Climate. Science 206:1363-68.

Soepadmo, E. 1983. Forest and man-An Ecological appraisal. An Inaugural lecture delivered at the University of Malaya on December 20, 1983. Kuala Lumpur, University Malaya.43p.

Spears, J. 1982. Preserving watershed environments. Unasylva 34:137.

Spencer, J.E. 1966. Shifting cultivation in Southeastern Asia. Univ. of California Press, Berkeley.

Thai, S.K. 1995. Status of Forest Plantation in Peninsular Malaysia. Paper presented at "Workshop Hutan Ladang", 21-22 August 1995, Tawau, Forestry Department, Sabah.

Thang, H.C. & Wadley, K. 1976. Report of the survival and development survey of areas reforested by line-planting in Selangor. Research Pamphlet No.67, Forest Research Institute, Kepong.

Walton, A.B. 1948. Some considerations for the future management and silviculture treatment of Malayan forests. Malayan Forester 11:68-74.

Weinland, G. & Zuhaidi, A. 1990. Management of *Acacia mangium* stands: Tending issues. In: Proceedings of the Conference on Forestry and Forest Products Research. Eds. Appanah, S. Ng, F.S. P. and Roslan I. Forest Research Institute of Malaysia, Kuala Lumpur. 41-53.

Whitmore, T.C. 1974. Tropical Rain Forests of the Far East (2nd Ed.). Clarendon Press, Oxford.

Wyatt-Smith, J. 1961. Provenance and Progeny trials of teak in Northwest Malaya. Malayan Forester 24:126-141.

Wyatt-Smith, J. 1963. Manual of Malayan Silviculture for Inland Forests. Malayan Forest Record No.23. Forest Research Institute, Kepong.

Forest Restoration and Rehabilitation in the Philippines

by

Lucrecio L. Rebugio, Juan M.Pulhin, Antonio P. Carandang, Eleno O. Peralta, Leni D. Camacho and Nathaniel C. Bantayan

PART A
STATUS OF LAND USE AND FOREST (AND LAND) DEGRADATION

The Philippines is an archipelago in Southeastern Asia made up of 7,107 islands and a total land area of around 30 million ha. It is favorably located in relation to many of Southeast Asia's main water bodies such as the South China Sea, Philippine Sea, Sulu Sea, Celebes Sea, and Luzon Strait. Luzon, Visayas, and Mindanao are the three major islands which constitute about 7 percent, 19 percent, and 34 percent, respectively, of the total land area (FMB, 2004). The country is divided into 17 administrative regions covering 81 provinces, 118 cities, 1,510 municipalities, and 41,995 *barangays*[1] (NSCB 2007).

The Philippines has a total projected population of about 87 million for the year 2006. The average annual rate of population increase from 1980 to 2000 is about 2.34%. While the average growth rate is expected to decline through time, current projection indicates that the population is likely to reach more than 141 million by the year 2040. As of 2003, about 30% of the total population subsists below the annual capita poverty threshold of P 13,133[2]. The average annual family income in the same year was P 148,616 (NSCB 2007).

As of 2003, 49.2 percent of the Philippines' land area, or 14.76 million ha, have been officially classified as "forestland" (FMB 2004). In the context of the Philippines, "forestland" refers to all property owned by the national government that is still in the public domain based on the official system of classification. It is a legal, not a botanical description. In reality, much "forest land" does not contain forests (Pulhin et al. 2006). Topographically, most of the forestlands are hilly and mountainous with slopes ≥ 18 percent and hence are not suitable for agricultural purposes. As such, they will remain part of the nation's permanent public forest estate according to Section 15 of the Revised Forestry Code of 1975. On the other hand, about 14.15 million ha are classified as "alienable and disposable". These are "lands of the public domain which have been the subject of the present system of classification and declared as not needed for forest purposes" (Section 3, Presidential Decree No. 1559). They may be issued with permanent title and/or used for varying purposes such as for residential, agricultural, commercial, and other use. The remaining 1.09 million ha of the country's land area have not been subjected to an official process of land classification and by virtue of existing government law, remain under the forestland category. Figure 1 presents the breakdown of 2003 land classification in the Philippines.

[1] *Barangay* is the smallest political unit in the Philippines and often corresponds to a village.
[2] Conversion rate: roughly 50 Philippine Pesos for one US Dollar.

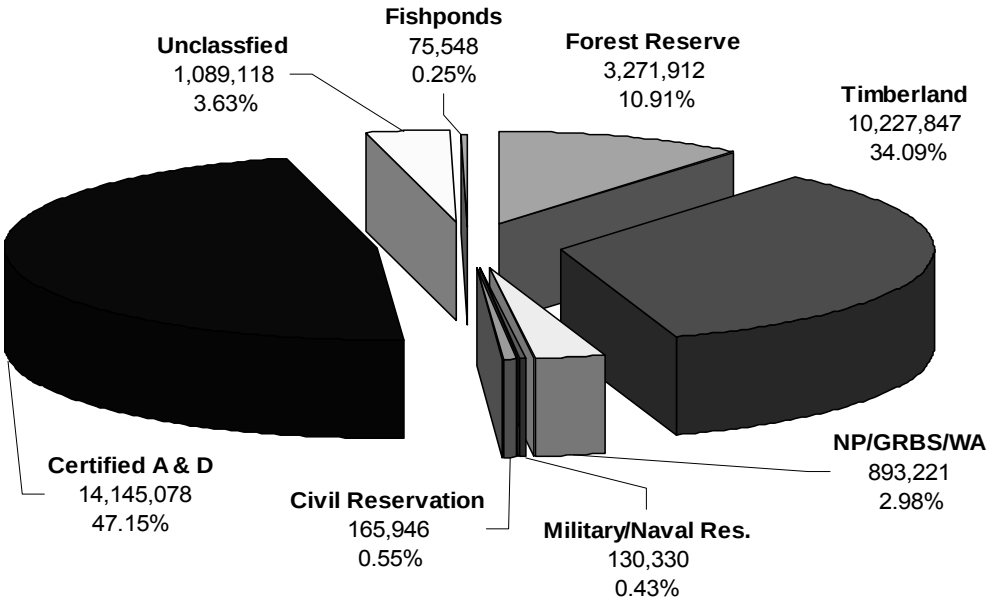

Figure 1: ***Status of land classification in the Philippines, 2003.***

1. Historical Overview of Forest Degradation

In its Global Forest Resource Assessment (FRA) 2000 Main Report, the Food and Agriculture Organization (FAO) of the United Nations (UN) defined forest degradation as "changes within the forest which negatively affect the structure or function of the stand or site, and thereby lower the capacity to supply products and/or services" (FAO 2001a:396). The same document describes deforestation as:

> *…"the long-term or permanent loss of forest cover and implies transformation into another land use. Such a loss can only be caused and maintained by a continued human-induced or natural perturbation. Deforestation includes areas of forest converted to agriculture, pasture, water reservoirs and urban areas. The term specifically excludes areas where the trees have been removed as a result of harvesting or logging, and where the forest is expected to regenerate naturally or with the aid of silvicultural measures."*

Some areas when degraded may recover naturally or with human assistance. In other cases, however, forest degradation may be permanent, and thus can lead to deforestation in the long run (http://glossary.eea.europa.eu/EEAGlossary/F/ forest_degradation). Indeed, in the context of the Philippine reality, "forest degradation" and "deforestation" the way FAO has defined them are closely intertwined. They can hardly be disentangled, hence are used interchangeably in this chapter.

The Philippines suffered from unrelenting onslaught on forest resources, leading to its current diminished and degraded state. When the Spanish colonizers first entered the archipelago in 1521, about 27 million ha or 90 percent of the country was covered with lush tropical rainforest (Lasco *et*

al. 2001). By the year 1900, about two years after the Americans substituted the Spanish, around 70 percent or 21 million ha was still forested (Garrity *et al.* 1993, Liu *et al.* 1993). The Americans introduced the first modern logging operations in 1904 when the Insular Lumber Company was granted a 20-year renewable concession to log approximately 300 km² of rich dipterocarp forest in Northern Negros in the Visayas (Roth 1983). Dipterocarp lumber, otherwise known as the "Philippine mahogany", was introduced to the world market.

Towards the end of the colonial period in 1940, 163 sawmill and logging companies were operating nationwide with a total investment cost of P 30,116,550. American firms accounted for 41 percent of investment in the sawmill industry of the nation, while the Filipino elite accounted for 34 percent (de la Cruz 1941). The Philippines had been transformed from a timber importer to Southeast Asia's largest timber exporter (Tucker, 1988).

American colonial records in 1920 state that 19 million ha or 64 percent of the country was covered with forest (Bautista 1990). Between 1934 and 1941, however, forest cover had declined to around 17 million ha or 57 percent of the land area (Table 1). From 1900 to 1941, close to 4 million ha of the forest cover were lost at an average of about 92,000 ha annually.

After World War II, the forestry sector supported the country's macro-economic policy geared towards the enhancement of industrialization to repair the war-ravaged economy. The sector started to liquidate the country's forest resources into solid capital to spur economic development. Forest industries were rehabilitated within a few years and the exportation of logs and some processed products was resumed (Boado 1985, Quintos 1989). By the 1950s, logging had grown so profitable that timber licenses proliferated. Towards the end of the decade (1959), the country was the major exporter of tropical timber accounting for almost one third of the world's market in logs (Quintos 1989).

Consequently, forest cover continued to decline after World War II (Table 1). By 1969, estimates of the remaining forest ranged from 10 to 10.9 million ha (Ganapin 1987, Revilla 1988). A national inventory conducted in 1982-88 by the RP-German Forest Resources Inventory Project of the DENR Forest Management Bureau (FMB) estimated forest cover at 6.46 million ha or 21.5 percent of the total land area in 1988 (Bautista 1990).

The 1990 Master Plan for Forestry Development estimated previous forest loss based on available information (DENR 1990). Between 1934 and 1990, the country lost 10.9 million ha of forest cover or an average annual loss of 194,000 ha. Of this area, 10.37 million ha, or 95 percent, were converted to other uses while 0.52 million ha were damaged by logging. From 1934 onwards, the loss rate increased dramatically until it peaked at 300,000 ha per year in the decade 1965-75. The rate then gradually declined to 100,000 ha per year from 1985-90 (Pulhin *et al*. 2006). Over the last 100 years, the deforestation rates have fluctuated with an average of about 150,000 ha per year (Rebugio *et al*. 2005).

2. Current Status of Forest Degradation

Until recently, figures on forest cover and deforestation varied even within the same government department depending on the sources. To reconcile conflicting information and come up with standard government statistics, the National Mapping and Resource Information Authority (NAMRIA) and the Forest Management Bureau (FMB) generated a set of land/forest cover

Table 1. ***Change in forest land area by forest type (million ha), 1934-2003 (c.f. Pulhin et al. 2006)***

Forest Type	1934	1934	1941	1969	1969	1976	1980	1988	2003
Old-growth dipterocarp	10.7	11.1		4.4	5.3	3.67	2.99	0.99	
Closed forest									2.56
Open forest									4.03
Commercial forest			13.52						
Non-commercial forest			3.72						
Residual dipterocarp, Second growth	n.a.	2.5		3.4	3.3	n.a.	n.a.	3.41	
Broad-leaved forest	2.5								
Pine (*Pinus*)	0.5	0.5		0.3	0.2	n.a.	n.a.	0.24	
Seasonal molave (*Vitex parviflora*)	0.4								
Seasonal without molave	0.4								
Mangrove	n.a.	0.3		0.2	0.3	n.a.	n.a.	0.14	0.25
Forest plantation									0.33
Bamboo	0.03								
Mossy, unproductive	0.7	2.6		1.7	1.8	n.a.	n.a.	1.14	
Sub marginal								0.54	
Mid-mountain	1.9								
Total forest area	**17.18**	**17.0**	**17.24**	**10.0**	**10.9**	**8.1**	**7.4**	**6.46**	**7.17**
% of country area	**57.3**	**56.7**	**58.22**	**33.3**	**36.3**	**27.0**	**24.7**	**21.5**	**23.9**

statistics using LANDSAT ETM images from 2003 (FMB 2004). Using a harmonized land/forest cover terms and definitions in accordance with the international standard, the analysis showed that the total forest cover in 2003 was about 7.2 million or 24% of the country's land area. Of these, 6.5 million were found within forest land while the remaining 0.65 million were within alienable and disposable lands. Open forests constitute 4 million ha, closed forest 2.5 million ha, plantations 330,000 ha, and mangrove 250,000 ha. In terms of regional distribution, much of the forests can be found in MIMAROPA, the Cagayan Valley, the Cordillera Administrative, the Central Luzon, and Eastern Visayas region, in that order (Table 2).

Table 2. ***Philippine forest cover by region, 2003 (area in hectares)***

Region	Closed Forest	Open Forest	Mangrove	Plantation Forest	Total Forest
NCR National Capital Region	0	2,790	30	*	2,820
CAR Cordillera Administrative Region	384,877	246,848	0	40,595	672,320
R-01 Ilocos Region	37,723	117,217	151	34,710	189,801
R-02 Cagayan Valley Region	503,149	604,473	8,602	33,621	1,149,845
R-03 Central Luzon Region	226,241	304,214	368	58,672	589,495
R-04a Calabarzon Region	117,162	161,165	11,346	*	289,673
R-04b Mimaropa Region	484,866	604,246	57,567	48,465	1,195,144
R-05 Bicol Region	50,618	90,284	13,499	2,075	156,476
R-06 Western Visayas Region	105,873	104,686	4,600	49,355	264,514
R-07 Central Visayas Region	2,231	43,026	11,770	17,842	74,869
R-08 Eastern Visayas Region	36,473	410,111	38,781	34,483	519,848
R-09 Zamboanga Peninsula Region	29,652	126,790	22,278	3,474	182,195
R-010 Northern Mindanao Region	107,071	226,400	2,492	1,530	337,493
R-11 Davao Region	177,503	240,986	2,010	536	421,035
R-12 Soccsksargen Region	126,385	218,858	1,350	2,641	349,234
R-013 CARAGA Region	64,729	431,832	26,731	*	523,292
ARMM Autonomous Region in Muslim Mindanao	106,319	96,661	45,786	1,580	250,346
Philippines	**2,560,872**	**4,030,588**	**247,362**	**329,578**	**7,168,400**

* Plantation Forest boundaries have not been provided.

Source: http://forestry.denr.gov.ph/landusereg.htm

The 2003 forest cover figure is 11 percent higher than 1988 forest cover of 6.5 million ha. DENR attributes this to the following factors (Defensor 2004, Pulhin *et al*. 2006):

- Slowdown in commercial logging due to a logging moratorium in several provinces;
- Shift in logging from old-growth to residual forests in the early 1960s;
- Log and lumber export bans;
- Accelerated public and private reforestation efforts;
- Expanded implementation of Industrial and Socialized Industrial Forest Management Agreements (IFMA and SIFMA) in areas where Timber Licence Agreements (TLAs) have expired or were cancelled; *and*
- Adoption of Community-Based Forest Management (CBFM) as the national strategy for managing the country's forest lands that have led to intensified forest rehabilitation and protection.

Some people outside the government on the other hand argue that despite the recorded increase in forest cover, old growth and secondary forests continue to decline because of logging and expanding frontier agriculture (Guiang 2001, Pulhin *et al* 2006). Accordingly, forest cover increase is primary due to regrowth vegetation and plantation established through reforestation projects and spontaneous tree growing by farmers and others.The estimate may also include agroforestry and fruit trees (Pulhin *et al* 2006). Even if the 2003 forest cover estimate is true, most of the country's forestlands are still in a degraded state requiring rehabilitation for ecological and socioeconomic purposes.

Figure 2 shows the statistics on forest degradation based on a study conducted under the ASEAN-Korea Environmental Cooperation Project (AKECOP). Appropriate GIS overlay procedures were conducted to derive the statistical estimates. The figure shows the forest estate (i.e. forestlands) of the country (in green and red colors estimated at 15.88 million ha). The areas in red show parts of the forest estate that are under non-forest use, which are estimated at 65%, or 10,322,000 ha. For the entire archipelago, the official figure on forest cover as mentioned above is 24%. Other estimates from FAO (2001b) put the figure at 19%. We estimate this figure to be 24% based on the GIS analysis undertaken, which is consistent with the government figure. Considering varying estimates, there may be around 9.3 to 10.3 million ha of forest lands showing various degrees of degradation requiring forest restoration and rehabilitation.

3. Causes of Forest Degradation

The causes of forest degradation in most tropical countries are complex. They constitute a confluence of socioeconomic, cultural, political and institutional factors. Following the framework of Contreras-Hermosilla (2000) in his analysis of *The Underlying Causes of Forest Decline,* forest degradation in the Philippines may be examined in terms of its *direct* and *underlying causes* (Figure 3). Direct causes are of two types: *natural*, and those resulting from human activities referred to here as "*direct anthropogenic causes"*. Natural causes are nature-instigated phenolmena that contribute to forest degradation such as fires, pests and diseases, and natural calamities particularly typhoons, floods and landslides. On the other hand, direct anthropogenic cau-

ses are those initiated by humans such as logging, agricultural expansion or shifting cultivation, cattle ranching, mining and infrastructure development like road and dam construction.

Figure 2. ***GIS map of forest restoration in the Philippines***

In contrast, the underlying causes refer to the deeper and much more fundamental forces that drive forest degradation. They are rooted in some of the most basic features of society, such as the inequitable distribution of economic and political power, attitudes towards corruption, population growth, flaws in the market system, and inappropriate government policies. They can also operate across time and space and may originate in other countries and transmit their effects through trade and other market forces. In reality, there are many underlying causes of forest degradation and they operate in numerous and variable combinations (Contreras-Hermosilla 2000).

Another important component of the forest degradation framework are the *agents*. Agents are individuals, groups of individuals or institutions whose actions or interventions result in forest degradation or deforestation. In the context of the Philippine forestry, they include the loggers, slash and burn cultivators, other upland migrants and speculators, agribusiness, cattle ranchers, miners, policy makers with vested interest, wood industries, forest products consumers, and others. The agents interact in a dynamic and complex manner with the direct and underlying causes. Thus, it is a mistake to attribute forest degradation to a simple cost-effect relationship or assume that such a relationship will remain unaltered over time. Multi-causal chains are more likely and the effect of a single force like population growth is very difficult to ascertain (Contreras-Hermosilla 2000, Geist and Lambin 2001).

3.1 *Direct Causes*

In the Philippines, some of the direct causes of forest degradation with available statistical support are *kaingin* or slash-and-burn cultivation, forest fire, logging, and other natural phenomena such as pests and diseases and natural calamities. Table 3 shows the extent of damage attributed to each factor over a period of 12 years from 1980 to 1991 and then for the year 2001 based on the official forestry statistics produced by the government. While these figures may be underestimated when compared to the annual deforestation as previously discussed, they nonetheless provide an idea of the contribution of each factor to forest degradation.

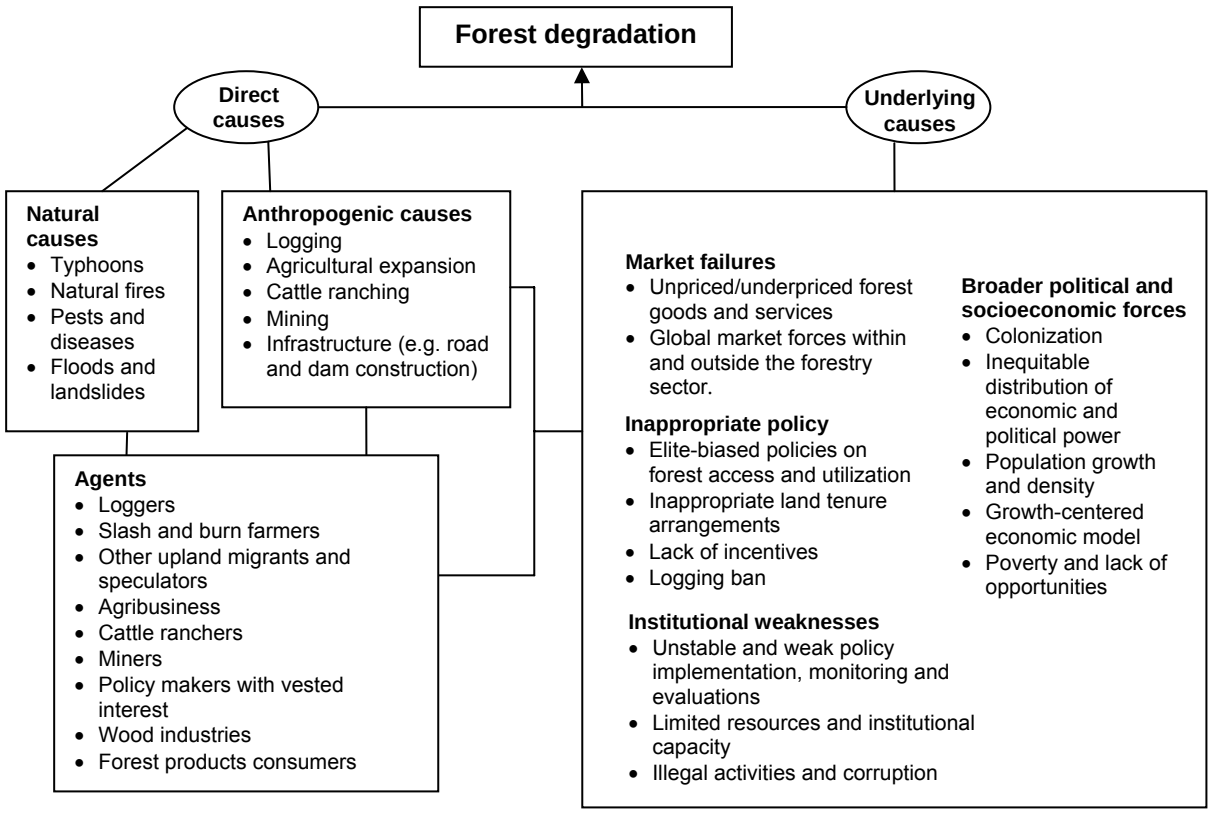

Figure 3. ***Causes of forest degradation in the Philippines (Modified after Contreras-Hermosilla (2000)***

Anthropogenic Causes

Historically, logging activities by big companies in conjunction with other anthropogenic factors have been a major driving force that contributes to forest degradation in the Philippines (Kummer 1992). Through logging, primary forests are first converted to secondary forests before they are totally denuded or converted to agricultural areas and other land uses. Logging is seen to abet forest destruction in several ways: through clear-cutting or careless felling that results in the destruction of forest regenerative capacity, and through the development of road networks. The latter is considered to be the most important factor since logging roads open forest lands to encroachment by people (Borlagdan 1997). Once inaccessible, forestlands become "invadable" (Cruz *et al*. 1992) by land-hungry migrants after they have been logged over and made accessible by logging roads. With almost nil effort from TLA holders to do forest protection in logged-over areas, these areas became very prone to non-forest development especially agricultural expansion.

Studying the formation and transformation of secondary forest in the Philippines, Lasco *et al.* (2001) noted that areas subjected to logging (known as residual forests) could be used as a useful indicator for analyzing the extent of forest degradation in the country. Using a temporal analysis, they observed that areas of residual forests remained the same over a 26-year period from 1971 to 1997. In contrast, the area of primary forest declined from over 4.5 million ha in 1971 to less than 1.0 million ha in 1997, a loss of 3.8 million ha in about 25 years. In theory, the said loss in primary forest could have been added to the area of secondary forest assuming the latter were not degraded or converted to other uses. Since residual forests remained almost the same during the 26-year period, the team deduced that 3.8 million ha of secondary forests were denuded in the

same span of time or an average of 140,000 ha per year. This figure is much higher compared to the government figures with a total area of only 28,860 over a 12-year period (Table 3). However, it appears to be more consistent with the overall deforestation pattern in the country, which as earlier mentioned, has been estimated at about 150,000 ha over the last century.

Table 3. ***Forest destruction and its causes in the Philippines in hectares (1980-2001)***

Year	Kaingin	Forest Fire	Logging	Others*	Total
1980	6,302	18,324	7,348	666	32,640
1981	5,826	12,471	6,108	0	24,405
1982	3,286	8,063	4,954	0	16,303
1983	2,241	117,951	1,015	0	121,207
1984	1,137	3,177	478	103	4,895
1985	941	11,743	1,918	0	14,602
1986	1,991	4,257	90	0	6,338
1987	570	5386	676	514	7,146
1988	2,914	423	4,474	2,444	10,255
1989	4,683	675	1,727	5,729	12,814
1991	759	5,872	72	530	7,233
2001	70	1,552	0	1,172	2,794
Total	**30,720**	**189,894**	**28,860**	**11,158**	**260,632**
% of Total	**11.79**	**72.86**	**11.07**	**04.28**	**100**

* “Others” refers to pests and diseases, natural calamities, etc.

Sources: Various Forestry Statistics

Other than logging, *kaingin-making* or slash-and-burn cultivation contributes to forest degradation. It is employed by both the indigenous forest dwellers in the Philippines as well as by the migrant groups although the practice varies widely from one group to the other (Borlagdan 1997). In general, indigenous forest dwellers employ more sustainable practices compared to their migrant counterparts. However, their environmentally-friendly traditional practices have been significantly altered as a result of the shortening of the fallow period brought about by limited areas available due to population pressure. From 1980 to 1991 government records indicate that a total area of 30,650 ha was destroyed due to various forms of slash-and-burn cultivation (Table 3). Since the early 1980s, the government has been promoting more sustainable farming practice, particularly agroforestry technology, under its various people-oriented forestry programs to reduce the negative impacts associated with *kaingin-making.*

Natural Causes

Recent natural calamities in the Philippines clearly point out that forest degradation is caused not only by anthropogenic pressures but also by the forces of nature. During the 2004 devastating landslides in Dingalan, Aurora and Infanta and Real, Quezon, many lives and properties were lost.

Just recently, in September 2006, Mt. Makiling, Laguna, was devastated by landslides and the low-lying towns were inundated by floodwaters. The tragedy of Aurora and Quezon pointed an accusing finger to improper forestry practice in general and rampant and illegal logging in particular. The analysis of land use/land cover, which spanned a period of fifteen years, revealed otherwise (Cruz *et al*. 2005). The changes in land use/land cover were analyzed and visualized through the use of remote sensing and geographic information system (GIS) technology. While an increase or decrease for a particular land use/land cover is elucidated, shifts over the geographic area (i.e., areas that have been forested before have been converted to another use) can also be seen. It was the force of nature that resulted in forest degradation through mass movement of soil. Incidentally, the contribution of natural calamities like landslides to the overall forest degradation has not been well documented, and hence is not fully understood and appreciated.

Among the various natural causes of forest degradation, forest fire is probably the most documented. While forest fires in reality are mostly human-initiated in the Philippines, natural factors such as dry weather conditions, high temperature, and strong wind velocity induced their occurrence and determine the extent of their damage. As presented in Table 3, forest fires have inflicted the highest forested area destroyed equivalent to a total 189,894 ha, or 72.86%, of the total damage over a 12-year period. It is also worth noting that the El Niño year of 1983 recorded the highest forest destruction brought about by forest fires estimated at 117,951 ha. This constitutes 45.25% of the total forest damaged caused by both human- and natural-induced forces recorded at 260,632 ha in 12 years.

Another natural cause of forest degradation in the Philippines is pests and diseases. However, historical record on the extent of forest degradation caused by this factor is very scanty. Diseases of trees and other plants in the Philippine forests have not been extensively studied unlike that of agricultural crops (Quiñones 1980). Experiences reveal that the occurrence of epidemics and widespread infestations in the country has been associated with the introduction of exotic trees in tree plantations. Examples were the varicose borer (*Agrilus* sp.) that infested *Eucalptus deglupta* from Papua New Guinea and the albizzia cancer. Since then, integrated research programs on pests and diseases of forest trees were undertaken (Rebugio *et al*. 2005). However, comprehendsive scientific assessment on the impacts of pests and diseases on forest degradation nationwide remains to be done.

3.2 *Underlying Causes*

Beneath the observable direct causes of forest degradation in the Philippines there are underlying causes involving a confluence of economic, political and institutional factors.

Market Failure

Many of the services provided by forests have no market price thereby providing the concerned actors very limited incentives to invest in forest protection and intensive management. For instance, participants of Community-Based Forest Management (CBFM) projects in upper watersheds do not get paid for the services they provide to downstream fishermen and farmers by protecting and rehabilitating the forests. These values include the protection of soil against erosion and irrigation and hydropower dams against sedimentation which can be substantial to downstream operators. Similarly, they do not obtain commercial profits for capturing carbon, maintaining scenic beauty or for preserving biodiversity resources. As a result, upland communities have little incentive to take

these benefits into account and therefore the production of these environmental services will be less than if they could sell them and receive a financial reward. Studies indicate that if it were possible to alter market forces to take these values into account, there would be a higher chance that some forest lands would not be deforested or degraded because they would be more valuable to the private agents like the local communities (Contreras-Hermisilla 2000).
Global market forces such as the high international demand for tropical logs in the world market have also contributed to the forest degradation in the Philippines. High market demand from the United States for premium logs from the Philippine forests from the early 1900 until before World War II and by the Japanese market after the War, contributed to massive timber harvesting and forest destruction during this period at the expense of environmental considerations (Pulhin 1996). Similarly, market forces outside the forestry sector such as the increase in the global oil prices and the decrease in the world price of sugar resulting in the collapse of sugar industry in Western Visayas in 1979 exert an influence on forest degradation. Thousands of affected families migrated into the country's forestlands adding environmental pressures to the already fragile upland ecosystem (Cruz *et al.* 1992).

Inappropriate Policies

Until recently, most of the Philippine forest policies have favored the privileged few in terms of having access to and control over the country's forest resources. Prior to the enactment of the 1987 Constitution, one TLA holder can have as much as 99,000 ha of timberland for exploitation. Such a policy had led to the highly skewed distribution of forest access and benefits in favor of the economically well-off and politically influential sectors of the society. For instance, during the Martial Law years from 1972 to 1982, close to 1/3 of the total land area of the country was under the control of 217 to 471 TLA holders (Pulhin 1996). It was during this period that the country recorded the highest rate of forest destruction ever, estimated at around 300,000 ha in a single year (Pulhin 1996).

On the other hand, until 1981, forest-dependent communities including the indigenous communities had been deprived of access to forest lands and were considered as "squatters" in their own lands. This had discouraged their participation in forest conservation and development in the past. With the establishment of the different people-oriented forestry programs in 1982, a number of land tenure instruments have been issued to forest occupants. However, the recent cancellation of more than 1000 Community-Based Forest Management Agreements by the former DENR Secretary nationwide has cast doubt on the sincerity of the government to pursue CBFM and hence threatens the continuous participation of the upland communities in forest protection and development.

Other policies that have negative effects on forest rehabilitation include the lack of an appropriate incentive system for the private sector to invest in forest production and rehabilitation as well as the lack of policy stability in relation to timber harvesting. Moreover, the recent government policy to ban logging in all natural forests and in forest plantations in some areas has negative socio-economic and environmental impacts and in the long run is likely to contribute to a further degradation of the country's forest resources.

Institutional Weaknesses

The DENR, which is the primary government agency responsible for the overall management of the country's forest resources, suffers from a number of institutional weaknesses. Among these are:

- unstable policies and weak policy implementation;
- limited resources and institutional capacity;
- poor monitoring and evaluation; *and*
- the involvement of some of its staff in illegal activities and corrupt practices.

These factors promote poor forest governance and hence contribute to the continuing degradation of the country's forestlands and resources.

Broader Political and Socioeconomic Forces

The broader political and socioeconomic forces in consonance with the other factors already mentioned also contribute to forest degradation. Forest degradation, for instance, was recorded during the colonial period in an effort of the colonial government, such as the Spanish and the Americans, to exploit the country's resources to advance their own economic interests and promote a growth-centered model of economic development (Pulhin 1996). Similarly, the inequitable distribution of economic and political power during the post-War period contributed to the diminution and degradation of the country's forestlands and resources that had benefited the few economically well-off sector of the society.

Population growth together with other structural factors is also seen as a major driver of forest degradation. Due to the intense population pressure in the Philippines and limited economic opportunities, more people are compelled to occupy hilly and mountainous areas. As of 1985, around 32 percent of the total population of the country, equivalent to 17.5 million people, resided in the "uplands" with 18 percent on a slope and above. The movement of population to these areas is primarily due to an increasing need for areas to cultivate. Farming of these areas, especially those beyond 30% slope, usually results in excessive soil erosion (Cruz *et al*. 1992). At present, a total of around 24 million people are believed to be residing in the uplands most of whom are dependent on the forest for survival. Aptly summarizing the combined effects of population pressure and other structural factors of the degradation of the country's forests, Cruz *et al*. (1992) noted:

> *"The Philippine uplands, already a refuge for the growing numbers of poor and landless, absorbed even larger numbers in the first half of the 1980s. The sharp increase in poverty, caused by the stabilization policies adapted so as to secure IMF loans amid the debt crisis, clearly contributed. Rapid population growth, especially among the rural poor in areas already densely populated, adds to the numbers without access to productive lands or alternative employment. Thus, migrants moved to public domain forest lands, sometimes facilitated by settlement programs and commercial loggers, looking for cultivable lands. The result has been further degradation of forests and soils."*

4. Impacts of Forest Degradation

Forest degradation has multiple impacts on the different sectors as well as the different groups in the Philippine society.

4.1 *Sectoral Impacts*

Viewed from a sectoral perspective, the impacts of forest degradation in the country involve at least three major areas: the economy, environment and governance.

The Economy

One of the well-established negative impacts of deforestation in the Philippines relate to the declining contribution of the forestry sector to the Philippine economy. In the early 1970s, wood and other forest products were top dollar earners. Forest products averaged 19 percent of the total value of exports from 1970 to 1973. In addition, the wood industry provided direct employment to many thousands of individuals. In 1982 for instance, the Forestry Development Center estimated that more than 400,000 people or about 1% of the country's total population were directly dependent on the wood industry for livelihood (FDC 1987).

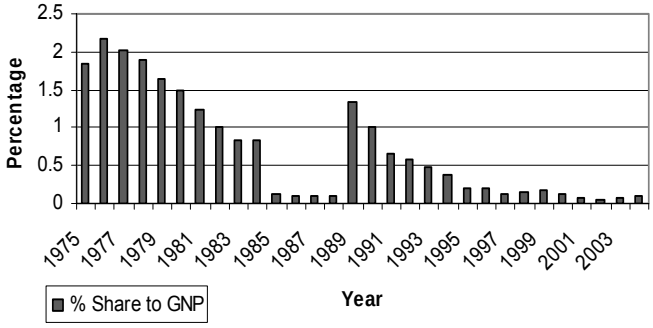

Figure 4. Percent Share to GNP of Forestry: 1975-2004

With the continuous degradation of the country's forestlands and resources, however, the contribution of the forestry sector to the Philippine economy has continued to decline. From around 2.17 percent in 1976, the percent share of forestry in the gross national product (GNP) has plunged to a meager 0.10 percent in 2004 (Figure 4). During the same period, the total forest area has declined by about 1 million ha.

Environment

Environmental impacts, although not as well documented compared to economic setbacks, are equally significant. Massive forest destruction has resulted in soil erosion and siltation of rivers and lakes. This in turn has led in some instances to the reduction in the lifespan of hydroelectric dams like the Magat Dam in Northern Luzon. Continuing onslaught on the country's forest has also rendered a number of upland areas environmentally vulnerable to soil erosion and landslides

especially during the typhoon months. Indeed, thousands of lives were lost in a number of recent landslides which may, to a certain extent, be exacerbated by forest degradation.

Forest degradation has likewise adversely affected and continued to threaten the rich biodiversity of the country. The Philippines is considered as one of the 17 megadiversity countries, which together contain 70 to 80 percent of global biodiversity (Mittermeier *et al*. 1997). However, with the loss of more than 90 percent of its original forest cover, 418 threatened species are already listed in the 2001 IUCN Red List (Hilton-Tylor 2002). As a result, it is now considered as one of the 25 global biodiversity hotspots (Myers *at al*. 2000). The variety of life found only in the Philippines is now greatly threatened with extinction due to continuing natural resource degradation (Ong *et al*. 2002).

Forest Governance

The inability of the State-centered mode of forest governance to address the continuing degradation and diminution of the country's forestlands and resources contributed to the evolution of a more participatory approach to forest management. Such an approach takes into account the importance of involving the different stakeholders including the local communities, local government units, non-government organizations, and others, in decision-making concerning the management of the country's forest resources. While the impacts of these in arresting the problem of forest degradation has yet to be ascertained, this recent trend appears to be more promising compared to the traditional highly centralized method of forest resource management.

4.2 *Impacts on the Different Societal Groups*

Another way of viewing the impacts of the forest loss and degradation in the Philippines is looking at them as they affect the different stakeholders in the society. Adapting the approach of Contreras-Hermisilla (2000) the impacts of forest degradation may be better understood in terms of identifying the specific groups of stakeholders that bear the consequences (negative or positive) of forest degradation. These include the range of stakeholders from on-site groups such as the forest-dwelling indigenous communities to local off-site communities, to urban dwellers, to Industrial companies with economic interests, to the national governments and to the global scientific communities (Table 4). While most stakeholders are negatively affected by forest degradation, the greater brunt of the impacts is normally shouldered by the local on-site and economically deprived communities, particularly the indigenous communities. Moreover, few of the stakeholders, such as the business sector, may benefit from forest degradation in terms of increased profits though this may not be sustainable in the long run. All these imply that stakeholder analysis is an appropriate tool to better understand the consequences of forest degradation to specific groups and hence develop a more responsive intervention to avoid further marginalization of the powerless groups.

Table 4. ***Consequences of forest degradation from the Philippines from the perspectives of the different segments of the society (Adopted from Contreras-Hermisilla 2000)***

Societal group	Implications of continuing forest loss and degradation
Forest-dwelling indigenous communities	• Loss of spiritual values. • Social disruption of traditional structures and communities. Breakdown of family values. Distress and social hardship. • Loss of traditional knowledge of how to use and protect forests in sustainable ways. • Reduced prospects for preservation of forest environmental and aesthetic functions of interest and potential benefit to society as a whole.
Forest farmers and shifting cultivators	• Immediate opportunity to survive. • Forest degradation and declining soil fertility. • Loss of access to forest land and the possibility of food crop production and reduced possibilities for harvesting forest products, both for subsistence and income generation. • Prospects of malnutrition or starvation. • Disruption of family structures and considerable social hardship.
Local communities, the poor and landless living outside forests	• Decreased availability of essential fruits, fuelwood, fodder and other forest products. • Reduced agricultural productivity. (Through loss of the soil and water protection potential of remnant woodlands and on-farm trees: loss of shelterbelt influence leading to reduced crop yield.) • Reduced income generation and possibilities to escape from the poverty trap.
Urban dwellers	• Reduced availability (and/or overpriced) essential forest products such as fuelwood, charcoal, fruits, building materials and medicinal products. • Reduced prospects for assured supplies of clean drinking water and clean air. • Loss of the recreational opportunities and amenity values afforded by national forest parks and wilderness areas.
Commercial forest industrial companies and forest worker communities	• Immediate large profits. • In the longer term, loss of company business and forced closure of forest operations. • Loss of jobs for forest-dependent communities, social disruption and hardship. • Loss of income and possible negative social implications of reduced income of shareholders with significant savings invested in forest industrial company stocks.

Table 4. continued

Mining and other industrial interests	• Improved access to potentially profitable mineral or other commercially valuable products located under forests. • Increased profitability of company operations and returns to company shareholders. • Politically negative impact on company operations of criticism by environmentally concerned groups.
Environmental advocacy groups and conservation agencies	• Loss of the essential environmental functions of forests including biodiversity, climate regulation, preservation of water catchments and fishery values. • Loss of cultural values and social hardship for the underprivileged communities whose welfare these groups are committed to protect. • Increased problems of environmental pollution. • Loss of those forest values that could be of vital importance and/or interest to the survival and welfare of future generations
The global scientific community	• Prospects that continued forest destruction will accelerate global warming with potentially negative consequences for human welfare and survival. • Continuing biotic impoverishment of the planet, loss of genetic resources, and all that implies for sustainable food production, and loss of potentially valuable medicinal and other products. • Increasing pollution and toxification of forest soils, contributing to declining forest health.
National government planners and decision-makers	• Immediate escape from political pressures when impoverished populations migrate to frontier forest areas. • Loss of a potential source of development revenues with consequences of reduced employment and opportunities, sustainable trade and economic development. • Loss of the wide range of environmental functions that forests provide in contributing to societal needs and a habitable earth. • Loss of political support in situations where forestry loss and degradation adversely affect the welfare of many citizens.

PART B
IMPLEMENTATION OF FOREST RESTORATION AND REHABILITATION

1. History of Restoration/Rehabilitation

Reforestation is a process of bringing back of crop cover, usually arborescent plants, in once vegetation-rich but now vegetation-bereft lands that also includes ecological reforestation and economic reforestation or their combination (Esteban, 2003). It may also refer to new plantings, assisted natural regeneration and enrichment planting. Reforestation can be interchanged with forest rehabilitation if combined with some vegetative or infrastructural measures to stabilize the soil while forest restoration is a special type of reforestation where the intention is to bring back a semblance of the original forest condition through planting of native species found in an area coupled with assisted natural regeneration and enrichment planting. On the other hand, rain-

forestation is reforestation strictly using indigenous species, but may also include the use of native fruit trees in combination with forest trees to regenerate the area.

The Philippines has almost a century of experience in reforestation. Since 1910, small-scale forest rehabilitation initiatives have already started when the first recorded rehabilitation initiative in the country was initiated by the Forestry School in Los Baños, Laguna (Luzon) as part of its silvi-cultural class (Annex Table 1). This initiative formed part of the overall concern about forest re-habilitation under the American colonial period (1910-1945). By 1916, about 600 species had been tried in the nursery and plantation of the School, which was then part of the administration of the Bureau of Forestry. The same year saw the government's initial attempt to embark on ex-tensive planting of barren lands when the Philippine Legislature appropriated the sum of P 10,000 under Act 2649 for the reforestation of the Talisay-Minglanilla Friar Lands Estate in Cebu province with an aggregate area of 4,095 ha. According to Orden (1960), the project started with the ejec-tion of the people considered as "squatters" in the area who were hostile to the project and 73% of the area was planted. Due to lack of funds, however, the work had to be stopped for some time re-sulting in local people returning to the area to make clearings and plant ipil-ipil and other fast-growing tree species.

From 1919 until the outbreak of World War II, several reforestation projects were opened through-out the country among which are as follows: Magsaysay Reforestation Projects in Arayat, Ilocos, and Zambales, all on the island of Luzon; Cincona plantation in Bukidnon (Mindanao) and other reforestation projects elsewhere in the country. Initial fundings were very limited then until 1936. In 1937 until WWII, more extensive and large-scale reforestation was observed. A special office was established under the Director of Forestry to inspect new reforestation projects.

At the outbreak of World War II, a total of 35 reforestation projects were in operation covering an area of 535,000 ha mostly located in Luzon. From 1910 to 1941, a total of about P3.57 million was spent on reforestation including nursery and plantation establishment and maintenance. The gov-ernment was the main actor in reforestation and the primary purposes were scientific enquiry, re-greening barren lands and presumably providing environmental services to the public. These pro-jects were to be long-term reforestation sites managed by the Bureau of Forestry. Appropriation by the government was the primary source of funding.

During the Post-war era (1946-mid 1970s), 29 of the 35 reforestation projects operating before the war were reopened. In July 1948, a new and permanent source of funding was made available under Republic Act No. 115 that revived reforestation activities that were halted during World War II. The Act levied charges for each cubic meter of timber (P0.5 for the first and second species groups, and P0.4 for the third and fourth species groups) cut and removed for commercial pur-poses from any public forest. This fund provided a great boost in the reforestation efforts of the government especially during the 70s when annual log production exceeded 10 million m^3 annually.

In 1960, the Reforestation Administration was created under Republic Act (RA) No. 2706. In 1972, 91 reforestation projects were being implemented almost entirely by the government. Also in this year, the Reforestation Administration was integrated with the Bureau of Forestry, Parks and Wild-life Office, and Southern Cebu Reforestation Project under Presidential Decree (P.D.) No. 1. Likewise, the Letter of Instruction (L.O.I.) No. 3 on the same year integrated reforestation active-ties into the mandate of the then Bureau of Forest Development (BFD).

In the mid-70s, multi-sectoral rehabilitation efforts had been given impetus. For example, P.D. 705 (1975) required the conduct of nationwide reforestation activities with the participation of the private sector.

From 1976 onwards, the holders of TLAs were given the responsibility to reforest inadequately-stocked forest lands within their forest concessions as a requisite in their operation plans (1-year, 5-year and long-term operations plan). The Program for Forest Ecosystem Management (PROFEM) was also launched calling for a holistic approach to forest ecosystem management involving all sectors of the society. In 1977, P.D. 1153 was issued requiring all able-bodied citizens, 10 years and above, to plant 12 seedlings annually for 5 consecutive years. In 1979, the Letter of Instruction (L.O.I.) No. 818 was enacted compelling all holders of existing timber licenses, leases, and permits to reforest one hectare of denuded or brush land for every hectare logged. By the end of the 1970s other sectors of the society such as the private sector, government agencies other than the Bureau of Forest Development, local government units and citizens were involved in various forest rehabilitation efforts. In 1981, the Executive order No. 725 was issued further encouraging and providing incentives in private sector involvement in reforestation through the establishment of Industrial Tree Plantations, Tree Farms and Agroforestry Farms all over the country.

People-oriented forestry programs such as the Integrated Social Forestry Program (ISFP) and the Community Forestry Program (CFP) were given much attention in the 1980s, mostly funded by foreign donors. This period ushered the participatory approach to forest conservation and development. Rehabilitation efforts were seen as a major strategy to address upland poverty and to promote livelihood opportunities among the participating communities.

The period of the late 80s through 1990s saw the more active participation of the different sectors in forest rehabilitation through the different policies and programs initiated by the government. The “People’s Power” Revolution in 1986 became an impetus to contract huge loans to fund forest rehabilitation. In 1987, the Forestry Sector Program (FSPI) from Forestry Sectoral Loan I was launched. There was a significant shift in the national reforestation strategy from regular BFD reforestation projects to contract reforestation by corporate groups, families, local government units, non-government organizations and communities under the National Forestation Program (NFP). The regular reforestation projects were just given meager funds for maintenance only, with no new targets in plantation establishment. Likewise, monitoring of plantation performance was given to independent private groups using a method developed in PICOP called “inspection chart mapping (ICM)”.

Assessment on FSP showed much success in sites developed by communities. In 1995, the second sectoral loan was contracted to launch the FSP II. This time, the vehicle to this nationwide program was the Community-Based Forest Management (CBFM) under the same NFP. In the same year, Executive Order No. 263 adopted CBFM as the national strategy for sustainable management and development of forest lands. Under FSP II, communities were contracted to do the reforestation and were given tenure over areas developed by them. In most areas developed under FSP I Forest Land Management Agreements (FLMA) were issued to communities; these areas were later also to become CBFMA sites.

The 1990s also saw many foreign-assisted projects being implemented all throughout the country. This was also the start of more active LGU involvement in forest rehabilitation and watershed management by virtue of the 1991 Local Government Code.

Major Driving Forces of Forest Rehabilitation in the Philippines

The first rehabilitation initiatives conducted in the country were driven by scientific needs in trying to find practical methods of converting *Imperata* grassland areas into forest plantations, of testing performance of several tree species over grasslands and as laboratory experimentation exercises for students. Likewise, a major driver of early reforestation efforts was the promotion of environmental stability. Most early reforestation projects were located in established forest reserves, national parks and in the watersheds. Environmental considerations continued to be a major reason in forest rehabilitation even in the 1960s and 1970s with a main purpose of restoring denuded or inadequately timbered areas for protection purposes. However, the 1980s and 1990s efforts were driven by political factors in the face of public clamour and pressure to restore forests that had been perceived as destroyed by commercial logging in the 70s and 80s. Hence, policies were issued compelling TLA holders, LGUs, OGAs and private citizens to plant trees. Rehabilitation efforts of all sectors peaked during this period. Eventually, efforts and enthusiasm for forest rehabilitation waned due to declining financial support from the government and lack of appropriate incentives to the private sector. Major rehabilitation efforts in the period of the 1970s to the 1990s were mainly driven by economic considerations due to the eminent symptoms of an impending timber crisis in the country. Development of tree farms, industrial forest plantations, agroforestry farms and other plantations boomed during this period.

Current efforts to rehabilitate degraded forests are still influenced by many factors but most of them converge on the two major drivers, namely the economic and environmental factors. These twin drivers are fully articulated in the current CBFM program. The Program promotes active and productive partnership between the government and the forest communities in developing, rehabilitating and managing vast tracks of forest areas. It is anchored on the thesis that if the government seriously addressed the poverty problems in the upland communities, these communities themselves would protect and manage the forests. Thus, the CBFM slogan "*People first, sustainable forestry will follow*." Under CBFM, the communities are being organized and given long term tenure instruments over forest areas with the privilege to derive direct benefits through harvesting of forest products, agroforestry and other livelihood programs with the corresponding obligation to manage and protect the forest area in the long term.

2. Current Policies Governing Land Use and Restoration/Rehabilitation

2.1 *Pres. Decree 705 (The Revised Forestry Code Of The Philippines (Pres. Decree 705 Dated May 19, 1975 as Amended)*

Although already thirty years old, this law has remained the statutory basis of the government's policies, plans and programs affecting the country's forest resources. It has provided for the reforestation of open and degraded forest lands mainly by the government. This law has also formalized the establishment, development and maintenance of industrial tree plantations, tree farms, and agrofestry farms and promoted these undertakings with a package of incentives. The incentives include tax discounts/credits, exemption from rents and forest charges, technical and material assistance from the government, and preferences on harvests. The establishment of industrial tree plantations was further enhanced with the issuance of Executive Order No. 725 to facilitate the country's reforestation efforts.

For the wood industry, this law mandated that no authorized person shall cut, harvest or gather any timber, pulpwood, or other products of logging unless he plants three times the same variety for every tree cut or destroyed by such logging or removal of logs.

2.2 *Executive Order No. 263*

This executive order launched the country's present national strategy for the rehabilitation of open and degraded open lands, the Community-Based Forest Management (CBFM) Program. This program consolidated previous people-centered forestry programs such the Integrated Social Forestry Program under LOI 1260 (1982) and Community Forestry Program under DAO 89-123 (1989). Under this program, the task of restoring/ rehabilitating open and degraded forest lands becomes the responsibility of the upland community through its people's organization (PO). The government extends technical and material assistance to these POs to ensure the sustainability of the CBFM project in their hands. The private sector provides the market for the products that will be derived from the production areas of the CBFM projects.

The DENR is required to work with local government units (LGUs), people's organizations (POs), non-governmental organizations (NGOs), religious groups, business and industry, and other concerned organizations. The principal participants in the CBFM program are the local communities represented by their people's organizations (POs). To encourage POs to participate in the CBFM program, they are entitled to:

- Usufructuary rights over the improvements introduced in the area;
- Possessory and custodial rights over the CBFM area;
- Over-all management of the CBFM project; *and*
- Technical and material assistance from the government.

2.3 *Executive Order No. 318 (Promoting Sustainable Forest Management in the Philippines)*

Recently, a presidential directive was issued to promote sustainable forest management in the country through EO 318 dated June 9, 2004. A very important guiding principle is the holistic, sustainable and integrated development of forestry resources with priority given to rehabilitation and slope stabilization and protection. This directive provided for incentives to enhance private investments, economic contribution and global competitiveness of forest-based industries such as

- Incentives and services for private forest development including deregulation;
- Development of high-value tree crops and non-timber forest crops; *and*
- Encouragement of co-management of forest resources.

2.4 *Philippine Strategy for Sustainable Development (PSSD)*

The country's national policy framework for sustainable development is contained in the Philippine Agenda 21 that detailed the Philippine Strategy for Sustainable Development (PSSD). The restoration/rehabilitation of open and degraded forest lands implements two important principles of sustainable development under the PSSD:

- ecological soundness that recognizes nature as our common heritage and thus respecting the limited carrying capacity and integrity of nature in the development process to ensure the right of present and future generations to this heritage; *and*

- bio-geographical equity and community-based resource management that recognizes that communities residing within or most proximate to an ecosystem of a bio-geographical region will be the ones to most directly and immediately feel the positive and negative impacts on that ecosystem, they should be given priority to the development decision affecting that ecosystem including the management of the resources. To ensure bio-geographic equity, other affected communities should be involved in such a decision.

A key component of the PSSD is the social reform and poverty alleviation program of the government that was institutionalized by the Republic Act No. 8425 (Social Reform and Poverty Alleviation Act). To implement this law, the Office of the President issued the Administrative Order No. 21 dated November 8, 2001, which articulated the Philippine approach to social reform and poverty alleviation composing of four dimensions that include:

- Ecological dimension or the sustainable use of productive resources to ensure the effective and sustainable utilization of the natural and ecological resource base, thus assuring greater social acceptability and increased participation of the basic sectors in environmental and natural resources conservation, management and development; *and*

- Governance dimension or equal representation and participation that address the issue of political equity and ensure equal participation in all venues in society, especially in decision-making and management processes.

2.5 *Revised Master Plan for Forestry Development*

One of the strategic policy measures of the revised master plan is forest resource expansion to be implemented as follows:

- Expand areas under forest and tree cover through afforestation/reforestation with appropriate species (from the point of view of site factors, utilization needs and profitability criteria) in available bare (non-forest lands), degraded lands, deforested areas and marginal lands.

- Further extend tree planting to farm lands, grazing lands, recreation areas, margins of roads and railways, as well as peri-urban lands.

- Provide encouragement and support for expansion and/or improvement of social/community/agroforestry, farm forestry, village woodlots and private forestry through adequate extension and appropriate incentives.

3. Case Studies on Forest Restoration/Rehabilitation Initiatives

In the past few decades, several/different sectors are involved in forest rehabilitation in the Philippines. Involvement can be categorized into initiators and implementers. The following actors fall under both categories as follows: the government itself through the Department of Environment and Natural Resources (DENR), the local government units (LGUs), the private sector, non-governmental organizations (NGOs), communities or people's organizations (POs) and other government agencies (OGA). In a study funded by the Center for International Forestry Research (CIFOR) in 2004-2005, several reforestation sites were studied in Luzon, Visayas and Mindanao including 12 sites with detailed case studies.[1] The main objective of such a study is to document the lessons learned in the long history of reforestation in the Philippines. In the following some case studies in forest rehabilitation examined in the study (Source: Chokkalingam, et al, 2006 (CIFOR)) are given. These case studies were selected and evaluated based on the following simple criteria:

- Driving factors of rehabilitation,

- Project success evaluation (bio-physical, social and environmental impacts),

- Factors contributory to success/failure,

- Lessons learned.

[1] The Philippine study team is composed of the following persons: Antonio P. Carandang, Rodel D. Lasco, Juan M. Pulhin, Romeo T. Acosta, Unna Chokkalingam, Ramon A. Razal, Mayumi Q. Natividad, and Rose Jane J. Peras.

Case Study 1: *IFMA of Col. Tiempo, Private Fund*

Location	Bgy. Tayawan, Bayawan City, Negros Oriental
Duration	1991 - present
Area (ha)	805 .0
Driving factors of rehabilitation effort	The rehabilitation effort was primarily driven by the desire to commercially produce timber and generate employment in the area. Secondary to the above purposes are the ecological objectives of bringing back the forest vegetation and contribute to watershed protection in the area.
Project success and impacts/effects	In terms of bio-physical accomplishment, the project is successful with accomplishment of at least 158% of the target area. The whole area is now fully stocked with planted trees (mangium, bagras and another eucalyptus sp.). The major impacts of the project are: livelihood/employment generation to the people living within the area through labor works at the plantation; environmental balance as brought about by the well-stocked established plantations; and wildlife tends to go back to the area due to the renewal of forest for their habitat.
Factors contributory to outcomes	The owner was able to obtain funds in 1994 from the Asian Development Bank with a principal sum of P19.8 M payable in 15 years, enough funds to develop the 805 hectare-tree plantations. Likewise, the owner made sure that proper silvicultural techniques from nursery to plantation maintenance are applied.
Lessons learned	One major problem encountered in the site constitutes the forest fires, which are caused by “jealous” people. In this case, the owner formed his own squad of protection personnel that scouts the vicinity of the plantation. Col. Tiempo stated that in the entire process of rehabilitation, government assistance is central in encouraging private capital to come in. As of the site visit in 2004, his main problem lies in the aspect of marketing the timber as he has yet to find a good buyer for his products.

Case Study 2: *IFMA/Davao ESP Resources, Private Fund*

Location	Magsaysay, Marilog District, Davao City
Duration	1992
Area (ha)	160.6
Driving factors of rehabilitation effort	The area was developed primarily to produce plantation timber to be sold in Davao City or any other outlet available. The other reason is to provide employment to the residents of the area.
Project success and impacts/effects	The project is successful in enlisting the support of the residents as they agree to help develop their areas by providing labor as well as protect these areas with the end purpose of sharing from the proceeds of the plantations. Physically, the plantations are of various qualities. Those in the ridge tops are mostly stunted, while those below the gullies and along creeks have good performance. In general, the estimate of the owner is that only about 50 percent of the plantations are good. Many of the plantations are now mature.
Factors contributory to outcomes	The owner was able to develop 160.59 ha of forest plantations based on the results of GPS validation conducted by DENR. Many residents in the area were able to obtain employment for a while. This effort has raised conciousness among the residents in the area as they also planted trees and rattan in their farms as a spin-off activity in the area. The technical knowhow gained by some farmers is now being put into good use. The care taker of the area has developed his own nursery where he supplies the seedling needs of the DENR and other local farmer groups who are into rattan and cocoa plantation.
Lessons learned	Two years ago, the IFMA holder tried to harvest the mature gmelina trees (*Gmelina arborea*). However, based on his computations, the proceeds from the timber cannot even pay for the harvesting costs, because of the very low price of gmelina timber in the area. An average cubic meter of gmelina only fetches from P 800.00 to P 1200.00, whereas harvesting costs also amounts to this on the average. The costs include felling, manual hauling and loading and trucking. Hence, the IFMA holder stopped harvesting operations to the dismay of his farmer partners because as a consequence they will not receive their share based on agreed rate of 10% of gross proceeds. At present, the IFMA holder is still looking for good price for his timber. According to the IFMA holder, it is discouraging to find that the forest plantation business is not as profitable as he has projected. The right choice of species plays a big role in the viability of plantations in Mindanao. He also said that it could have been more profitable if portions of his area had been developed into sugarcane plantations because this is allowed in the IFMA PROGRAM. Nevertheless, he hopes to recover when his other crops like mangium (*Acacia mangium*) and mahogany (*Swetenia macrophylla)* mature.

Case Study 3: ***Ihan Reforestation Project, NGO-led, PO-implemented and funded by AUSAID***

Location	Ihan, Kiblawan, Davao del Sur
Duration	1995
Area (ha)	17.0
Driving factors of rehabilitation effort	Basically, the area covered by the project is a combination of public forests and privately-claimed lands. The areas were formerly covered by grasses, hence the farmers agreed to plant their farms with forest trees, particularly mahogany (*Swetenia macrophyla*), Teak (*Tectona grandis*), Gmelina (*Gmelina arborea*) and Bagras (*Eucalyptus deglupta*). Their main objective is to produce timber as the timber sources in the area have become increasingly scarce.
Project success and impacts/effects	The project is successful, which is evidenced by the very good growth of the planted trees. The aesthetic value of the area was tremendously boosted by the lush scenery, compared to adjacent areas which were not developed as other farmers did not cooperate. The area is now becoming a favorite site for field trips by students. Several staff of AUSAID have reportedly visited the area and were happy to see the results of their support. For a while, plantation establishment has provided employment to PO members. The farmers are now happy with the outcomes of the project and are looking forward to harvest time.
Factors contributory to outcomes	The farmers were successful with the family approach where each family planted trees on their own claims and private lands which are very near to them. Hence, maintenance was not a problem as they can always maintain their sites whenever they have free time. The motivation that good maintenance would produce good plantations worked in these families. Besides, there was no funding problem in the project as it is small.
Lessons learned	As far as the farmers are concerned, planting trees for their own benefits alone is already a good incentive to them, especially as they were given free seedlings and were paid for their labor during planting, maintenance and protection.

Case Study 4: ***Pilar Watershed Rehabilitation Project, LGU-led and funded through sharing by different sectors/agencies***

Location	Pilar, Bohol
Duration	1997 - 2001
Area (ha)	20.0
Driving factors of rehabilitation effort	The municipality of Pilar, Bohol, through its Mayor, has been encouraging its constituents to plant trees in their respective backyards. There are annual festivities devoted to the environment. In 1997, during the inauguration of the reservoir, the then President Ramos saw the need to reforest/rehabilitate certain parts of the watershed due to the siltation/sedimentation experienced at the reservoir. That same day President Ramos promised a P 1 million budget for the rehabilitation of the nearby degraded upland areas. Basically, the quality of water produced at the reservoir is the major driving factor that led to the rehabilitation of this watershed by the local government unit of Pilar.
Project success and impacts/effects	According to the projects contractors, non-contractors and members of the cooperative, on average the project success is rated 9 in a scale of 1-10, 10 being highly successful. From the focus group discussion con-ducted, the participants strongly believed that the project had significantly improved the environmental conditions in the area. However, some participants were negatively affected due to a decrease in their farming area.
Factors contributory to outcomes	The relative success of the project was attributed to the smooth implementation of the project. Beneficiaries and non-beneficiaries believe that there is no doubt that the project has provided services to the environment, particularly in reducing the frequency of soil erosion and enhancing the micro-climate.
Lessons learned	It was strongly recommended that in order to be able to compensate those that are negatively affected, they should be given appropriate livelihood project/s and should let those benefiting from the project/s share something in return.

Case Study 5: ***Elcadefe CBFM Planters Association, Inc., Funded by JBIC, DENR led, PO implemented***

Location	Sta Fe, New Corella, Davao del Norte
Duration	1997 to date
Area (ha)	1,149.0
Driving factors of rehabilitation effort	Saug watershed is an important source of water for irrigation purposes in Nabunturan and Montevista, of Compostela Valley and New Corella of Davao del Norte. Likewise, the watershed is being earmarked to generate electric power through hydro power construction along the Saug River.The project was implemented primarily to rehabilitate the watershed through the community-based forest management approach. The project envisioned to provide a sustainable source of income to participant communities through rehabilitation and institutionalize community participation in forest management.
Project success and impacts/effects	The project area was successfully developed by the PO with a total of 1,232.93 ha of forest and agroforestry plantations established, thus exceeding their planned target. The latest monitoring and evaluation report conducted by an independent NGO showed an average survival rate of 85.23 percent. At the time this survey was conducted, the PO members were busy in maintaining and protecting the plantations especially, the agroforestry sites where they expect to sustain their benefits over the long term. There are a total of 707.79 ha of different fruit trees particularly Durian (Durio zebithenus), Lanzones, Mango and Rambutan. The PO expects to start harvesting some fruits from these plantations by 2006. Full blast production of these fruit trees is expected to come by the year 2008. By any standard, these agroforestry farms are large enough to elevate the standard of living of project participants. Project benefit assessment also showed a significant increase in household income from an average annual income of PhP 13,757.39 in 1995 to PhP 19,257.50 in 2002.
Factors contributory to outcomes	The PO attributed their success to the full support given by the DENR to their site with a full project staff (subproject site management office – SUSIMO) supporting them full-time. Likewise, the project was fully funded by JBIC, hence only a small counterpart was provided by PO like PO management support to the project and time of their leaders. PO members who are working in the fields are fully paid by the project. Moreover, most community members consented to using their own farms as part of the project development target.
Lessons learned	In CBFM projects, the most critical activities come during the formative period of the people's organization. Experience in the Philippines showed the significant effect of good community organizing activities to the success of the project. ELCADEFE is a similar case. The efforts of assisting the organization that carried out the community organizing activities provided the critical inputs for the organization of the project communities and in their preparation in conducting forest development as well as keeping their organization intact. However, such a period (the community organizing phase) lasted only two years and due to the concerns to strengthen the organization and capacitate them both technically and socially, the assessment conducted intimated that the PO could have been stronger, if this CO phase were longer, giving enough time for the POs to internalize the CO processes, so that they themselves can confidently continue the CO activities.

Case Study 6: *Lunga Farmers Association (LUFA), PNOC led, (OGA)*

Location	Lunga, Valencia, Negros Oriental
Duration	2004
Area (ha)	152
Driving factors of rehabilitation effort	Before the Phil. National Oil Company entered into the forest area of Barangay Lunga, most of the residents had been practicing the "kaingin" system of farming. The water shortage brought upon by the El Niño phenomena in 1983 and 1991, the diminishing forest cover within the Banika watershed, and the Ormoc tragedy that has cost thousands of lives had led the community of Lunga to form an or-ganization that would help minimize the experienced impacts of water shortage through forest rehabilitation as well as generate sustainable sources of income for the community.
Project success and impacts/effects	The Lunga Farmers Association (LUFA) officers and members rated the project success since its establishment on the average as 7.38 from a scale of 1-10, with 10 being highly successful. Among the projects' positive impacts are: provision of livelihood projects; seminars/trainings on livestock production, agroforestry, reforesta-tion, food processing, recording/bookkeeping; environmental awareness/education; travel/trips to other demo areas; provision of additional income through the reforestation component of the project; enhanced micro-environment; interdependence of the community/ social cohesion more intense; good social relationship/ social capital; low/no conflict at all/ good conflict management; and children were sent to high school and college.
Factors contributory to outcomes	The presence of a willing PO that was capacitated to implement the project contributed much to its success.
Lessons learned	Continuing community empowerment and continued support from the funding agency (PNOC) is necessary for sustained project implementation. The PO is still weak in law enforcement. Other incentives like alternative livelihood sources for participating households are necessary to sustain their interest.

4. Assessment of Existing Capacities of Stakeholders' Involvement in Forest Rehabilitation

The Philippines has a long tradition and rich experience in forest rehabilitation involving different stakeholders including government institutions, private sector, local communities, non-government organizations, civic organizations, local government units, and ordinary citizens. This has been gained through programs of various sizes and forms that were implemented all throughout a century of forest rehabilitation in the country. Technically, the country is equipped to implement any type of rehabilitation program involving different stakeholders. The appropriate technologies on reforestation have long been present and tested, from silvicultural regeneration techniques that include mass production of planting materials through cloning, to models on species site matching up to plantation management as developed by Bukidnon Forests Inc. and others. The FSP II demonstrated that given enough preparation even the communities are capable of reforesting vast tracts of denuded lands. The experience in Pilar, Bohol showed that LGUs can successfully implement rehabilitation programs, provided that a sharing of resources (logistics, manpower and expertise) among stakeholders takes place. The country is not replete with stories of successes and failures that were even documented so that factors contributing to success may be adopted while those contributing to failures may not be repeated in the future.

Nevertheless, there are other aspects of forest rehabilitation, particularly concerning stakeholders as implementers, like social mobilization, organizational, managerial, financial and up to utilization and marketing capabilities of stakeholders that need to be carefully considered in any design of future forest rehabilitation programs in the country. In the CIFOR study mentioned above it was found that institutional capacity of agencies funding and coordinating the effort is central in implementing successful reforestation projects. Capability building in terms of human resource development, financial management, and public relations aspects should be carefully designed, instituted and sustained. Human resource capacity should be supplemented by appropriate logistic support and long-term incentives, and everything else follows naturally.

With regard to other implementers, technical capability can be greatly enhanced by employing knowledgeable people to prevent costly errors. However, other aspects of rehabilitation aside from technical matters must be given enough attention as social and economic dimensions attendant to this endeavor can make or break the project. Further considering that the target areas for these endeavors are usually uplands with plenty of communities, successful rehabilitation goes beyond putting the trees on the ground as it should be simultaneously be concerned with putting the livelihood of the people off-the-ground while enhancing their forest management capability.

PART C
FUTURE ACTIONS FOR ENHANCING RESTORATION/REHABILITATION

1. Policy Improvement/Reform

The main law mandating the restoration/rehabilitation of the country's open and degraded forest lands – the Presidential Decree 705 – is already 31 years old. Congressional attempts to revise this law have not been successful so far. Right now, the proposed revision – the Sustainable Forest Management Act – is still pending in Congress and there is no positive indication that it will soon be passed. There is a need for a stronger and more sustained advocacy program to mobilize pressure groups pushing for the passage of the pending bills on sustainable forest management.

At the local levels, it is imperative that national and even international policies enhancing restoration/rehabilitation of open and degraded forest lands should be passed and implemented. The local government units have the required mandate and authority under existing laws to enact the necessary ordinances to pursue a local forest restoration/rehabilitation program or activity.

While “hard laws” are being deliberated, intra- and inter- institutional arrangements can be undertaken. These institutional arrangements could be anchored on the respective mandates, plans and programs of the concerned institutions. The example of the co-management arrangement between the province of Nueva Vizcaya and the regional office of the DENR for the management of a watershed is a model that has been recognized and adopted in other places.

2. Building Research and Educational Capacities

It is important that the country’s research and educational capacities have a solid foundation on sustainable forest management so that it can launch an effective forest rehabilitation/restoration program. In this regard, the University of the Philippines at Los Baños (UPLB) College of Forestry and Natural Resources (CFNR) has re-oriented its research and academic programs to respond squarely to the needs and challenges of sustainable forest management. In the process, the university adopted four general strategies:

- Shifting toward sustainable development and environmental conservation as a guiding framework/paradigm for program development;
- Re-aligning R & D around sustainable forest management-related programs such as in biotechnology, sustainable management systems, participatory resources management, and policy studies;
- Re-aligning curricular programs through curriculum change and development, both in formal and non-formal education; *and*
- Institutional development through staff training and organizational re-engineering.

Curriculum development and change were undertaken by:

- Enriching existing courses by integrating sustainable management strategies;
- Enriching the existing curriculum by instituting new courses in sustainable forest management;
- Revising the existing curriculum to re-orient it towards sustainable forest management; *and*
- Instituting a new curriculum related to sustainable forest management.

3. Reconciling Global and National Policies

3.1 *Present State*

While existing international conventions contain provisions regulating forest-related activities, there is yet no global legal instrument wherein all environmental, social and economic aspects of forest ecosystems are discussed. The closest one that is adopted by the international community is the "Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of all Types of Forests (Forest Principles)." This document contains the authoritative statement of principles for a global consensus on the management, conservation and sustainable development of all types of forests. Among the more important principles is: "*2(b). Forest resources and forest lands should be sustainably managed to meet the social, economic, ecological, cultural, and spiritual needs of present and future generations. These needs are for forest products and services such as wood and wood products, water, food, fodder, medicine, fuel, shelter, employment, recreation, habitats for wildlife, landscape diversity, carbon sinks, and reservoirs…*"

The more important global conventions related to forests are:

- International Tropical Timber Agreement (ITTA);
- United Nations Framework Convention on Climate Change (UNFCCC);
- Convention on Biological Diversity (CBD); *and*
- United Nations Convention to Combat Desertification in those countries experiencing serious drought and/or desertification (UNCCD).

The ITTA came into force on April 1, 1985 with the Philippines as a signatory under the category of timber producing country. This treaty recognizes the importance of, and the need for, proper and effective conservation and development of tropical forests with a view to ensuring their optimum utilization while maintaining the ecological balance of the regions concerned and of the biosphere. Relevant to restoration/rehabilitation of open and degraded forest lands are its three objectives:

- To encourage increased and further processing of tropical timber in producing member countries with a view to promoting their industrialization and thereby increasing their export earnings;
- To encourage members to support and develop industrial tropical timber reforestation and forest management activities; *and*
- To encourage the development of national policies aimed at the sustainable utilization and conservation of tropical forests and their genetic resources, and at maintaining the ecological balance in the regions concerned.

The UNFCCC's ultimate objective is to limit human-induced disturbances to the global climate system by seeking to achieve a stable level of greenhouse gases in the atmosphere. An additional legally binding instrument – the Kyoto Protocol – has a more explicit provision related to forests: industrialized countries are obliged to implement and/or further elaborate policies and measures

that include the “promotion of sustainable forest management practices, afforestation, and reforestation.”

Among the goals of CBD is the sustainable use of the components of biological diversity, and considering that forest ecosystems contain an estimated 70% of the world’s plant and animal species, it has considerably expanded its horizon to include forests.

The long-term strategies of UNFCC to combat desertification focused on improved productivity of land and on the rehabilitation, conservation and sustainable management of land and water resources.

In its 4th Session (Jan. 31-Feb. 11, 2000) in New York, the International Forum on Forests (IFF) concluded that the underlying causes of deforestation and forest degradation are the interrelated social and economic factors such as: poverty, lack of secure land tenure patterns, inadequate recognition of the rights and needs of forest-dependent indigenous and local communities; inadequate cross-sectoral policies; undervaluation of forest products and services; lack of participation; lack of good governance; absence of an economic climate that supports sustainable forest management; illegal trade; lack of capacity; lack of enabling environment; national policies that distort the market and encourage forest lands conversion to other uses.

Hence, combating deforestation requires the involvement of many actors, including national and sub-national governments, civil society, forest owners, international organizations, the private sector, research organizations and international and bilateral aid agencies.

Also needed is a broad participation of indigenous and local communities including indigenous peoples and other forest dependent people practicing traditional lifestyles, forest owners possessing important traditional forest-related knowledge and women in forest-related processes.

The most recent international policy initiative is the UN Millenium Declaration that was adopted by the General Assembly of the United Nations held in New York, USA, from 6 to 8 September, 2000. One fundamental value that was considered was “Respect for Nature”, which was described as prudence in the management of all living species and natural resources, by intensifying collective efforts for the management, conservation and sustainable development of all types of forests.

3.2 *Immediate Challenge*

The immediate challenge is how to translate these global conventions related to forests into the current forest policy system. For the CBD, the country has already passed a counterpart law – Wildlife Resources Conservation and Development Act – but for UNFCCC and UNFCC, so far only “soft” policies have been promulgated. The following important developments in the global arena should now be integrated into the country’s forest policy system:

- Increasing influence of global markets on forest management including the growing capacity of forest plantations to help meet the world’s wood demands.

- Emerging demands for the environmental services that forests provide, from water purification to eco-tourism.

- Shifting from an excessive focus in establishing new protected areas to strategies that emphasize integrated landscapes and mosaic approaches.

- Widening recognition of the role of forests as carbon sinks and as a common biome for addressing synergies between CBD, UNCD and UNFCCC.

- Growing acceptance of governance, transparency and accountability including the growing role of independent certification as indicators of good resource management.

- Increasing awareness of emerging threats including the risks posed by climate change and non-native invasive species.

- Development of a strong forest conservation infrastructure with a new generation of institutions with the capacity to deal with the complexity and unpredictability of forest ecosystems, manage across jurisdictions within the country, deal with forest problems in an integrative, holistic way and create markets to enable payments for ecosystem services.

Underlying the task of building research and educational capacities of the country is the new sustainable forest management paradigm that puts premium to forest restoration/rehabilitation as a basic strategy.

3.3 *Formulate National Program to Combat Forest Fires, Pests and Diseases and Regulate Introduction of Exotics and Alien/Invasive Species*

The country through the Department of Environment and Natural Resources (DENR) initiated a Forest Fire Control and Management Program (FFCMP) in 1981. This program was implemented until 1984 by the then Bureau of Forest Development (Bartolazo, 1994). It involves four major activities:

- *Fire prevention* through the Information, Education, and Communication (IEC) strategy;

- *Fire preparedness,* which covers all preparations for actual firefighting in case fire prevention fails;

- *Fire suppression:* The actual fire suppression is in the hands of the firefighters who are deployed in the different DENR Offices; *and*

- *Monitoring* and *evaluation*.

All activities in the implementation of the forest fire control and management program are monitored, evaluated, and analyzed for the purpose of improving the system and serve as a basis for policy- and decision-making. An important strategy of this national program to combat fires, pests and diseases is the direct involvement of the upland community and the local government units. This extends the participation of the upland community in the sustainable management of forest resources found in their areas and ensures the support and cooperation of the local leaders.

Further, the government is currently implementing the Rep. Act 9147 (Wildlife Resources Conserva-tion and Protection Act) regulating the introduction of exotic wildlife. This means that indigenous species are preferred for forest rehabilitation/restoration programs. This law is supplemented by Rep. Act 7586 that prohibits exotic species to be used in the restoration of forests within protected areas.

4. Creating Public and Community Awareness and Support

The success of any undertaking to rehabilitate/restore open and degraded forest lands depends to a large degree on the support and cooperation of society. Towards this end, the government has mobilized civil society organizations, local government units, and the private sector in enlisting the support of the public in forest rehabilitation/restoration. The media, church groups, civic organizations, and non-governmental organizations have been very strong in advocating sustainable forest management through forest rehabilitation and restoration of the country's open and degraded forest lands. The country's educational system, particularly the public elementary and secondary schools, now integrates modules on environmental protection and natural resources conservation in their curricular programs.

5. Planning, Implementation and Monitoring and Evaluation

The Revised Master Plan for Forestry Development (2003) in the Philippines noted the inadequacies of planning and programming in many aspects of forestry development in the country. Planning/programming are important tools to translate the policies into implementable components (either by subject area, geographic coverage, and time periods, or a combination of those). With respect to forestry plantation development, however, some constraints to proper planning, programming and project implementation must be overcome as follows:

- Inadequate planning capability of institutions implementing plantation development.
- Lack of linkages of several of the ongoing plantation activities to any long-term umbrella plans with a definite programme structure.
- Inadequacies of the knowledge base, reliable statistical information, maps, inventories, surveys, etc. to support realistic planning.
- Inadequate appreciation of economic concepts (e.g. Pareto optimality) of planning and importance of the program structure for future planning and for monitoring and evaluation.
- Lack of a relevant and fresh outlook in forestry development.

In the planning and programming for a wide-scale reforestation, a new forest plantation development outlook is needed. Past trends, current situation and projections of future scenarios provide materials for outlook in plantation development. This outlook is a combination of several forestry outlooks on land use, productivity, ecology, technology, demand and supply, human resources, institutional situations, etc. For example, future production of timber can be estimated based on projections on the above forestry outlooks with several interacting elements such as forestland (area), technology/productivity, local human resources, global and local demand/consumption pattern and others. Each of these, in turn, depends on influencing factors, such as income, price

and related elasticities, availability of substitutes, competing demand, and efficiency levels in production, processing and use (Chandrasekharan, 2003). Program planning and development would then proceed considering other factors such as political situations, stakeholder's capability, community needs and institutional and social dynamics in project areas. Realistic goals and targets on the national, regional and local levels could then be set based on the above outlook analysis. Hence, it is possible to have several levels of plans (national, regional and project/field level plans) depending on local conditions but will still follow the general plan formulated out of a fresh outlook in plantation development.

Monitoring and evaluation (M & E) will be an integral component of the plan. The number of M & E design will also correspond to the number of modules developed in the planning stage. Simple but effective data-capture forms must be developed for affordability in implementation.The costs of this activity must be deliberately included in the estimates of budgetary requirements of the overall plan. Nevertheless, ingenuity in the design of M & E is needed to capture relevant experiences in various sites that would be inputs in the improvement of the program designs and serve as inputs to plantation development researches that would be integral to the overall plantation development program. For purposes of reliability of results, M & E activities must be implemented by independent entities. However, it is imperative for individual project implementers to have internal M & E system that can easily be verified by external M & E.

6. Financing for Forest Restoration

6.1 *Mobilizing Resources for Reforestation*

It has been observed no current major forest rehabilitation programs are in the pipeline or being prepared by the government. Nevertheless, pockets of efforts to obtain funding can be seen in some national programs like the Mindanao Rural Development Project II, where a natural resources management component aims to pilot small efforts of forest rehabilitation through the communities and is being integrated into the whole programme. The Department of Agriculture and the Department of Environment and Natural Resources have pipeline proposals on forest management/biodiversity programs requesting the Global Environmental Facility (GEF) to be considered under its current resource allocation framework for the country. Still fragments of small efforts are observable in some LGUs and Regions where small local and international funding is available. Definitely, forest rehabilitation is a daunting task. However, there are some basic questions that need to be answered before we strategize on mobilizing resources for reforestation, among which are as follows:

- ***Is the government still interested in forest rehabilitation?***
- ***If it is, can it fund forest rehabilitation?***
- ***How much area is needed to be developed to have a significant impact?***

Assuming that the government would target 2.5 million ha of denuded forests in 25 years it has to develop at least 100,000 ha per year with at least 2 years lead time for negotiation and planning. With development costs of P 36,000 per ha (2006 prices), the government needs 90.0 billion pesos or roughly 1.8 billion USD to do this.

6.2 *Traditional Sources of Rehabilitation Funds*

In the past, the country was able to acquire forest rehabilitation funds from several sources among which are as follows:

- Multilateral donors (WB, ADB, JBIC) – all loans, not forthcoming in the near future, not feasible in the short term;

- Bilateral donors (USAID, foreign embassies coming from their official development assistance to third world countries);

- International Donors/NGOs (WWF, OISCA) – cover small areas, very site-specific, very difficult to access;

- National Government Agencies – DENR, NIA, NAPOCOR, PNOC, etc., no more budget for rehabilitation except NAPOCOR from its watershed management fund;

- Local government units – forest rehabilitation not a priority, if at all, only small amounts are available;

- Local NGOs – effective, but feasible in small areas only because of high cost/unit area;

- Private Sector – competitiveness of the effort with respect to other investment options, not enough incentives because of very high risks of not recovering capital, unstable policies, low potential profit in forestry businesses, *and*

- POs/local communities – vast managerial and labor potential, with people power, however, no money and incentives for them to plant on their own.

6.3 *New Potential Funding Source*

In the face of the budgetary difficulties the country is facing, it is also difficult to convince policy makers to allot budgets for forest rehabilitation in the regular budget cycle of the government as regularly enacted through the general appropriations act (GAA). Thus, it is strategic to explore all possible sources of funds as follows:

- RUPES: rewarding the upland poor for environmental service;

- Adopt a Mountain Program, where interested and committed civic organizations and private businesses will be encouraged to support efforts to rehabilitate and protect a particular mountain or forest, especially if this is the source of their water supply;

- GEF (Global Environmental Facility) for biodiversity conservation, sustainable land management and other operational strategies that are being funded under its many programs through conduit organizations like UNDP and World Bank;

- CDM (Clean Development Mechanism) for carbon sequestration and trading;

- Multilateral environmental agreements; *and*

- Other sources like CBD, CCD, UNFCCC.

6.4 *Formulation of a National Strategy for Reforestation*

The following are some of the basic ideas the authors are forwarding with respect to keeping the Philippines green:

- Develop a long-term national forest rehabilitation plan that would involve various stakeholders (with ecological, economic and social development components).

- The country needs only 400,000 ha for industrial production purposes (RMPFD, 2003). This must be deliberately planned to achieve such a target. Hence, appropriate high-yielding species of high economic value must be planted on appropriate areas specifically established for this purpose and to be maintained for such purpose. The plan must include provisions for processing, marketing and replacement of harvested areas, including reinvestment of surplus income.

- Another 300,000 ha are needed in CBFM for production purposes (agroforestry, high-yielding forest plantations). This strategy would cater for community needs and hence, the adoption of species would be anchored on the socio-economic requirements of the communities. Develop/implement a system on how to recover costs in production areas. Strategies for marketing and utilization and benefit sharing must be in place.

- The rest or around 1.8 million ha maybe developed for restoration/protection purposes, where no harvest will be allowed. All stakeholders may potentially be involved in this endeavor. This would require multi-donor financing, and creative sustainable funding sources. Maintenance of these restoration areas must be ensured and strategies on how to recover costs from these must be thought of (e.g., explore innovative sources of funds (CDM, RUPES, Ecotourism and Mountain projects, etc.)

- Explore Multi-Sources of funds for particular end uses. Ensure sustainability of funding sources. Some fund for subsequent rehabilitation may come from harvests from plantations established in initial years.

- The plan must ensure the sustained COMMITMENT of everybody.

REFERENCES

Bautista, G.M. 1990. The forestry crisis in the Philippines: Nature, causes and issues. *The Developing Economies* 28 (1): 67-94.

Boado, E. L. (1985). Forestry in development: Philippines and Malaysia. Ph. D. Thesis. State University of New York.

Borlagdan, S. B. 1997. Small-scale community logging and community-based forest management. Ph.D. Thesis. University of the Philippines Los Baños, College, Laguna, Philippines.

Chandrasekharan, C. 2003. Final Consultant Report: Philippine Forestry Policy and Institutions. SPPD/PHI/01/010: Sustainable Forest Management, Poverty Alleviation and Food Security in Upland Communities.

Chokkalingam, U., Pulhin, J., Carandang, A., Lasco, R. and Peras, J. 2006. Forest Rehabilitation Outcomes and Sustainability in the Philippines: Lessons from the Ground.

Contreras-Hermosilla A. 2000. The underlying causes of forest decline. CIFOR Occasional Paper No. 30. Bogor:Center for International Forestry Research.

Cruz, Ma. C., C.A. Meyer, R. Repetto and R. Woodward. 1992. Population growth, poverty and environmental stress: frontier migration in the Philippines and Costa Rica. World Resources Institute, Washington D.C., USA.

Cruz R. V. O. et. al. 2005. Could Forests Stop Floods? The Case of Tignoan, Agos and Dingalan Watersheds. Paper presented during the Philippine Forestry Development Forum. Asian Development Bank Auditorium, Pasig City, June 2-3, 2005.

Cruz Ma. C., C.A. Meyer, R. Repetto and R. Woodward. 1992. *Population growth, poverty and environmental stress: frontier migration in the Philippines and Costa Rica*. World Resources Institute, Washington D.C., USA.

De la Cruz, E. 1941. The socio-economic significance of the Philippine forest. *The Philippine Journal of Forestry* 4 (2): 141-160.

Defensor, M. 2004. State of the Philippine forests. Paper presented at the conference on Integrating Forest Conservation with Local Governance, Subic Free Port Zone, Zambales, Philippines, November, 10, 2004.

Department of Environment and Natural Resources (DENR). 1990. *Master plan for forestry development: main report.* Department of Environment and Natural Resources, Quezon City, Philippines.

Esteban, I. 2003. Appended forest plantation report. In *Revised Philippine Master Plan for Forestry Development*. Forest Management Bureau, Quezon City.

European Environmental Agency. 2006. European Environmental Agency Glossary. http://glossary.eea.europa.eu/EEAGlossary/F/forest_degradation. Retrieved October 25, 2006.

Executive Order No. 263 (Launching Community-Based Forest Management as the National Strategy to Achieve Sustainable Forestry and Social Justice). Manila, Philippines. July 19, 1995.

Executive Order No. 318 (Promoting Sustainable Forest Management I the Philippines). Manila, Philippines. June 9, 2004.

Food and Agriculture Organization (FAO) 2001a. *Global forest resource assessment. Main report*. 2000. FAO Forestry Paper 140. Rome: Food and Agriculture Organization.

Food and Agriculture Organization (FAO) 2001b. *State of the world's forests*. Rome: Food and Agriculture Organization.

Forest Management Bureau (FMB). 2004. *Philippine forestry statistics*. Forest Management Bureau, Department of Environment and Natural Resources, Quezon City, Philippines.

Forest Principles (UN General Assemble). June 1992. New York. USA.

Forestry Development Center (FDC). 1987. Rationalizing the wood industry. Policy Paper No. 23, Industrial Forestry Task Force, Forestry Development Center, College of Forestry and Natural Resources, UP Los Baños, College, Laguna, Philippines.

Ganapin D. 1987. The timber trade of the Philippines. In *Forest resources crisis in the Third World.* Sabahat Alam Malaysia.

Garrity D. P., D. M.Kummer, and E. S. Guiang. 1993 *The upland ecosystem in the Philippines: alternatives for sustainable farming and forestry*. National Academy Press, Washington, D. C.

Geist, H. J. and E. F. Lambin. 2001. *What drives deforestation. A meta-analysis of proximate ad underlying causes of deforestation based on subnational case study evidence*. LUCC Report Series No. 4. Land Use and Land Cover Change International Project Office, University of Louvain, Belgium.

Guiang, Ernesto S. 2001. Impacts and effectiveness of logging bans in natural forests: Philippines. In: Forest out of bounds: impacts and effectiveness of logging bans in natural forests in Asia-Pacific, eds. C. Brown, P.D. Durst and T. Enters, pp. 103-135. Food and Agriculture Organization, Bangkok, Thailand.

Hilton-Taylor C. (Compiler) 2002. *2000 IUCN red list of threatened species*. IUCN, Gland, Switzerland and Cambridge, UK.

Intergovernmental Forum on Forests. January 31-February 11, 2000. New York.

International Tropical Timber Agreement. Geneva, Switzerland. January 26, 1994.

Kummer, D. 1992. *Deforestation in the post-war Philippines*. Ateneo de Manila University Press, Quezon City, Philippines.

Lasco, R.D., R.G. Visco and J.M. Pulhin. 2001. Secondary forests in the Philippines: formation and transformation in the 20th century. *Journal of Tropical Forest Science* 13 (4): 652-670.

Liu, D.S., L.R. Iverson and S. Brown. 1993. Rates and patterns of deforestation in the Philippines: application of geographic information systems analysis. *Forest Ecology and Management* 57: 1-16.

Mittermeier, R. A., P. Robles Gil, and C. G. Mittermeier. 1997. *Megadiversity, earth's biologically wealthiest nations*. CEMEX, Monterrey, Mexico.

Myers N. R., R. A. Mittermeier, C. G. Mittermeier, G. A. B. da Fonseca and J. Kent. 2000. Hotspots: Earth's biologically richest and most endangered terrestrial ecoregions. *Nature* 403: 853-858.

National Statistical Coordination Board. 2007. Statistics. http://www.nscb.gov.ph/panguna.asp.

Ong, P. S., L. E. Afuang, and R.G. Rosell-Ambal (eds). 2002. *Philippine biodiversity conservation priorities: a second iteration of the national biodiversity strategy and action plan*. Department of Environment and Natural Resources – Protected Areas and Wildlife Bureau, Conservation International Philippines, Biodiversity Conservation Program – University of the Philippines Center for Integrative and Development Studies, and Foundation for the Philippine Environment, Quezon City, Philippines.

Orden T. 1960. Brief history of Philippine reforestation. *Philippine Lumberman 7(1): 76-80.*

Pres. Decree 705 as amended (Revised Forestry Code of the Philippines). Manila, Philippines. May 19, 1975.

Pulhin, J. M. 1996. Community forestry: paradoxes and perspectives in development practice. Ph.D. Thesis. The Australian National University, Canberra, Australia.

Pulhin, J. M. U. Chokkalingam, R. J. J. Peras, R. T. Acosta, A. P. Carandang, M. Q. Natividad, R. D, Lasco, and R. A. Razal. 2006 "Historical Overview." In U. Chokkalingam, A. P. Carandang, J. M. Pulhin, R. D. Lasco, R. J. J. Peras, and T. Toma (eds.) *One century of forest rehabilitation in the Philippines: approaches, outcomes and lessons*. Bogor, Indonesia: Center for International Forestry Research, 5-41.

Quiñones, S. S. 1980. Notes on the diseases of forest trees in the Philippines. *Sylvatrop Philippine Forest Research Journal* 5(4):263-271.

Quintos, M. M. (1989). The log export restriction policy and the development of forest industries in the Philippines. M. S. Thesis. The Australian National University, Canberra, Austrlia.

Rebugio, L.L., R.V. O. Cruz, W. M. Carandang, E. L. Tolentino, L. U. de la Cruz, R. D. Lasco, R. G. Visco, J. T. Dizon, F. B. Pulhin, R. V. Dalmacio, N. C. Bantayan, M. M. Calderon, and L. D. Camacho. 2005. *Forest restoration in the Philippines. a review of research and development initiatives.* University of the Philippines Los Baños, Office of the AKECOP Coordination in the Philippines, College of Forestry and Natural Resources, College, Laguna.

Rep. Act No. 7160 (Local Government Code of 1991) dated October 10, 1991.

Republic Act No. 7160 (Local Government Code of 1991). Manila, Philippines. October 10, 1991.

Revilla Jr, A.V. 1988. The constraints to and prospects for forestry developments in the Philippines. In *The Philippine forest resources inventory: application of results to forest policy*, eds. R. Lennertz and K. Uebelhor, pp137-147. Philippine German Forest Resources Inventory Project seminar proceedings, 15-19 February 1988, Quezon City, Philippines.

Revised Master Plan for Forestry Development (RMPFD) in the Philippines. Forest Management Bureau and Food and Agriculture Organization of the United Nations. Final Report, 2003.

Roth, D.M. 1983. “Philippine forests and forestry: 1565-1920”. In R.P. Tucker and J.F. Richards (eds.) *Global deforestation and the nineteenth century world economy*. pp. 30-49. Duke Press Policy Studies. Duke University Press, Durham, N.C., USA.

Tucker, R. P. (1988). “The commercial timber economy under two colonial regimes in Asia”. In: Dargavel, J., K. Dixon and N. Semple (eds.) *Changing tropical forests: historical perspectives on today's challenges in Asia, Australasia and Oceania*. Canberra: Centre for Resource and Environmental Studies: 219-229.

ANNEX 1

Table 1. ***Evolution of national rehabilitation initiatives in the Philippines***

Date	Description of Events	Main Actor/s Involved
1910	First recorded rehabilitation initiative in the country by the Forestry School in Los Baños, Laguna (Luzon) as part of silvicultural class.	Academe-Forestry School in Los Baños
1914	Some 118 species were tried and planted in Los Baños.	Academe-Forestry School in Los Baños
1910-1936	The "piloting period" since the trial plantings laid down the foundation or more extensive reforestation in the years to come. It may be noted, however, that reforestation was sporadically. Undertaken depending upon the release of the budget by the Philippine Legislature.	Government/Bureau of Forestry
1916	Act 2649 – established Reforestation of the Talisay-Minglanilla Friar Lands Estate in Cebu Province (Visayas) with budget of P10,000. Later, other reforestation projects were opened (e.g. Caniaw, Nasiping, Paraiso, etc.)	Government/Bureau of Forestry
1919	Magsaysay Reforestation Project established in Arayat, Ilocos, and Zambales (Luzon).	Government
1919-1926	Reforestation funded from general appropriation of the Bureau. Limited funds confined activities to small projects.	Government/Bureau of Forestry
1927-1931	Act No. 3238 appropriated P 50,000 to continue reforestation activities. Cincona Plantation in Bukidnon (Mindanao) plus 3 other projects established.	Government/Bureau of Forestry
1932-1936	P 310,000 made available for reforestation activities. Money was used to maintain the then existing projects and no new projects were started.	Government/Bureau of Forestry
1937-1941	Establishment of Makiling Reforestation Project (Luzon) Extensive reforestation due to substantial fund appropriation by government to enhance previous efforts Special Office under the Director of Forestry established to conduct inspection of new reforestation projects. A new Division of Reclamation and Reforestation under the Bureau of Forestry was established in 1939. Of the 545,000 hectares of open, denuded grasslands in critical watershed, about 28,000 hectares already planted.	Academe/ Bureau of Forestry

Table 1. ***continued***

Pre-World War II	Total of 35 projects established with a total area of 535,000 ha (11 in Northern Luzon, 14 in Central Luzon, 1 in Southern Luzon, 6 in the Visayas and 3 in Mindanao) Total area planted was 26,660 ha; Forest nurseries with a total area of 24 ha and annual capacity of 17 million seedlings established; A total of P3.57 million spent on reforestation from 1910 to the start of World War II.	Government/Bureau of Forestry
Japanese Period	Large portion of established plantations destroyed, only 15% or 4000 ha survived the war. Republic government, through RA 115, imposed a reforestation fee of 50 centavos and 40 centavos on every cubic meter cut in the public forest on the 1st and 2nd group and 3rd and 4th group of species, respectively.	
Post War: 1946	Commonwealth Act No. 718 appropriated P540,000 for reforestation; 29 of the 35 projects reopened.	Government/Bureau of Forestry
1948-1960	Congress passed Republic Act 115 to solve funding gap; levied P0.5 for each cubic meter of timber from the 1st & 2nd group species and P0.4 for 3rd & 4th group species removed from public forest to support reforestation projects.	Government/Bureau of Forestry
1960	R.A 2706 created Reforestation Administration as a separate agency under the then Department of Agriculture and Natural Resources (DANR) It attained an average rate of 10,000 hectares planted annually and even reached 35,400 hectares in 1963. Reforestation projects increased in number from 57 in 1960 to 91 in 1972 with a total of 182,000 hectares planted.	Government
1966 onward	Reforestation became a joint undertaking by the government through its regular and foreign assisted funding; the industrial tree plantation (later the IFMA), tree farm and agro-forestry schemes and the upland people through socially-oriented programs in which reforestation is a component such as the Integrate Social Forestry (ISF), the Community Forest Stewardship Management Agreement (CFSMA), and the Community Forest Management Agreement (CFMA). Project under PD No. 1 and Letter of Instructions No. 3 into Bureau of Forest Development.	Government, Private Sector
1972	LOI No. 3 integrated reforestation activities into mandate of the Bureau of Forest Development.	Government
1974	By 1974, more than 91 projects since 1916. Area planted from 1946-74 equals 161,714 ha.	Government

Table 1. ***continued***

1975	P.D. 705 issued requiring the conduct of reforestation nationwide; the Bureau of Forest Development (BFD) was formally organized.	Government, private sector
1976	Launching of PROFEM to intensify reforestation activities; called for a holistic approach to forest ecosystem management involving all sectors of the society.	Government
1977	P.D. 1153 issued requiring all citizens to plant 12 seedlings annually for 5 consecutive years.	Government/Citizens
1979	LOI No. 818 requires all holders of existing timber licenses, leases and permits to reforest one hectare of denuded or brush land for every hectare logged.	Government/Lease holders
1981	Executive Order No. 725 issued encouraging the establishment of Industrial Tree Plantations (ITPs).	Government/ Lease holders
1982	Integrated Social Forestry Program launched;	Government/foreign donors
1980s	NGO work on forest regeneration and agriculture with upland communities;	NGOs/communities
1986	Launching of National Forestation Program (NFP) to involve wider sector of the citizenry in reforestation; integrated all reforestation efforts undertaken by government and non-governmental sector. 6.5 M ha total target, 1.4 M ha target from 1987-2000.	Government
1987	Community Forestry Program launched;	Government/ foreign donors
1987	Around 135 regular reforestation projects under the jurisdiction of the then Bureau of Forest Development (BFD) were already established throughout the Philippines with an aggregate area of about 1,055,000 hectares. Of these, about 263,000 hectares were already planted as of March 1986 (BFD, 1989).	Regular BFD budget
1988	Forestry Sector Project Loan I (under NFP) replaced the traditional government reforestation by contract reforestation which involves contracting families, communities, NGOs, LGUs, corporations and others to reforest.	Government/various sectors of the society Funded by ADB, OECF, GOP: USD 283 M
1995	E.O. 263 adopted CBFM as the national strategy for sustainable forest management and social justice; Entrusted the responsibility of forest rehabilitation, protection and conservation to communities with the promise of equitable access to forest benefits; Forestry Sector Project Loan II (under NFP) using CBFM	Government/legitimate organized communities Funded by JBIC, ADB and GOP: USD 140 M
1990s	Other foreign-assisted community-oriented projects continue; LGU efforts intensified with enactment of the 1991 local government code;	Government, NGOs, communities, LGUs

Table 1. ***continued***

By 2002	Area planted from 1975-2002 equals 1.6 million ha, 58% by DENR, 31% private sector, 6% by LGUs and OGAs, and 5% by citizens. Budgeted amount in this period ≥ USD 570 M.	All sectors

Sources: Esteban, 2003, Chokkalingam et al, 2006, Pulhin, et al. 2006, and RMPFD, 2003.

Urban Forest Rehabilitation – A Case Study from Singapore

by

Geoffrey Davison

PART A
STATUS OF LAND USE AND FOREST (AND LAND) DEGRADATION

1. Forest Land Use and Land Use Change

The Republic of Singapore is an island city-state of 699 km^2 and approximately 4.4 million people (Singapore Department of Statistics, 2005). It lies at the Southern tip of the Malay Peninsula, approximately 137 km north of the equator (1° 14 N, 103°55 E). Despite being one of the most urbanized and built-up countries in Southeast Asia, Singapore is also renowned for its national mission of making Singapore a "City in a Garden".

Prior to the British colonization in 1819, Singapore was covered with lush forest (Lum 1999), with more than 80% lowland dipterocarp forest, 5% freshwater swamp forest and 13% coastal mangroves. Only small areas along the coast had probably been under settlement, cultivation, or otherwise disturbed at that time. Today, more than 50% of the island is urbanized. There are less than 2,000 ha of primary forest, which is 3% of the total land area (Corlett 1992; Lum 1999). The largest single expanse of primary forest (70 ha) is found in Bukit Timah Nature Reserve (LaFrankie et al. 2005). Other primary forest fragments are found in the Central Catchment Nature Reserve, in the extreme West of Singapore, and on a few of the larger offshore islands. However, these primary forest fragments occur within a matrix of disturbed secondary forest and re-growth.

In consideration of the small size of land-scarce Singapore and its high degree of urbanisation, forestry in Singapore's context can be broadly categorized as:

- Forests in gazetted Nature Reserves, consisting mainly of remnant primary forests and regenerating secondary forests; *and*

- Urban streetscapes, consisting mainly of closely planted roadside trees along 95% of Singapore's roads, and trees in urban developments, urban parks and vacant lands, as well as planted and managed trees on offshore islands and reclaimed lands.

1.1 *Forests in Gazetted Nature Reserves*

Currently, there are 3,347 ha of Nature Reserves with full legal protection. They comprise the Bukit Timah Nature Reserve, the Central Catchment Nature Reserve, the Labrador Nature Reserve and the Sungei Buloh Wetland Reserve. The former two reserves consist of mainly remnant primary lowland dipterocarp forest and secondary re-growth, while the latter two respectively consist of mainly coastal forest and mangrove forest. The Central Catchment Nature Reserve includes a historically important area of freshwater swamp forest which has been the basis for research of regional significance (Corner 1978).

The flora and fauna within the Nature Reserves are very diverse. For example, the Bukit Timah Nature Reserve and the Central Catchment Nature Reserve support 840 species of flowering plants and more than 380 species of vertebrate animals which include 44 species of mammals, 207 species of birds, 33 species of fishes, 72 species of reptiles and 25 species of amphibians (Chan & Corlett 1997). In a Smithsonian Institution study, a 2-ha plot at Bukit Timah Nature Reserve consists of 15,000 trees of 312 species (Smithsonian Tropical Research Institute, 2005), which underlines the health and diversity of forests in nature reserves in Singapore.

The 130-ha Sungei Buloh Wetland Reserve is an important site for migratory birds on the East Asian-Australasian flyway. Developed from an old prawn farm, efforts have been made to improve the secondary and mangrove forest in the Reserve. It was selected as an ASEAN (Association of South East Asian Nations) Heritage Park in 2003, as being a good representative example of the natural heritage of ASEAN.

These Reserves are protected from the effects of development, although surrounding developments may impact upon the edges of the forests within these Reserves. Conservation efforts have also been spelt out in the Singapore Green Plan 2012 for the forests within the gazetted Nature Reserves (Ministry of Environment & Water Resources, 2002).

1.2 *Urban Streetscapes*

Singapore has established a widespread programme of roadside planting for expressways, major and minor roads, as well as for open car parks. This forms the backbone of the Garden City of Singapore, giving Singapore its green mantle. These roadside urban forests alongside approximately 3,130 km of paved roads (CIA, 2005) are managed by certified National Parks Board (NParks) arborists who provide expert tree care and management services. A number of roads have been designated as Heritage Roads, in order to safeguard roadside trees and vegetation, drawing attention to the aesthetic, historical and cultural significance of these trees. 161 majestic old trees have been designated Heritage Trees. Singapore also has two Tree Conservation Areas in Tanglin/Bukit Timah as well as Changi, where trees above 1m girth over bark are protected by law. These include remnant specimens of locally rare species and, amongst others, provide seed stock for reforestation in the Nature Reserves.

The urban forests are mainly under the care and management of NParks and a few other government agencies, namely the Singapore Land Authority (SLA), the JTC Corporation (JTC), the Housing Development Board (HDB), and Town Councils. These government agencies implement and manage urban forests provided for under the prevalent guidelines for greenery provision established by the Urban Redevelopment Authority (URA) and NParks. Some examples of such guidelines include the requirements for:

- To provide green space of 0.8 ha per 1,000 population (URA, 2000);
- Open car parks to provide the necessary tree plantings for shade and aesthetics; *and*
- The “Road Code” provisions for designating tree planting verges along roads.

2. Status of Forest (and Land) Degradation

Singapore's rapid development as a global city in the past forty years since independence has been based on industrial development, particularly processing and service industries. Singapore's land surface has grown by some 120 sq km. Since then, several strategies described later have been employed to rehabilitate forest landscapes.

Current forest degradation has been minimized, the risk factors including the intensity of human use for recreation, climate change (and short term weather fluctuations such as prolonged drought), chance extinctions due to small remaining population sizes of forest plants and animals, potential breakdown of pollination and dispersal mechanisms through loss of species, and isolation from potential sources of genetic exchange and recolonisation.

3. Causes of Forest (and Land) Degradation

Land now covered in secondary forest was repeatedly cultivated since the early 1800s. The major cash crops grown in Singapore were gambiar (*Uncaria gambiar*), pepper, coconuts, pineapple, tapioca, and rubber (*Hevea brasiliensis*). Many other crops were grown on a trial basis, in small plantations, or as supplements to other agricultural activities. For example, nutmeg (*Myristica fragrans*) was an early plantation crop. By the 1920s, 60% of the land was cultivated (Shono *et al*. 2006). With transition to a more developed economy, the small land area of Singapore became less able to support low intensity land uses, and agriculture was substantially reduced. Upon being abandoned, the agricultural lands later regenerated into secondary forests dominated by *Adinandra dumosa* after suppression of fire (Corlett 1991, 1992). Eventually, they regenerated into the more diverse secondary forest (Turner 1997) that exists today.

Singapore has no indigenous timber industry, and none of the remaining forested areas, either primary or secondary, is used in any manner for the commercial extraction of forest products. Singapore thus differs from other countries in the region, in that commercial forestry has not been a significant contributor to forest degradation.

4. Impacts of Forest (and Land) Degradation

When agricultural practices exhausted the soil, or when cultivation was no longer economically viable, farmlands were abandoned to lalang (*Imperata cylindrica*) grasslands, which were prone to fire. These grasslands slowly regenerated to secondary forest known as Adinandra belukar (named after the dominant species, *Adinandra dumosa*) (Corlett 1991, 1992). Persistence at this stage is variable (Corlett 1991), but eventually, the *Adinandra* forest is replaced by a more diverse secondary forest (Turner 1997). Small areas within the secondary forest became dominated by resam fern (*Dicranopteris linearis*) and *Smilax setosa* climbers when the regenerating secondary forest was cut for firewood (Burkill 1961). These aggressive weeds prevent tree regeneration by forming dense thickets, leading to arrested succession. Dominance by *Dicranopteris* may persist for decades or even centuries (Russell et al. 1998).

There has been steady regeneration within the areas of secondary forest, creating a diverse, multi-layered vegetation structure. This includes native species and, at present, introduced species such as *Albizia (Paraserianthes) falcataria* and *Acacia auriculiformis*. These can be effective in providing shade during the establishment phase for regenerating seedlings of other species, but are considered weeds that should ultimately be removed.

The total flora for Singapore lists 2,282 species of vascular plants (Tan 1995). Approximately 584 of these (25.6%) were presumed to be locally extinct (Tan 1995), although rediscoveries continually occur so that the total presumed extinct is now closer to 20%. Another 556 species (24.4%) were considered endangered or vulnerable (Tan 1995). No attempt has been made to apportion these losses between those due to loss of forest cover, and those due to degradation in remaining forest quality.

The proximity of Singapore to Peninsular Malaysia, and its repeated fusion with adjacent landmasses during Late Pleistocene lowering of sea level, has not facilitated the evolution of endemic plants. Only seven taxa, two of them natural hybrids and five full species, are definitely known to have been endemic, representing only 0.3% of the indigenous flora (Kiew & Turner 2003). Only one of these, *Cryptocoryne* x *timahensis*, has survived within Bukit Timah Nature Reserve. Singapore is the type locality for many plant species, and can therefore act as a resource for the region in conserving topotypical populations, both for reference and research.

Fortunately, the bulk of the remaining forest surrounds the nation's reservoirs, so that the immediate catchments are protected in terms of runoff and sedimentation. So, the areas most readily available for reforestation and rehabilitation are situated around the reservoirs, too.

PART B
IMPLEMENTATION OF FOREST RESTORATION AND REHABILITATION

1. History of Forest Restoration/Rehabilitation

Forests in the areas now within the Nature Reserves have been allowed to regenerate of their own accord for many years. Most examples of active forest rehabilitation in Singapore have occurred since 1991.

Because of the absence of a commercial forestry sector within Singapore, there has not been any economic pressure to reforest or rehabilitate forests with the objective of sustaining timber production. The motivation to reforest and rehabilitate comes largely from the desire to maintain important ecosystems for recreation, tourism, research, education and awareness. This in turn has meant that reforestation and rehabilitation might have begun later than in other countries in the region, and with a different emphasis.

2. Current Policies Governing Land Use and Restoration/Rehabilitation

In the past forty years, the Singapore Government has given emphasis to providing greenery, especially in the urban context. Launched by a Tree Planting Campaign in 1963, the Garden City policy saw widespread planting of roadside trees and the island wide development of urban parks and green spaces as green lungs.

The Parks and Trees Branch in the Public Works Department (which later became the Parks and Recreation Department) was created to spearhead and implement the Garden City policy in 1968, and a Garden City Action Committee was created in 1973 to formulate Garden City policies and programmes in tandem with the development of Singapore. The National Parks Board (NParks) was set up in the 1990s to (among other things) manage the remaining forest areas which were unaffected by the rapid development, and is the current authority on greenery.

The greenery creates a comfortable, pleasant environment for Singaporeans and has attracted investors to Singapore. Although the economic contribution of the greenery may appear intangible, the 2003 'Leisure Lifestyle and Park Usage Pattern Survey' revealed that 82.8% of respondents agreed that being a Garden City improves Singapore's global competitiveness, and that 72.7% felt that living in a Garden City enhances their quality of life (National Parks Board 2005). Clean air, towards which greenery contributes, is considered to be one of Singapore's competitive advantages in comparison with other city states.

The Urban Redevelopment Authority (URA) is the lead agency in land use planning in Singapore. The URA Master Plan is equivalent to the Structure Plan in other countries. It guides land use decisions, but is flexible enough to take into account changing economic, social and geographical conditions. Under the Master Plan various more detailed plans are applicable to particular land use categories. The most relevant to reforestation and rehabilitation is the Parks and Waterbodies Plan. There is also a Special and Detailed Controls Plan, under which 22 Nature Areas are designated. These are not legally protected, but are subject to consultation with relevant agencies such as NParks, and should be retained for as long as possible.

Singapore is increasingly looking at the concept of linking fragments of natural habitat through land use planning, and perhaps more active creation of physical links. Examples are the Southern ridges from Mount Faber through Telok Blangah to Kent Ridge Park, and the possibility of restoring a physical link between Bukit Timah and Central Catchment Nature Reserves.

National Parks and Nature Reserves are protected under the Parks and Trees Act 2005 (which replaced earlier legislation).

NParks is currently undertaking a Plant Conservation Strategy, which should make planting materials more readily available for forest rehabilitation. This is a set of activities in line with the Global Plant Conservation Strategy under the Convention on Biological Diversity. It is coordinated by NParks, which is also the agency that conducts many of the activities, in collaboration with academic institutions. The Plant Conservation Strategy is guided by rarity and conservation status of all plant species (Ng & Wee 1994), not just trees. There are active programmes to increase the population size of ferns and orchids, including by tissue culture for recalcitrant species. Thus, forest rehabilitation in Singapore is not confined to trees, but is meant to embrace the whole plant community.

3. Forest Restoration/Rehabilitation Initiatives

Since 1991, NParks has been reforesting degraded vegetation within the Nature Reserves and the surrounding edge to accelerate succession and restore the degraded areas to a late secondary forest with a primary forest component (Shono *et al*. 2006). Reforestation efforts are contributed by non-governmental agencies, private corporations and students. NParks uses this programme to raise public awareness on the importance of restoring degraded forest (Shono *et al*. 2006). The Central Nature Reserve Branch, which manages these reserves, actively engages students and volunteers to participate in their reforestation effort. The volunteers usually help in planting the saplings, and some tougher ones also assist in the clearing of the aggressive weeds such as resam fern (*Dicranopteris linearis*) and *Smilax setosa* vines. These aggressive weeds form dense thickets, preventing seedling establishment (Shono *et al*. 2006).

Mangrove restoration is being conducted at Sungei Buloh Wetland Reserve. Since 1993, about 1.2 ha of secondary forest and 0.7 ha of mangroves have been reforested with 62 plant species, totaling 5000 trees (NParks, Sungei Buloh Wetland Reserve Branch).

Since 1991, NParks has been reforesting areas of degraded vegetation at Bukit Timah and the Central Catchment Nature Reserve, with the objective of accelerating succession and restoring them to a late secondary forest with primary forest components. Species that are known to be native to Singapore are used in the reforestation program. Since future timber harvest is not one of the objectives of forest restoration in Singapore, a wide variety of native species have been tested for their reforestation potential. Since 1991, 15 ha have been replanted with 17,000 saplings of 150 species. The saplings were obtained from various sources, viz., raised from seeds of native stock; salvaged from other forest patches; or purchased from nurseries. The average size of the saplings at planting is 1.5 m in height and the use of larger saplings is thought to enhance the survival in competition with the weedy species.The average spacing between saplings is 3 m, and the average size of reforestation plots is 0.25 ha. Prior to reforestation, the target area is cleared of above-ground *Dicranopteris* biomass using grass cutters. The debris is left in situ to decompose. The *Dicranopteris* rootmat is left untouched.The saplings are placed into planting holes 1.5 times the size of their root balls. Then the soil is backfilled and firmly packed. Each sapling is watered at the time of planting and also in the next few weeks as needed. The only maintenance operation thereafter is the periodic removal of *Smilax* vines that sprout from rhizomes. Some of the saplings are stifled by climbers and by competition from fast growing pioneers that naturally establish on the bare soil exposed around the planting holes. NParks uses the reforestation program as an opportunity to raise public awareness of the importance of restoring degraded ecosystems. Schoolchildren, volunteers, and employees of corporate sponsors typically participate in the planting sessions.

Pulau Semakau, one of Singapore's Southern islands, was developed by the National Environment Agency (NEA) as a new landfill site in 1999. Some coastal mangroves were cleared during the development of this 350 ha landfill site. These have been fully replaced with two plots of planted mangroves with a total area of 13.6 ha. This landfill site was opened for nature-related recreation in July 2005. Further efforts by the NEA are being made towards rehabilitation for recreation in addition to protecting the ecosystems and rich biodiversity during the planning, design and construction of the landfill (NEA, 2005).

In the Nature Areas in offshore islands, such as Pulau Ubin, active steps are taken to rehabilitate degraded old quarry work sites and abandoned rubber plantation areas. Topsoil has been brought in to fill up areas that have been dug and stripped of any good soil. Depending on the sites, only native and naturalized trees and plant species are selected for planting. Since the reforestation effort started in the year 2000, over 200 tree species amounting to over 3000 trees have been planted out. So far, 16.5 ha of land have been rehabilitated. In addition, there are on-going projects to rehabilitate another 25 ha of degraded forests in other old quarry sites (NParks, Pulau Ubin Branch). These will provide much needed greenery to supplement the natural character of Pulau Ubin's Recreation Areas for use by locals, visitors and tourists.

Since 2005, the Southwest Community Development Council (SWCDC) has initiated a community-led effort to 'Plant 100,000 Native Plants' over the next three years. This contributes to urban forests, especially in residential areas in the Southwestern part of Singapore. The species selection emphasizes native trees which are compatible with roadside conditions. A multi-stakeholder committee guides the project and includes government agencies, school teachers, and members of the grassroots community.

4. Ongoing Research

In July 2005, a new research initiative on reforestation and forest restoration was implemented by the Center for Tropical Forest Science – Arnold Arboretum Asia Program (CTFS-AA) and NParks. This project sought to bring together the practical knowledge on reforestation that NParks has accumulated over the past decade and the scientific expertise of CTFS-AA in designing and conducting ecological research. The collaboration aims to improve and develop techniques for restoring degraded forest sites in Singapore that will be applicable elsewhere in the region.

The first phase of the project entailed tagging, mapping, identifying and measuring girth and height of planted saplings in order to evaluate reforestation potential of the native trees species. Currently, 2500 planted saplings belonging to 80 species on 2 ha of land are being monitored to provide long-term data on growth and mortality. Improving species selection is one of the important objectives of this research work. We have collected a lot of information on native species identifying those which are the most promising for reforestation. Fast growing species, which tolerate the harsh environmental conditions of degraded sites, can quickly shade out the light-demanding weeds and ameliorate the physical environment to allow for natural recruitment of other tree species. Canopy closure significantly increases species diversity of woody natural recruitment and reduces the abundance of *Dicranopteris* ferns, climbers, grasses and sedges.

Preliminary findings suggest that matching species to site characteristics is another important consideration when deciding which species to plant. Natural recruitment at the reforestation sites was also surveyed in order to understand the patterns and processes of vegetative recruitment and development of floristic diversity in these restored forests. Additional experiments have been implemented to examine the effects of the *Dicranopteris* rootmat in preventing the establishment of natural regeneration, the response of planted saplings and natural regeneration to addition of nutrients, and the performance of various species along moisture and light gradients.

5. Assessment of Existing Capacities of Stakeholders' Involvement

The private sector is not forestry-based. Interest in contributing to forest restoration and rehabilitation is therefore to be understood as a community service, not as a business-related venture. Since there is no logging industry, it is not an option to include replanting, enrichment planting or other silvicultural treatments in any contracts.

The time of NParks staff is divided between many tasks, including visitor management, maintenance of facilities, education and outreach programmes, as well as safeguarding of the forest. Efforts towards forest restoration and rehabilitation therefore have to take their place within a list of other priorities.

The contributions of volunteers and members of the community are limited by time and numbers. Volunteers are more interested in planting saplings than in weeding or in maintaining the young trees. NParks therefore has to strike a balance between rehabilitation of more areas versus maintenance of the areas that have already been treated; the latter effort falls more on NParks staff.

For these reasons, reforestation and forest rehabilitation have to remain government-led, even though they are on a small scale compared with other countries.

PART C
FUTURE ACTIONS FOR ENHANCING RESTORATION/REHABILITATION

1. Improving/Revising Policies

The URA Master Plan and the Singapore Green Plan are periodically revised (URA 2000; MEWR 2002). They are both open to public inputs, and a Garden City Action Committee (GCAC) monitors the implementation of the Singapore Green Plan.

Because the motivation for reforestation and rehabilitation of forests is not based upon the need for an indigenous timber industry, the criteria for site selection and species selection are likely to differ from those used in other countries. Species need not be selected for growth rate or timber yield and quality. Sites need not be selected to restore logging damage.

The National Climate Change Strategy being developed in 2006-2007, acknowledges the role of greenery in mitigating climate change, and in reducing local temperature extremes caused by the urban heat island effect. Greenery enhancement is therefore included as a continuing strategy.

2. Building Research and Education Capacities

NParks encourages staff in its relevant divisions to acquire professional qualifications. Most relevant among these is the qualification of Certified Arborist from the International Society of Arboriculture. All arborists are expected to undertake a minimum number of training days per year. Furthermore, NParks is expanding its programme of staff scholarships, locally and overseas.

In 2005, NParks reorganised its structure to bring former work sections (rather than divisions) together into a new Streetscape Division. The core business of this Division can be described as urban forestry. At the same time a new Research Division was established, and staff numbers were increased to take up the role of coordinating and collating existing research work conducted by the various divisions. A Research Master Plan has been developed and research advisors have been appointed from the academic and private sectors.

NParks is also aiming at the education of young people. A Young Arborists' Programme is being set up in schools, with workbooks designed around simple projects that schoolchildren can undertake. The Biodiversity Centre of NParks is designing a series of educational posters, ecosystem by ecosystem, meant to facilitate curricular and co-curricular activities.

3. Reconciling Global and National Policies

Singapore is a signatory to the Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species of Flora and Fauna in Commerce (CITES), and participates in other international discussions such as the United Nations Forum on Forests.

Forests in Singapore contribute only a tiny proportion to the global or even the regional total. Nevertheless, Singapore's position concerning conserving and rehabilitating its remaining forest is in line with the above agreement. Singapore also contributes statistics to the United Nations Food and Agriculture Organization (FAO), supporting the compilation of statistical data about the world's forests.

4. Partnership and Collaboration with the Private Sector

Forest restoration and rehabilitation are planned and coordinated by government agencies. The main role of the private sector to date has been to help through contributing manpower. Staff clubs and voluntary organisations often wish to contribute to the environment. For this purpose family days or tree planting events are organised.

Some forest-related work is contracted out to the private sector.This is particularly true for the maintenance of urban forestry. It applies less to reforestation and rehabilitation.

5. Creating Public Awareness and Support

The Nature Reserves receive several hundred thousand visitors per year, of whom the majority are Singaporeans. Each of these visitors is exposed to information about the management of forests in the reserves, through standing exhibitions, pamphlets and other activities.

A major effort is made to involve schools in forest rehabilitation. The targets are mainly secondary schools, such as Hillgrove Secondary, Chestnut Drive Secondary, Naval Base Secondary, and the Canadian International School, the emphasis being on schools which are close to the Nature Reserves and those which can conduct repeat activities. It is hoped that this will create an expanding pool of committed individuals amongst the public, as former school pupils move on into the professional sphere and new generations of schoolchildren are exposed to such programmes.

6. Community Involvement

NParks is facilitating a programme named ‘Community in Bloom’, which is meant to encourage greening of the environment through involving and engaging communities in gardening and planting-related activities. Inevitably, more emphasis is placed on residential areas and gardens than on natural forest. The role of the community in the latter effort is being promoted through volunteer events, educational talks, posters and other forms of outreach mentioned above.

Efforts such as those of the Southwest CDC will be continued.

7. Monitoring and Evaluation for More Effective Restoration/Rehabilitation

New scientific understanding of forest restoration from the CTFS-AA project will lead to the development of techniques that are most effective for accelerating natural succession and restoring a biologically diverse forest ecosystem.This knowledge will be shared among our partners in the region that face similar challenges of restoring tropical rainforest on land with degraded soils in an increasingly fragmented landscape.The results from our monitoring pro-gramme suggest that the reforestation programme has been largely successful in accelerating succession, controlling invasive weeds and facilitating natural recruitment of native tree species. Furthermore, it also underlines the importance of active management in restoring the floristic and structural complexity of primary forests, since almost all natural regeneration that was established in the restored forest consisted of common secondary forest species. The natural recovery of floristic diversity proceeds at a slow pace and many of the primary forest species may never be able to colonize these restored forests in a highly fragmented landscape such as in Singapore, due to geographical barriers, lack of seed dispersers and unfavorable micro-site conditions. Further intervention may be ne-

cessary to complement the natural recovery of the forest ecosystem with planting of rare or large seeded primary forest species.

8. Effective and Practical Applications

Restoration has other benefits in addition to species return, such as watershed protection, buffer zone development, creation of more forest areas for recreation, etc.

9. Financing for Forest Restoration

At present all financing for reforestation and rehabilitation of forests in the Nature Reserves comes either from government recurrent budgets or from donations by the private sector. Public access to the Nature Reserves is free, except for use of some facilities such as camping sites or barbecue pits. This financial scenario is likely to continue until and unless the reforestation activities are greatly expanded.

ACKNOWLEDGEMENTS

Choi Yook Sau, Genevie Y.K. Chua, Chew Ping Ting and Sharon Chan kindly provided material for this paper. Comments on the manuscript were given by Wong Tuan Wah, Kong Yit San, Simon Longman and Lena Chan.

REFERENCES

Burkill, H.M. 1961. Protection of wild life on Singapore Island. Pp 152-164 in Wyatt-Smith, J. and Wycherely, P.R. (Eds.), *Nature Conservation in Western Malaysia.* Malayan Nature Society, Kula Lumpur.

Chan, L & Corlett R.T. (eds) 1997. Biodiversity in the Nature Reserves of Singapore. Proceedings of the Nature Reserve Survey Seminar. *The Garden's Bulletin, Singapore* Vol. 49, Part 2.

Corlett, R.T. 1991. Plant succession on degraded land in Singapore. *Journal of Tropical Forest Science* 4(2): 151-161.

Corlett, R.T. 1992. The ecological transformation of Singapore, 1819-1990. *Journal of Biogeography* 19: 411-420.

Corner, E.J.H. 1978. *The Freshwater Swamp-forests of South Johore and Singapore*. Gardens' Bulletin Singapore, Supplement No. 1.

CIA 2005. The World Factbook – *Singapore* [online], available on 12 Sep 2005, URL: http://www.cia.gov/cia/publications/factbook/geos/sn.html.

Kiew, R. & Turner, I. 2003. Are any plants endemic to Singapore? *Gardens' Bulletin, Singapore* 53: 173–184.

LaFrankie, J.V., Davies, S.J., Wang, L.K., Lee, S.K., and Lum, S.K.Y. 2005. *Forest Trees of Bukit Timah*: population ecology in a tropical forest fragment. Simply Green, Singapore.

Lum, S.K.Y. 1999. Tropical Rainforest. Pp 24-34 in Briffett, C. and Ho, H.C. (Eds.), *State of the Natural Environment in Singapore*. Nature Society (Singapore), Singapore.

Ministry of Environment & Water Resources, 2002. *The Singapore Green Plan 2012, SGP 2012 Action Programmes, Conserving Nature.* [online], available on 20 Sep 2005, URL: http://www.mewr.gov.sg/sgp2012/apc_conserving_nature.htm.

National Environment Agency (NEA) 2005, *Semakau Landfill* [online], available on 12 Sep., 2005, URL: www.nea.gov.sg.

National Parks Board 2005, *National Parks Board Annual Report 2003-2004* [online], available on 12 Sep 2005, URL: www.nparks.gov.sg.

Ng, P.K.L. and Wee, Y.C. 1994. *The Singapore Red Data Book*. Nature Society (Singapore), Singapore.

Russell, A.E., Raich, J.W., and Vitousek, P.M. 1998. The ecology of the climbing fern *Dicranopteris linearis* on windward Mauna Loa, Hawaii. *Journal of Ecology* 86: 765-779.

Shono, K., Davies, S.J. & Chua, Y.K. 2006. Regeneration of native plant species in restored forests on degraded lands in Singapore. *Forest Ecology and Management* 237: 574–582.

Singapore Department of Statistics 2005, *Keystats* [online], available on 12 Sep 2005, URL: www.singstat.gov.sg.

Smithsonian Tropical Research Institute 2005, *Center for Tropical Forest Science, Asia Program* [online], available on 12 Sep 2005, URL: http://striweb.si.edu/ctfs_global/doc/asiaprogram_bukit-tamah.htm.

Tan, H.T.W. (ed.). 1995. A Guide to the Threatened Plants of Singapore. Singapore Science Centre, Singapore.

Turner, I.M., Wong, Y.K., Chew, P.T., and Ali bin Ibrahim. 1997. Tree species richness in primary and old secondary tropical forest in Singapore. *Biodiversity and Conservation* 6: 537-543.

Urban Redevelopment Authority of Singapore (URA), 2000. Concept Plan 2001 Press Release 26 Aug 2000. URL: http://www.ura.gov.sg/cpr2001-Aug26-2000/cpr2001_plan1a.html.

Forest Rehabilitation – Experiences from Thailand

by

Monton Jamroenprucksa

PART A
STATUS OF LAND USE AND FOREST (AND LAND) DEGRADATION

1. Forest Land and Land Use Change

Thailand is well endowed with cultivable land covering about 40.9% of the country's land area. This mainly includes:

- 10.4 million ha suitable for paddy,
- 4.5 million ha suitable for upland crops, *and*
- 4.5 million ha suitable for perennial crops.

In 2000, forests occupy about 17.0 million ha, or 33.2 percent , of the total land area .Generall, over the past few decades the area of agricultural land has expanded at the expense of the forest. Table 1 shows the distribution of land uses by different regions in the country. It is evident that all regions in the country have reasonable areas of both agricultural land and forests, with the North being the most heavily forested.

During the past few decades farmers have been encouraged to move from subsistence agriculture to more market-oriented cash crops, requiring an expansion of the agricultural land base. The government has also had a policy of leasing "degraded forest lands" to the private sector for the establishment of plantation crops such as oil palm, eucalypts and for large-scale shrimp farming. Some of the resulting large agri-businesses forced people off their land so that they had to seek new farming land, which generally meant they were obliged to move into the forest and clear more land.These economic factors operating outside the forest sector have been major drivers of forest clearance.The Northern region, which has traditionally been an area dominated by shifting cultivation, has witnessed a significant shift towards more permanent agricultural practices, with an emphasis on cash crops (in some cases as a replacement for opium).

Despite relative land abundance, land ownership lacks clarity for many farmers. As many as 1 million farm households, or a fifth of the total population, are technically squatters on forest reserves as their farms are located on lands belonging to the Royal Forest Department (RFD). Even outside the reserve area, at least 30 % of farmers have not been able to obtain sufficiently clear land titles to use their lands as collateral. The implications of this lack of clarity of land ownership are two-fold. First, with such a large number of people occupying forest reserve land, the RFD has great difficulty in developing and implementing policies for sustainable management and conservation of forests.

Second, because farmers do not have guaranteed tenure and cannot use their land as collateral, they are unwilling or unable to make investments in the land or equipment. This in turn affects the potential to manage the land (both agricultural land and forest) in terms of productivity. Furthermore the ambiguous situation has led to a rise in tension between farmers and the government in general and the RFD in particular. This adds to the difficulties in resolving the dilemma.

In 1993, 5.52 million ha of reserved forest land were passed to the Office of Land Reform for redistribution to farmers under the so-called "Sor-Por-Kor 4-01" program, which was a kind of land right certificate. However, distortions occurred in the process of land distribution and influential non-farmers were able to acquire large areas of land. The resulting scandal had major political ramifications (Siamwalla et al., 1993).

When certain areas were declared protected in the past 30 years, the people who resided within the boundaries became "illegal squatters", irrespective of their length of residence. This has caused considerable conflict. Forced resettlement has been attempted in many situations, but has not worked well. The people affected were not consulted during planning for resettlement, and the program largely failed. Productive forests outside the protected areas were cleared to make room for new settlements, but most of the resettled people returned to their old farms inside the newly created protected areas.

Table 1. ***Distribution of land uses by different regions in Thailand***

	Northern	**North-eastern**	**Central Plain**	**Southern**	**Total (ha)**	**% of total land**	**% of agric. land**
Total land	**16,964,429 (33.1)**	**16,885,434 (32.9)**	**10,390,120 (20.2)**	**7,071,519 (13.8)**	**51,311,502 (100.0)**	**100.0**	
Forestland	9,627,028 (56.7)	2,652,694 (15.7)	2,990,013 (28.8)	1,741,343 (24.6)	17,011,078 (33.2)	31.4	
Agriculture land	4,477,260 (26.4)	9,279,877 (55.0)	4,142,745 (39.9)	3,069,715 (43.4)	20,969,596 (40.9)	40.9	100.0
Housing area	150,135	224,058	121,396	84,927	580,516		2.8
Paddy land	2,245,122	6,069,126	1,649,768	471,278	10,435,294		49.8
Field crops	1,428,255	1,849,981	1,230,030	10,398	4,518,664		21.5
Underfruit tree	496,849	536,606	884,519	2,335,497	4,253,471		20.3
Undervegetable	60,385	41,264	64,428	18,381	184,459		0.9
Grassland	16,777	82,987	25,427	16,509	141,700		0.7
Idleland	37,438	297,175	49,295	55,265	439,174		2.1
Other land	42,298	178,678	117,882	77,461	416,320		2.0

Source: Office of Agricultural Economic (2001)

2. Status of Forest Degradation

The country has two main forest types, namely evergreen forest and deciduous forest – see Table 2 for details of area covered by different forest types. Broadleaved closed canopy forests or tropical evergreen forest cover some 36% of the total forested area. Small but important areas of bamboo, pine forests and mangroves also occur.

Broadleaved open canopy forests cover 54% of the forest area and include:

- Mixed deciduous forest with and without teak
- Dry dipterocarp forest, *and*
- Savannas

Table 2. ***Regional distribution of forest land covered by different forest types in 2000***

Forest Types	North	North - eastern	Central	South	Total (ha)	%
Tropical Evergreen Forest	1,988,762	766,642	1,049,677	1,462,824	5,267,905	(31.0)
Mixed Deciduous Forest	6,349,859	835,180	1,559,167	269	8,744,474	(51.4)
Dry Dipterocarp Forest	965,541	818,551	72,860	-	1,856,952	(10.9)
Swamp Forest	487	-	321	29,593	30,400	(0.2)
Inundated Forest	-	25,679	-	-	25,679	(0.2)
Beach Forest	-	-	520	11,976	12,496	(0.1)
Pine Forest	33,143	13,065	-	-	46,208	(0.3)
Bamboo Forest	20,082	39,734	89,021	1,514	150,350	(0.9)
Mangrove Forest	-	-	35,948	209,308	245,255	(1.4)
Total Natural Forest	**9,357,874**	**2,498,852**	**2,807,511**	**1,715,484**	**16,379,720**	**(31.9)**
Forest Plantation	140,462	92,792	112,328	2,119	347,699	(2.0)
Secondary Growth Forest	128,693	61,051	70,174	23,740	283,659	(1.7)
Total Forest Area	**9,627,028**	**2,652,694**	**2,990,013**	**1,741,343**	**17,011,078**	**(33.2)**
% of Total Land Area	56	15.8	55	24.8	33.2	
Total Non-Forest Area	**7,566,792**	**14,085,875**	**7,364,033**	**5,283,726**	**34,300,424**	**(66.8)**
Total Land Area	**17,193,820**	**16,738,569**	**10,354,046**	**7,025,069**	**51,311,502**	**(100.0)**

Sources: RFD (2001) *Forest Statistics of Thailand*

The Royal Forest Department reported that the forest cover of Thailand in 1910 amounted to 35.9 million ha, or 70% of the land area. In the intervening decades the forest area has declined to the present 26% coverage in 1993. Much of the loss has taken place since the 1960s, when the forest area has halved (see Table 3).

The biggest percentage-wise loss of forest took place in the Northeast Region with a reduction from 7.0 million ha in 1961 to 2.1 million ha in 1998. At the end of the 1960s, about 70 % of the North of the country was covered with forest. However, by the 1990s, two thirds of the forested area above an elevation of 1,000 metres had been modified through shifting cultivation by ethnic Thai and hill tribe people. In addition, a large percentage of forest in the North had been heavily logged or burned and as a result has been converted to savanna woodlands and open grassland (Charuppat, 1998).

Table 3. ***Forest area in Thailand by region, 1961-2004***

Year	Region				Total (ha)
	North	Northeast	Central	South	
1961	11,784,644 (68.54)	7,028,525 (41.99)	5,608,453 (54.17)	2,942,801 (41.89)	27,364,424 (53.33)
1973	11,512,982 (66.96)	5,023,245 (30.01)	3,804,038 (36.74)	1,831,435 (26.07)	22,171,700 (43.21)
1976	10,371,312 (60.32)	4,112,666 (24.57)	3,330,744 (32.17)	2,027,435 (28.86)	19,842,158 (38.67)
1978	9,621,662 (55.96)	3,094,961 (18.49)	3,057,715 (29.53)	1,748,540 (24.89)	17,522,878 (34.15)
1982	8,894,363 (51.73)	2,566,023 (15.33)	2,566,556 (24.79)	1,633,329 (23.25)	15,660,270 (30.52)
1985	8,526,415 (49.59)	2,535,893 (15.15)	2,484,783 (24.00)	1,538,490 (21.90)	15,085,582 (29.40)
1988	8,148,151 (47.39)	2,348,421 (14.03)	2,432,555 (23.49)	1,453,487 (20.69)	14,382,614 (28.03)
1989	8,130,957 (47.29)	2,338,378 (13.97)	2,421,552 (23.39)	1,450,677 (20.65)	14,341,565 (27.95)
1991	7,818,030 (45.47)	2,160,949 (12.91)	2,354,237 (22.74)	1,336,168 (19.02)	13,669,384 (26.64)
1993	7,625,459 (44.35)	2,129,146 (12.72)	2,324,408 (22.45)	1,272,240 (18.11)	13,351,253 (26.02)
1995	7,487,909 (43.55)	2,107,386 (12.59)	2,313,598 (22.34)	1,237,115 (17.61)	13,146,007 (25.62)
1998	7,305,700 (43.06)	2,098,400 (12.43)	2,355,600 (22.67)	1,212,500 (17.15)	1,297,229 (25.28)
2000	9,627,028 (56.75)	2,652,694 (15.71)	2,990,013 (28.78)	1,741,343 (24.62)	17,011,078 (33.15)
2004	9,206,842 (54.27)	2,809,569 (16.64)	2,948,357 (28.38)	1,794,329 (25.37)	16,759,098 (32.66)

Note: Figures in parentheses are shares of forest area (in percent) in the respective region

Source: Royal Forest Department, Forestry Statistics of Thailand

The most recent techniques of land use and forest cover estimation showed that in 2000 the area was covered with forests at about 17,011,078 ha or 33.15 percent of the country. The new statis-

tics deriving from present technology of satellite image interpretation revealed the increasing forest cover as compared to 25.28 percent of 1999. It should be noted that different sources give different estimates of areas under various types of land use. These variations are caused partly by the use of different techniques and different standards for defining forest and non-forest land. In addition, the aerial photo data base is quite old, so even if estimates are precise, they may not represent the present-day reality. However, they give useful comparative data.

3. Causes of Forest Degradation

Numerous factors that contribute to deforestation have already been discussed in various papers (Kao-saard, 2000; TFSMP, 1992). Generally accepted causes of deforestation and forest degradation relate to population growth, extension of permanent and shifting cultivation, poorly planned and managed logging by concessionaires and illegal logging. The Government has encouraged the commercialization of the agricultural sector.This has brought substantial economic benefits, but it has been at the cost of forest cover.The RFD has attempted to contain this loss by curtailing forest encroachment, particularly by small holders. A major difficulty has been the lack of policy and planning coordination between the various sectors. The forest sector has attempted to develop and enforce regulations that apply to forest land (as is its mandate). Similarly, the agricultural sector encourages agricultural expansion and the move to cash cropping. However, much agricultural land is within forest reserves, so there are overlapping mandates and policies. The lack of effective coordination mechanisms has been a constraint to developing overall approaches to land use planning. In addition, rising demands for fuel wood, charcoal and other wood products have accelerated deforestation. It is difficult to separate the overall impact of legal and illegal logging from population growth and agricultural expansion.

From the study of TFSMP (1992), population density and wood prices were found to be major factors underlying the decline in forest cover in Thailand. A third important factor having a negative impact on forest cover was found to be a rise in agricultural productivity that increased the demand for land, implying that profit and export-oriented cash cropping causes more forest clearing than subsistence farming. In this area, rubber plantation, which is an export-oriented cash crop, is found to be dominant and constitutes the major cause of forest encroachment.

Institutional factors have also contributed to deforestation in Thailand. The 1954 Land Code created an incentive for clearing forests, because it allowed people to gain “ownership” of occupied public land through registering previously occupied forest land, or land falsely claimed to be occupied. The inefficient enforcement of this code has provided an incentive for landless people and farmers to clear forests (that cannot be owned by private people) into agricultural land (that can be owned by private people). Forest clearing also became one way of claiming previously unused public land.
The government has been relatively inefficient in enforcing land and forest policies, which in many areas has resulted in public lands becoming “common property”. Everyone wants to use these lands, but no one wants to take the responsibility of long-term land management. Because of the relative ease of obtaining land “freely”- the cost of clearing forests being the price of land – it has been more economical to expand agriculture through expanding the area under cultivation instead of intensifying agriculture. This has been easy also because agricultural and forest land have not been demarcated.

Large-scale logging, both legal and illegal, has contributed to degradation of the country’s forests both directly and indirectly. In a direct sense, over-exploitation of forests has often left them in a condition which puts their long-term sustainable use in jeopardy. Indirectly, construction of access

roads through forests has often provided access for the subsequent movement into the forest of people seeking new agricultural land. The RFD has had difficulty in exercising effective control over legal logging operations, and in curtailing illegal logging, even in national parks. In addition, little attention has been paid to regenerating the logged forests. Figure 1 shows the various factors that contribute to on-going forest degradation and loss.

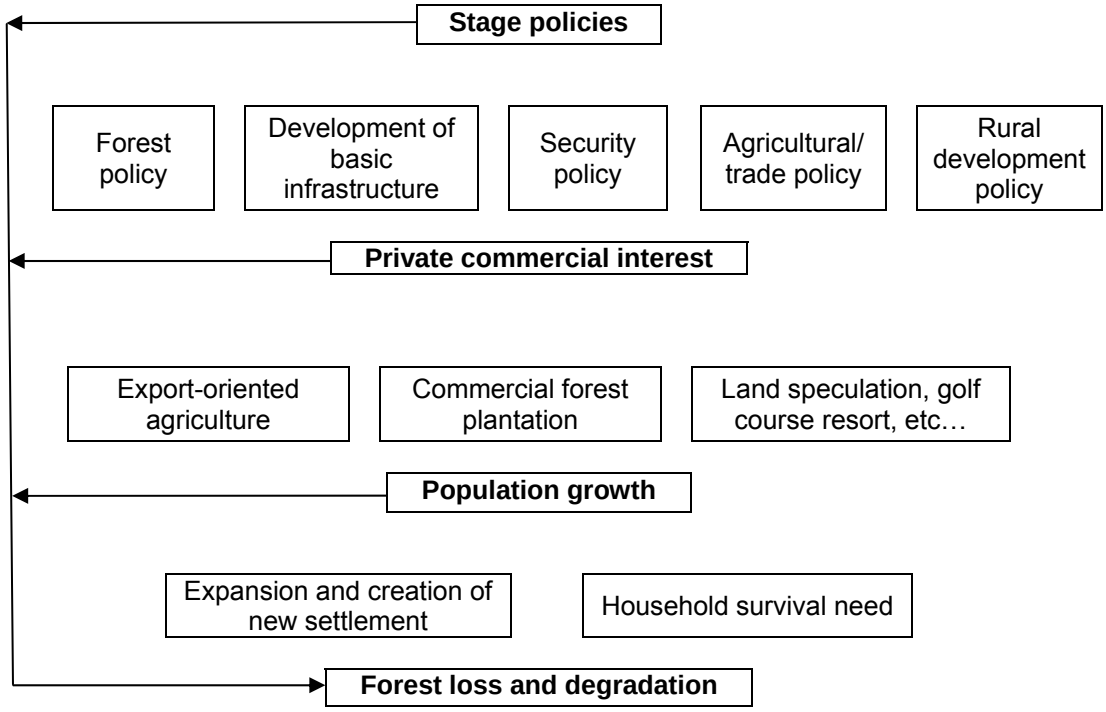

Figure 1. ***Various factors contributing to degradation and loss of forest (TFSMP, 1992)***

The degradation and destruction of forest resources in Thailand stems from a variety of reasons. The private purchase, direct or indirect and for whatever purpose, of extensive tracts of farmland in former forested areas, which were officially reclassified as non-forest areas, has driven the land-dependent peasants to resume their production activities by clearing land in the Forest Reserve for cultivation. The extensive conversion of forests into farmland is also caused by the farmers' need for additional land to increase output, because existing agricultural productivity is usually rather low. Meanwhile, failures by the state can be considered as another major underlying factor of forest resource destruction and degradation. Many government policies are either inappropriate or unclear in their objectives, design, direction and operation, such as the policies concerning infrastructure development, tourism promotion, and export crop promotion. Certain laws, official rules, and regulations related to forest resources are not well-defined either, and may therefore hamper the accomplishment of goals established by the National Forest Policy and the National Land Policy. This is because the legal mechanisms cannot function to guide and control land use in the desired manner, especially the usage of land according to conservation practices in the watershed headland. Another pitfall is, perhaps, the difficulty to accurately assess the forest situation because the available statistics and information concerning forest resources are not gathered on a continuous basis nor by using the same methods each time, and the definitions used in succeeding studies and reports are not always the same (Kaosa-ard and Wijakprasert, 2000).

4. Impacts of Forest Degradation

The disappearance of large tracts of forest vegetation denotes the possible loss of important forest ecosystems, particularly those characterized as unique or uncommon and possessing a great diversity of sophisticated life in all of the vertical stratification. They also serve as natural habitats to rare and endemic species of plants and animals in Thailand. The loss of forested areas often makes it difficult or even impossible to restore the ecosystem to its natural state. The loss of many distinctive forest ecosystems from the country must be taken as the most negative experience. It must be prevented at all costs, not only for the purpose of protecting biodiversity in all trophic levels, but also because the general public and future generations may be deprived of their right to biodiversity and welfare. Once the rare and unique forest ecosystems are depleted or damaged, there will be no likely way of finding replacements or alternatives for future generations to pursue advancement in science or to utilize the various biological resources to sustain human well-being and development.

The qualitative degradation of forest ecosystems involves changes in the community structure of wild plant species induced by human activities such as wood cutting, foraging and land clearing, but which take place sporadically and not to any great extent, or to an extent that permits the ecosystem to successfully restore itself to its original state over the years. To assess whether the extent to which external disturbances will have a bearing on the sustainability of an ecosystem, various indicators are needed such as species richness, tree density, basal area, the growth distribution of each species, relative density, relative dominance, relative frequency, and the importance value index of each species in a specific forest ecosystem. In addition, tree vigor, regeneration patterns, and stages of succession can also serve as indicators of the degree to which forest ecosystem degradation has occurred.

Nevertheless, the most obvious consequence of forest loss and degradation is the loss of biodiversity. Thailand’s rich reserves of biodiversity have been severely degraded, particularly during recent decades. However, the extent of the loss is not clear. Also of importance is the loss of environmental services, such as watershed functions and carbon sequestration. Quantification of these services is even more difficult to determine. There is also a widely held view that the loss of forest cover has impacted adversely on water supplies in Thailand’s major river systems. Even though the weight of scientific evidence does not support these views, they have become part of the local belief system.

PART B
IMPLEMENTATION OF FOREST RESTORATION AND REHABILITATION

1. History of Restoration/Rehabilitation

In Thailand, reforestation was introduced in 1906 when teak was planted in the form of taungya plantations. From then until 1960 small areas were planted annually. However, no clear reforestation plan came up until the first National Economic and Social Development Plan (NESDP) was introduced in 1960. Accomplishments were very modest; only about 8,754 ha were planted before 1960, of which 92 percent was teak. In the First and Second Plan, it set up planting targets at 13,000 ha and 140,000 ha, respectively. The planting target was increased towards the Fourth Plan at 500,000 ha, then declining to 300,000 ha in the Fifth Plan. In the Sixth Plan, the target was not specified in terms of ha per year. Instead, the government stated that the Kingdom's forest

cover should be increased from 28 to 40 percent (15 percent for protected forests and 25 percent for economic forests) of total land area. This target was reversed in the Seventh Plan, i.e., 25 percent for protected forests and 15 percent for economic forests. By the time when the Eighth and Ninth Plan were introduced reforestation work had become less important for development in the government's view due to previous unsatisfactory results. At the present, it is unlikely that the government will consider reforestation work as an important means for rehabilitating degraded forest land rather than enhancing natural regeneration by only protecting the area from forest fire.

Table 4. ***Targets and achievements of reforestation work in the national economic and social development plan***

NESDP	Years	Period	Plan Target/Objectives (ha)					Achievements (ha)
			Total	Teak	Non-teak	Industrial /Private /Farm	Natural Forest	
Before	-	Before 1961	None	-	-	-	-	8,754
1st	6	1961-66	13,000	5,000	8,000	-	-	12,409
2nd	5	1967-71	140,000	90,000	50,000	-	-	25,965
3rd	5	1972-76	242,500	-	-	150,000	92,500	57,788
4th	5	1977-81	500,000	-	-	500,000	-	305,691
5th	5	1982-86	300,000	-	-	300,000	-	210,072
6th	5	1987-91	None	-	-	-	-	834,686
7th	5	1992-96	1,600,000	-	-	800,000	800,000	
8th	5	1997-01		-	-			95,592
9th	5	2002-06	None	-	-	-	-	35,876
10th	5	2007-11	None	-	-	-	-	-
Total			**2,795,679**	**95,000**	**58,000**	**1,750,000**	**892,500**	**1,586,833**

Sources: Assessed by the author

2. Current Policy Governing Land Use and Restoration/Rehabilitation

2.1 *Forest Land Zoning*

Since 1989 following the declaration of the logging ban operation in Thailand, the Ministry of Agriculture and Cooperatives instructed the Royal Forest Department to undertake a survey of the status of the forest in all areas that previously had been allocated as logging concessions. The purpose of this survey was to establish clearly defined forest land classifications within national forest reserves. The three zones are classified as follows:

- *Conservation Zone (or Zone C)*
  The land in this zone is covered with forest trees that are healthy and must be conserved. The area is managed for being national parks or wildlife sanctuaries.

- *Economic Zone (or Zone E)*
  The forest condition in this zone is partly degraded. However, the assessment of soil capability indicates that these areas are suitable for the cultivation of tree crops, particularly forest tree crops.

- *Agricultural Land Reform Zone (or Zone A)*
  The land in this zone has been deforested and is occupied by permanent settlers. The communities in these areas are permanent and people are cultivating a combination of rice, upland crops, and permanent tree crops. These areas have been shifted from the control of RFD to Agricultural Land Reform Office in order to give land tenure to the settlers.

Table 5. ***Different categories of forest land and existing uses in Thailand.***

Category	Symbol	Area in 1991			Existing Uses
		km^2	% by country	% by forest	
Good condition forest in conservation zone	Cf	114,496	22.3	48.6	Protected area, National Park, Wildlife sanctuary
Degraded forest in conservation zone	Cd	26,672	5.2	11.3	Illegal uses, Fallow, Reforestation
Good condition forest in economic zone	Ef	14,112	2.7	6.0	Maintaining
Degraded forest in economic zone	Ed	68,912	13.4	29.2	Leasehold for reforestation,Illegal uses, Fallow, Reforestation
Agriculture zone of forest reserve	A	11,552	2.2	4.9	Legal use, Illegal Use, Fallow
Total forest land	**-**	**235,744**	**45.9**	**100.0**	
Non-forest land	**-**	**277,856**	**44.1**	**-**	Agriculture, road, house, reservior etc.
Country land	**-**	**513,600**	**100.0**	**-**	

In Thailand, any piece of land not covered by deeds or documents according to the processes of the Land Code of 1954 was to be defined as forest land. Therefore, the state forest can be considerably expanded in spite of having forest settlers. In 1999, there are 1,221 units of forest reserve of 23,037,000 km^2 or 45.9% of the country (Royal Forest Department, 2001).
The potential areas for reforestation are in the category of Conservation and Economic zones which covered 18.6 percent of the country area or 9,558,400 ha. However, it has been found that there are a number of small holders already occupying the land. It requires their cooperation for reforestation of the land, and appropriate incentives should be provided.

2.2 *Land Right Certification*

The government has tried to reserve and protect land for forestry. Large forest reserve areas have been destroyed in spite of this. The enforcement of the law and the protection of natural and planted forests have been ineffective. Another dimension of the problem is the fact that about 6 million hectares of encroached forest land where farming has been practiced for decades is actually suitable for agriculture (Onchan, 1990). However, the government is reluctant to give up, or alienate the land to people now occupying it. It has for a long time not been argued that if the land was legally allocated to the farmers it could be used more efficiently. Forest farms could be such an efficient land use. On the other hand, there is a worry that if the forest occupants are given the land certificate, they will sell the land right illegally, move and continue forest encroachment.
The government has granted land rights through a number of land allocation agencies such as Agricultural Land Reform Office, Public Welfare Department, Cooperative Promotion Department, and Royal Forest Department. However, this has so far been rather ineffective in reducing forest encroachment.

In the study area, it is estimated that the area under rubber plantation and fruit tree plantation covering 30 percent of the watershed has received land right certificate (S.P.K.4-01) issued by the Agricultural Land Reform Office. As the survey revealed, there are some farmers who prefer not to have all their land subjected to that land right certificate in spite of having illegal ownership. This is the case when they have more land than the rule by the government defines which allows less than 50 rai for the certificate.

2.3 *Permission to Use Forest Land*

The National Reserved Forest Land Act defines the forest reserve land. Its intention is to protect and preserve trees and nature in the national forest land. Some of the regulations of this act are of high interest when discussing reforestation development:

- *The Permission Regulation for Living and Land Utilization in the Forest Rehabilitation Area*
  If someone occupies the forest reserve land before the minister's declaration, the province governor can give permission for him to live and utilize the land; a maximum of 20 rai (1 rai = 0.16 ha) per family with a duration of 5 years can be allocated, which is renewable for up to 30 years thereafter. A maximum additional area of 35 rai per family can be allocated if it is occupied and if it will be reforested, for a duration of 5 to 30 years. Land permission fee or logging fees are not to be paid.

- *The Permission Regulation for Reforestation in the National Reserved Forest Land*
  This regulation is used to give permission to the private sector to establish forest plantations in the national reserved forest land. The Director General of the Royal Forest Department has the authority to give permission to people to plant trees on denuded forest land of up to 2,000 rai at a time. However, the Minister has to approve the project first. The cabinet may issue the permit if the application covers more than 2,000 rai. Maximum duration of permission is 30 years. The regulation states that whenever the holder of the permission wants to cut the trees he planted, permission is needed and logging fees etc. must be paid.

- *The Permission Regulation for Agroforestry Reforestation*
  This regulation is used to give permission to local people living close to a government forest plantation to plant agricultural crops in between the rows of the planted trees. The permit is given for one year at a time, and the harvest and utilization of the crop yield can be used freely by the permission holder.

- *The Permission Regulation for Living and Land Utilization in the National Reserved Forest Land*
  This regulation is used to give permission to people to live and utilize areas inside the na-tional reserved forest land from five to maximum 30 years. Main possible uses are for agriculture, mining, etc. A part of any land allocated under this regulation must be reforested under RFD control. If permission is given for 16-50 rai at least 10% of the permitted area should be reforested. For 51 to 100 rai, 20%, and from 101 rai up at least 40% of the permitted land must be reforested.

2.4 *National Forest Policy*

A National Forest Policy was drawn up and adopted by the cabinet in 1985 in an attempt to harmonise the forest policy in the country and to place forestry within the context of overall national development. The process of preparing the policy was thorough and detailed, with extensive public hearings and input. Reforestation and afforestation were seen as important initiatives to supply wood for future needs. This part of the policy encouraged the private sector to become involved in tree planting projects for both domestic and export supply. Emphasis was placed on a partnership with the private sector. However, the private sector was interpreted to mean concessionaires and business people rather than rural people.

Although the forest policy was adopted by the cabinet in 1985, it is widely considered that it did not give adequate attention to three crucial areas (RFD, 1993). These are:

- Deforestation, with all its negative impacts, continued because its root causes were not addressed;

- The Kingdom’s household and industrial wood demand was not met in a sustainable manner; *and*

- The conflict over forest land use by many "illegal" occupants of state forest land remained unresolved, thereby accelerating land degradation and maintaining social tension.

2.5 Watershed Classification Regulation

The Watershed Classification Regulation was introduced in the late 1970s to classify areas for watershed protection, production forestry and agriculture. Based on an agreement among state agencies, five watershed classes were characterized as follows:

- WSC1 – *Protection or conservation of forest and headwater sources*. Areas under this class are usually at high elevations and have steep slopes, so that they should have permanent forest cover. There are two subclasses: WSC 1A if the area is wholly undisturbed, or WSC 1B if part of it has already been cleared for cultivation.

- WSC2 – *Commercial forest*. Areas under this class may be at high elevations and may have steep slopes, but their landform results in less erosion than WSC1. They may be used for logging, mining, or grazing, or for crop production if appropriate soil protection measures are taken.

- WSC3 – *Fruit tree plantation*. Uplands with steep slopes, but less erodible landform than WSC 2; may be used for commercial forests, grazing, fruit trees, or some agricultural crops if soil conservation measures are taken.

- WSC4 – *Upland farming.* Gently sloping, and suitable for row crops, fruit trees and grazing with moderate use of soil conservation measures.

- WSC5 – *Lowland farming*. Very gentle slopes or flat; suitable for paddy fields and other agricultural crops with few restrictions.

3. Forest Restoration/Rehabilitation Initiative

3.1 Reforestation

As discussed above, Thailand absolutely needs a massive reforestation program for at least three reasons. Firstly, the country has suffered a negative wood balance. Secondly, as the country's population increased to 63 million in 2003, it needs wood from man-made forest to release consumption pressure on natural forest. Thirdly, due to the impact of past shifting cultivation destroying huge forest areas of watershed headlands, the country needs effective reforestation to rehabilitate the degraded forest.
Therefore, reforestation in Thailand can be divided, by type of planting land and forest policy, into three categories, namely: reforestation on public land, on leasehold, and on titled land.

Reforestation on Public Land

The Royal Forest Department is the main agency implementing reforestation programmes in the country operating under the following two offices:

- The Office of Conservation is responsible for reforestation in the conservation zone especially in degraded watershed headlands *and*

- The Office of Reforestation with its two units, - i.e., the Division of State Reforestation and the Division of Private Reforestation - is responsible for reforesting degraded forest reserves and promotion of private reforestation in leasehold forest land. Forest Industry Organization (FIO) and Thai Plywood Company, which are state-owned enterprises, are permitted to use public land for reforestation to supply wood material in a sustainable manner.

Forest logging concessionaires were also active agencies for reforestation according to the concession agreement before the logging ban in 1989. After that, the reforestation burden moved to FIO.

Table 6 shows the result of reforestation programs done by various planting agencies totalling about 1,176,226 ha. The main purpose of reforestation on public land by the government budget is to reforest the watershed areas heavily destroyed by shifting cultivators in the past as well as lowland degraded forests. The former planting sites were more common in the mountainous terrains rather than in the lowlands, while the latter reforestation gave rise to the development of forest villages and management of community forestry.

From 1994 to 1996, the Royal Thai Government through the Ministry of Agriculture and Cooperatives (MOAC) launched a large scale reforestation programme in commemoration to the Golden Jubilee of King Bhumipol Adulyadej's ascension to the throne (the Fiftieth Anniversary of H.M. the King) to rehabilitate deteriorated conservation forest as well as planting trees along roadside of the main highways. The government was successfully doing a billion-baht fund raising campaign for its implementation. Besides, RFD and state-owned enterprises have been using the budget from other agencies such as the Electricity Generation Authority of Thailand, the Royal Irrigation Department, and concessionaires to launch the reforestation program on public land.

Table 6. ***Annual reforestation in public land classified by budget (Unit: ha.)***

Items	Until 1999	2000	2001	2002	2003	Total ha
Afforestation by government budget	667,262	5,477	4,208	5,592	3,136	685,675
The reforestation campaign in commemoration of the Royal Golden Jubilee	355,712	12,972	16,005	16,831	1,436	402,956
By Forest Industry Organization (FIO)	32,949	710	-	-	-	33,659
By Thai Plywood Co., Ltd.	3,188	378	341	572	122	4,601
Reforestation according to Ministry's regulations	15,106	1,478	1,914	450	468	19,416
Reforestation by concessionaire budget	22,458	54	138	2,400	4,869	29,919
Total	**1,096,675**	**21,069**	**22,606**	**25,845**	**10,031**	**1,176,226**

However, most problems of reforestation on public land are the lack of adequate maintenance due to less budgetary support especially after 6 years of plantation establishment. Forest fire is another big problem causing mortality of planted trees in large areas.

Private Reforestation on Leasehold

After the logging ban in 1989, the government has set up the new target of forest cover being 25 percent for conservation forest and 15 percent for economic forest in the Seventh Plan (1992-1996). Recognizing the potential role of the private sector in reforestation for economic purposes, RFD promoted private-sector involvement by providing them the privilege to rent degraded forest land which is in the economic zone for fast-growing tree planting. Thus, encroached land in forest reserves is rented to private companies for eucalyptus plantations at a rate of only 10 baht per rai (or 0.16 ha). The government also grants promotional privileges to participating companies through a Board of Investment (BOI) promotion program. This policy has led to a major controversy as private firms have to pay farmers living on encroached land to move out. If this policy were widely implemented, there would be a major concern on ensuring the welfare of the approximately 7.8 million poor farmers now living in forest reserves. The National Forest Reserves Act of 1964 cannot be enforced unless the government finds a way to deal fairly with such a large number of settlers. Past experience has shown that driving people out of the forest reserves without appropriate compensation is a sure recipe for trouble.

However, for this reason, there were many private enterprises applying to utilize degraded forest lands for the establishment of industrial plantations throughout the country, especially after 1980. Table 7 reveals the areas by region and province where the Royal Forest Department allowed the private enterprises to use degraded forest lands for fast-growing-tree plantations. In the central provinces the plantation area was largest with about 11,810 ha followed by the North (6,769 ha), the South (4,477 ha), and the Northeast (1,049 ha), making the total areas already approved 24,107 ha. Major tree species proposed for planting are *Eucalyptus camaldulensis*, *Casuarina junghuhniana*, *Casuarina equisetifolia*, *Rhizophora apiculata*, *Leucaena leucocephala*, and *Acacia auriculiformi*s.

Nowadays, there are two main groups which have similar approaches in the management of their reforestation for securing raw material. The first group, in the Prachinburi and Chachoensao province, has its own plantation of about 32,000 ha in which some are leasehold, some are contract farming area with farmers of the size of about 48,000 ha. The second group, in the Kanchanaburi province, has a contract farming area of about 25,600 ha in addition to non-contract farming of 40,000 ha (Banjachaya, 2002). Mostly, the species planted is *Eucalyptus camaldulensis*.

From the social point of view, the industrial reforestation project, which is large-scale in nature, must ensure that local people get long-term benefits from the reforestation effort.

Table 7. ***Areas of degraded forests already approved by the Royal Forest Department for private industrial plantation of fast-growing trees***

Region	Provinces	Area(ha)	Tree species
North	Chiang Mai	265.6	Paulownia
	Chiang Rai	699.2	Aau., Csi., Eca., Lle.
	Kamphaeng Phet	540.5	Eca., etc.
	Lampang	421.9	Etc.
	Phayao	1,215.4	Aau., Csi., Eca., Lle.
	Phrae	3,466.6	Aau., Cju., Eca., Lle., Maz., Tgr.
	Tak	160.0	Eca., Lle.
	Total	**6,769.1**	
Northeast	Buri Ram	360.8	Ama., etc.
	Nakhon Ratchasima	369.0	Cju., Eca., Lle.
	Surin	320.0	Ect.
	Total	**1,049.8**	
Central	Chachoengsao	2,448.2	Eca., Gar., etc.
	Chanthaburi	1,349.6	Cju., Lle.
	Chon Buri	150.9	Cju., Lle.
	Kanchanaburi	332.2	Etc.
	Phetchaburi	1,524.3	Ain., Eca., Lle., Rap.
	Prachuap Khirikhan	2,021.9	Ain., Aau., Ceq., Ciu., Eca.
	Ratchaburi	1,837.4	Aau., Ceq., Cju., Eca., Lle.
	Saraburi	1,200.0	Cju., Eca., Lle.
	Suphan Buri	192.0	Bamboos, etc.
	Trat	753.9	Cju., Rap., etc.
	Total	**11,810.4**	
South	Chumphon	1,208.3	Etc.
	Nakon Si Thammarat	480.0	Ceq., Rap.
	Surat Thani	2,789.6	Ceq., Cju., Rap.
	Total	**4,477.9**	
	Grand Total	***24,107.2***	

Source: Thaiutsa (1988)

Note :
Aau.: *Acacia auriculiformis*
Ain.: *Azadirachta indica*
Ama.: *Acacia mangium*
Ceq.: *Casuarina equisetifolia*
Cju.: *Casuarina junghuhniana*
Csi.: *Cassia siamea*
Eca.: *Eucalyptus camaldulensis*
Gar.: *Gmelina arborea*
Lle.: *Leucaena leucocephala*
Maz.: *Melia azedarach*
Rap.: *Rhizophora apiculata*

The benefits from the large-scale reforestation to local people can be listed as follows,

- Cash from employment in nursery, planting, maintenance, protection, harvesting and road construction work;
- A share of the revenues when the trees are harvested;
- Possibilities to use the land temporarily or permanently for the people's own production;
- Wood or profit sharing contracts; the wood or the profits from timber harvesting in plantations shared in relation to the inputs to the plantation; *and*
- Various extension activities in which technical assistance is provided to local people, so that they can establish forest and agroforestry plantations on their own titled or permitted land.

Reforestation on Titled Land

Recently, in the period of 1994 to 2000, the government has established incentive schemes to promote economic tree farming on titled land. It has provided a subsidy of 3,000 baht per rai (18,750 baht per ha) for five years, divided into five installments, as the established plantation has proven successful. This project has faced a lot of problems due to unclear directions for future management of the plantation as well as small wood markets. Some farmers, who joined the promotion, gave up and switched to other uses of the planting plot. The results of the implementation from 1994 to 1998 are shown in Table 8. It can be seen that the number of farmers joining the promotion and planting area from the beginning, the period of 1994 to 1998, has decreased to 81,486 farmers and 174,256 ha.

Table 8. ***Results of the promotion of farmer tree plantation program (1994 -1998)***

Planting year	In 1994		In 1998		Difference	
	Farmers involved	ha	Farmers involved	ha	Farmers involved	ha
1994	49,565	115,291	28,477	62,811	-21,088	-52,480
1995	65,596	151,548	28,817	56,494	-36,779	-95,054
1996	27,537	65,806	10,861	23,846	-16,676	-41,960
1997	16,386	38,509	10,545	24,476	-5,841	-14,034
1998	2,786	6,629	2,786	6,629	-	-
Total	**161,870**	**377,783**	**81,486**	**174,256**	**-80,384**	**-203,527**

Source: Division of Private Reforestation, Royal Forest Department

To solve the problems in the long term, the farmers have been encouraged by the Royal Forest Department to form farmer organizations, so-called "Private Reforestation Cooperatives", to help members in running their own wood-based business and to solve marketing problems. At present, there are 34 cooperatives established throughout the country. However, there are a number of problems the farmers have to face such as slow growth and survival of trees, lack of appropriate technology for the utilization of small logs, and an unclear market for wood.

However, the success and failure of reforestation projects showed that participation of local people is a key factor. The most important measure to achieve participation consists in assuring an interesting market for the products coming from plantations. With a good market at hand, people will look upon any plantation as something valuable, something worth as private property.

3.2 *Forest Rehabilitation in Watershed Headland*

Watershed management became a priority for the RFD in the early 1950s. Public relations work was started through print and broadcast media to inform people about the damage to soil and water resources caused by frequent fires. At about the same time rehabilitation of denuded watersheds by means of reforestation commenced in the Northern region. A number of RFD stations were established in the North and Northeast of the country for headwater protection and rehabilitation. Rehabilitation by reforestation continued on the assumption that only forests can provide ideal hydrological conditions. The watershed management activities were mainly agency-oriented and were focused on technical interventions.

From 1965 to 1996, the RFD through its Watershed Management Division rehabilitated 211,231 ha of forest primarily through reforestation activities, and mainly in the Northern region.
All highland communities are directly affected by the national forest policy and its implementation. As all mountain lands essentially "belong" to the RFD, the highland villager's rights to use land can be revoked by a forestry officer at any time. At the village level, this policy translates into an enforcement of land use restrictions without redress to any social and economic assistance. An example of how the insecurity of tenure can have a devastating effect on people's lives comes from the experience of the Lahu village of Lo Pa Krai, North of Chiang Mai. Their village was selected for economic development, and a large tract of this land in the area was awarded by the RFD in Bangkok to the Forestry Industry Organisation (FIO), a government owned company mandated to develop eucalypt plantations. This action essentially disenfranchised the local villagers from their traditional lands, and they were without redress (Ramitanondh and Somswasdi, 1992).

However, the approach of the RFD to watershed management has evolved over the years, as experience has been gained. Table 9 summarizes the major policy and practical shifts that have taken place in the past four decades.

Table 9. ***Evolution of watershed management policy in Thailand***

Period	Policy Focus	Major Activities
1976-1980	Watershed rehabilitation	Reforestation of abandoned swidden area; relocations of hill tribe villages and improvement of quality of life.
1980-1990	Integrated watershed management	Land use planning, soil and water conservation measures, forest fire control and promotion of agricultural extension.
1990-1999	Participatory watershed management	Local people's participation, village committee, watershed network, rules and regulations.
2000 onward	Watersheds for the people	

Source: Watanaprateep, 1999

4. Assessment of Existing Capacity of Stakeholder Involvement

4.1 *Development of Forest Policy*

In Thailand, the concrete policy for reforestation can be accounted from the beginning of the first National Economic, Social and Development Plan (1961-64), when substantial declines in forest area had occurred, and forest conservation and replanting were becoming increasingly essential.

In 1985, the first comprehensive National Forest Policy was established. The target of maintaining forest areas was then set at 40 percent. 15 percent were classified as conservation forest area; 25 percent were classified as economic forest area. This target was reversed in the Seventh Plan (1992-96), namely to 25 percent for protected forests and 15 percent for economic forests. The policy has been set up to conserve and protect the natural environment by accelerating the city planning process and designating specific areas for forests in each province, residential, rural and agricultural use to prevent forest land encroachment. Reforestation by the public and private sectors for domestic industrial consumption shall be promoted. Export of wood and wood products shall be encouraged. Community forestry such as reforestation on public land by private sector, tree planting on marginal agricultural land and establishment of forest woodlot for household consumption shall also be promoted.

4.2 *Decentralization Process*

Governments across the world, including liberal democracies and authoritarian regimes, are pursuing decentralization reforms. Among the many motivations of governments to decentralize, one of the most common is a desire to improve the efficiency of the government administration and delivery of services (Dupar and Badenoch, 2002).
Under the country's existing administrative structure (see Table 10), authority is delegated from the capital to the region and then to local areas. In general, development policy and planning in Thailand is a combination of top-down and bottom-up approaches, while the public administration system of the country is highly centralized.

Thailand has gradually strengthened the capacity of local government. During the 5th and 6th National Plans, local governments played a greater role in setting development priorities. Nevertheless, the proposed development plan has to be agreed upon and the budgets have to be approved by the central government.

To further enhance the role of local government and local development efficiency, the Seventh and Eighth National Plans called for the decentralization of fiscal authority and asset holding as important mechanisms to help strengthen local administrative capacity.

As the structure and management system of the local government have been put in place by the end of the Eighth National Plan, the Ninth National Plan (2002-2006) will concentrate upon improving the development capability of the local administrations. Development plans will integrate all aspects, monitoring systems will be enhanced, information system upgraded, and human resource capability increased.

Table 10. ***Thai public administration and structure***

Basic level of public administration	Attribution
Central administration	• consists of 20 ministries; • Various departments, offices, bureaus, divisions and sub-divisions established in each ministry.
Provincial administration	• The central government delegates some of its power and authority to its officers in provinces and districts. • These officers are from various ministries and departments and carry out their work according to laws and regulations assigned by the central government. • At present, the provincial administration consists of 75 provinces (excluding Bangkok), 795 districts, 81 minor districts, 7,255 sub-districts or Tambon, and 70,865 villages (data as of February 2001).
Local administration	• Allows local people to participate in local affairs under concerned laws and regulations. • The general type existing in every province: o Provincial Administration Organization o Municipalities, urban areas with a crowded population and level development o Tambon (or Sub-district) Administration Organization (TAO), sub-district area outside the boundaries of municipalities. • The special type o Bangkok Metropolitan Administration o City of Pattaya.

The 1992 Tambon Administration Act (TAO) provides for a greater role for local government units in forest management. Under this act, TAOs (sub-district governmental units) bear the responsebility for managing all natural resources within their boundaries. This decentralization plan was further supported by the new Thai Constitution which came into force in 1997. The constitution states that local people and organizations should be involved in managing their natural resources. Both of these laws further enshrine people's participation in forest management and pave the way for clarifying land-use issues and people's role in forest management (Poffenberger, 1999).

4.3 *Adaptation to Economic Crisis*

After achieving an average growth rate of 6.8 percent during 1960-1996, the Thai economy faced the severest crisis in 1997. This crisis had some effects on the structure of the economy. The government had launched the public sector adjustment policy to review the role of government agencies. It was decided that all work that could be carried out by the private sector should be privatized. Correspondingly, all work which could be undertaken by local people should be transferred to local organizations. Under this policy, the RFD will terminate government reforestation projects, private plantation promotion, seedling distribution, and wood and non-wood checkpoints. These activities as well as all the work concerning forest engineering (such as road construction, forest boundary survey and all mechanical engineering) shall be transferred to the private sector.

Plantation and forest protection activities will be transferred to local organizations. The process of the adjustment was initiated in 1998 and is ongoing (Komon, 2000).

PARTC
FUTURE ACTION FOR ENHANCING RESTORATION /REHABILITATION

1. Proposed Model for Community-Based Reforestation

Reforestation is often regarded as key activity in sustainable natural resource management. Representative and accountable community-based institutions are seen to be potentially more dynamic and responsive to rapidly changing local realities.

In Figure 3 a model of Community-Based Reforestation is presented that can be set up through support by funding organizations such as the government or a donor agency. As mentioned earlier, community-based reforestation is a form of decentralization which emphasizes local people's participation through collaboration of two governmental reforestation units which have different complimentary roles. One, called "Local Reforestation Unit (LRU) ", is based on local organizations which may be the one within the structure of the local administration or the one from farmer cooperatives. This depends on the situation of each community. Another one, called "Technical Reforestation Support Unit (TRSU)", is a qualified professional team in reforestation and natural resources management. TRSU should get an initial fund from the so-called "Funding-support Reforestation Organization (FRO)" to prepare a reforestation plan as well as a research and extension plan with the local people and LRU. Then, they should submit the plan for approval to FRO for further funding and implementation.

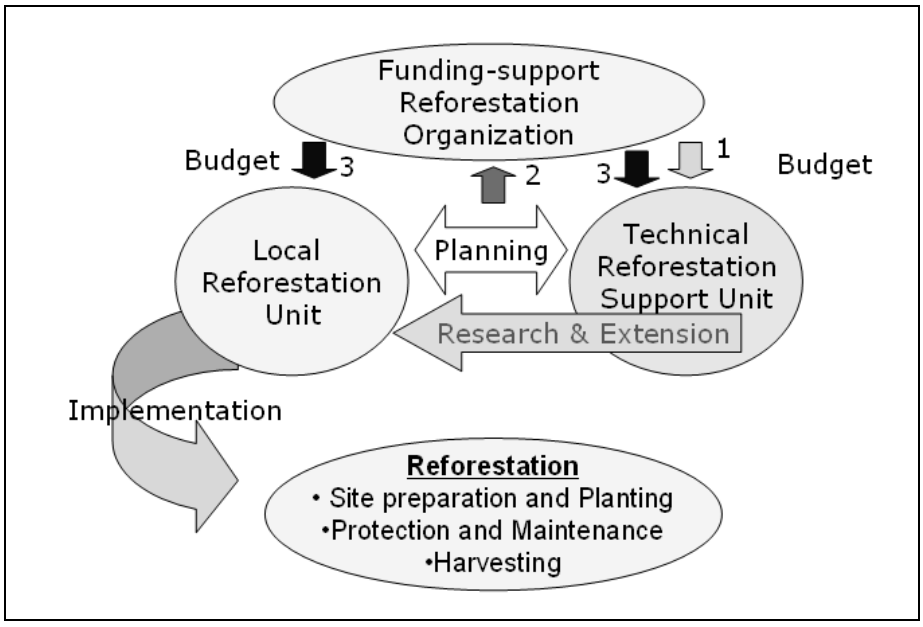

Figure 3. ***Proposed model of community-based reforestation (Jamroenprucksa, 2003)***

With the above model, LRU will play a key role in implementing reforestation plans starting from the beginning of the project period to the end of harvesting. During the project period, FRO will

release the reforestation fund to LRU and TRSU together on the basis of their collaborative report submission. FRO can get return indirectly from harvesting timber for further financial support of the next implementing cycle.

2. Integrated R&D Approach

Integrated research and development (IR&D) is an iterative process and a form of natural resource management. Therefore, agricultural science must definitely be subject to the value-driven preferences of diverse interest groups or learning communities. Resource management involves negotiating goals and acceptable trade-offs among multiple stakeholders, including the different learning communities. For poor farmers in semi-subsistence agriculture, there are trade-offs between satisfying the family's daily food and income needs and maintaining the viability of the natural resources required to produce them. For better-off farmers in commercial agriculture, there are trade-offs between cutting costs to capture slender profit margins and long-run investment in the management practices and technology needed to sustain productivity.

Research aimed at improving the management of reforestation has to incorporate the management objectives of the different stakeholders with regard to how best to use natural processes, cope with disturbances, and internalize externalities.

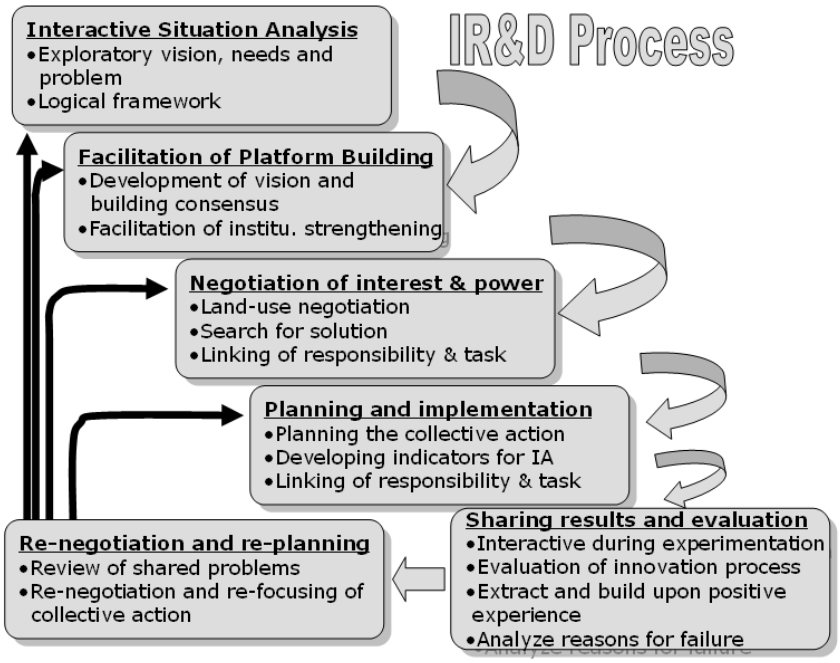

Figure 5. ***Basic steps for carrying out integrated research and development. (adapted from Hagmann et al., 2002)***

The methodological sequence can be viewed as a cyclical spiral of collective action, reflection, and self-evaluation (Figure 5). Each cycle brings new learning experiences on which the next cycle can be built. Not even the situation analysis is static; it will provide more insights during implementation that might require new actions. This action learning is an iterative process, aimed at full engagement and ownership of the process by local people with their own goals, values and needs.

The process of the IR&D consists of 5 basic steps, namely

- *Interactive situation analysis:*
  This step aims to participatory assess the situation existing in the project environment. It consists of exploratory vision, needs and problems related to reforestation and livelihood. The preliminary result can be a draft of logical framework for the further discussion with local organizations.

- *Facilitation of platform building:*
  The technical reforestation support unit should conduct a forum for local people to discuss in order to develop vision and build consensus on the subject matter. Interest groups can be formed for in-depth analysis and scenario-building.

- *Negotiation of interest & power:*
  With the participatory building scenarios, the team should conduct negotiations with land users to search for solutions. Then, responsibilities and tasks for the stakeholders can be drawn.

- *Planning and implementation:*
  Planning can be done by the technical team and approved by joint a committee for implementation. Indicators for successful implementation must be developed.

- *Sharing results and evaluation:*
  During the implementation, the stakeholders must have interactive discussions to share experience and analyze reasons for failure. Development impact assessment should be conducted before the discussion.

- *Re-negotiation and re-planning:*
  After reaching the end of the implementing cycle, the teams should review and share problems to re-focus action for the next cycle which may start again at any step above depending upon the findings and decisions of the teams.

PART D
MISCELLANEOUS

1. Forest Fire

1.1 *Forest Fires and Forest Destruction*

Forest fires in Thailand have generally been occurring annually during the dry season in the deciduous forests of drier environments, but now also moist and evergreen forests are affected, and double burning (burning twice per year) on dry sites has become a regular feature.

The amount and distribution of rainfall strongly affect forest fire occurrence. The monsoon rainfalls in Thailand are strongly seasonal, lasting from about May to October. The dry season can last up to 7 months, during which at day-time temperature extremes can exceed 40° C. On the Malaya Peninsula the climate is moister and less extreme. In Thailand, annual rainfall varies between 700 mm in inland areas and the Northeastern plateau to about 4000 mm in coastal areas.

The distribution of forest types closely follows the rainfall distribution pattern. Natural forest vegetation can be grouped into dry, hill and moist evergreen forests types of the moister areas (totaling about 43%) and mixed and dry dipterocarp forest in drier areas, representing 22% and 31% of the forest respectively. The remaining 4% include primarily mangroves and pine forests (RFD, 1992/2).

In terms of forest fires, data collected between 1984 and 1986 showed that about 21% of the forest land was affected by fire annually. In 1992, it was about 15%. This corresponds to an area of about 1.9 million ha (Tab.11). The majority of the fires occurred in the North. Forest plantations that constitute about 5% of the forest area are twice as prone to fires as natural forests (RFD 1992/1).

Table 11. ***Regional and total forest burned over in Thailand in 1992. The extrapolated value is based on the forest area surveyed***

Region	Total land area (km^2)	Forested area (km^2)	Area sampled during 1992 inventory (ha)	Burned areas within sampled areas (%)	Extrapolated area burned per year (km^2)
North	169,644.79	77,141	381,445	18.19	14,032
Northeast	168,854.34	21,798	171,328	10.32	2,250
East	36,502.50	7,690	113,529 *	8.65 *	2,102 *
Central	67,398.70	16,616			
South	70,715.19	13,449	91,662	7.62	1,025
Total	**513,115.02**	**136,694**	**757,964**	**13.70**	**18,727**

1.2 *People's Attitude to Forest Fires*

There is a widespread belief among scientists as well as rural people that Southeast Asia's forests are adapted to regular fires. The long time-span that is involved before changes in the forest structure are visible, getting accustomed to large areas on fire during the dry season and the fact that most fires remain ground fires of low to moderate fire intensity contribute to this belief. However, recent studies have shown that seedlings and undergrowth are usually completely destroyed by fire, and sapling growth is reduced by 20-25%, with 40% dying. One to five year old trees have mortality rates of about 20%, as do 80% of the roots near the surface (Kasetsart University, 1991). My own investigations showed seedling survival rates after fires as low as 10%, supporting the above-mentioned findings.

Studies conducted by the Royal Forest Department show that gathering of fuel and non-timber products and burning of agricultural debris are the reasons for about half of all forest fires (25% and 20% respectively). Arson, primarily for speculative reasons, is responsible for 19% of the fires. Hunting, carelessness and unidentified causes are responsible each for 12% of the fires. No naturally caused forest fires were recorded during 12 years of observation.

1.3 *Forest Fire Control in Thailand*

The control of forest fires is the responsibility of the Royal Forest Department, carried out by the Forest Fire Control and Rescue Bureau, which is split into 4 administrative sections. The bureau maintains 4 upcountry Forest Fire Control Centres as its working units. These centres maintain

34 sub-units, 14 Forest Fire Control Stations, and 20 Forest Fire Control Projects, that were initiated by his Majesty the King.

The strategies applied in forest fire control include forest fire promotion campaigns (mobile campaign units, mass-media, school programmes, exhibitions, billboards etc.) and forest fire suppression. Of the total forested areas about 12% (20.000 km^2) are covered by forest fire control, concentrated in the North of the country. The biggest stations control 1.500 km^2, the smallest less than 5 km^2. Of the areas under control only about 0.5% (100 km^2) are affected by fire annually, compared to about 15% nationwide, indicating the success of the fire prevention and control efforts. They include training of staff and local volunteers in fuel management, fire detection and reporting, fire suppression and law enforcement and rescue operations.

2. A Look into the Future

In the light of continued and accelerating forest destruction and the inability to reforest these areas (less than 25% of the annually destroyed areas can be replanted) fire control has shown to be a successful means to reduce or halt the process. A successful control of fires would remove one of the conditions necessary to convert forest land to other uses. If this can be combined with more effective law enforcement and the development of alternative wood and fuel resources for the local population, the Thai forests have a chance of recovering and surviving.

However, to achieve this, the forest fire control measures have to be made a priority and applied nationwide. Fire control efforts have to be coordinated among different institutions and scientifically adjusted to prevailing local conditions. The legal framework has to be adjusted so as to be able to apply forest fire legislation in and outside forested areas. Furthermore, legal adjustments regarding land ownership and user rights outside the forest are necessary to change current short-term oriented land use attitudes towards a long-term oriented and sustainable management.

REFERENCES

Benjachaya, Somchai, 2002. The Further Processing of Tropical Timber in Thailand. In the First Thai Biomass Utilization Symposium on Effective Utilization of Forest Biomass for Regional People in Thailand.

Charuppat, Thongchai (1998) Forest situation of Thailand in the past 37 years (1961-1998). Forest Research Office, RFD, Bangkok, Thailand.

Dupar, Mairi and Badenoch, Nathan 2002. Environment, Livelihoods, and Local Institutions: Decentralization in Mainland Southeast Asia. World Resource Institute.

Hagmann, J. R., E. Chuma, K. Murwira, M. Connolly, and P. Ficarelli. 2002. Success factors in integrated natural resource management R&D: lessons from practice. Conservation Ecology 5(2): 29.

Jamroenprucksa, Monton. 2003. Integrated R&D approach for community-based reforestation. Asian Timber. Vol 22 No3 May/June 2003.

Kasetsart University 1991. Forest fire and its effect on the forest ecosystems in Thailand. Bangkok (in Thai).

Kaosa-ard, Mingsan and Wijukprasert, P., 2000. The State of Environment in Thailand: A Decade of Change, Thailand Development Research Institute, 321pp.

Komon Pragthong, 2000. Recent Decentralization Plans of the Royal Forest Department and Implications for Forest Management in Thailand. In Decentralization and Devolution of Forest Management in Asia and the Pacific. T. Enters, P.B.Durst, and M.Victor, eds. Bangkok: RECOFTC.

Onchan, T. 1990. A land policy study. TDRI. Bangkok, Thailand.

Office of Agricultural Economic, 2001. Agricultural Statistics of Thailand. Center for Agricultural Information. Office of Agricultural Economics. Ministry of Agriculture and co-operatives. Bangkok, Thailand.

Poffenberger, Mark (ed.). 1999. Communities and Forest Management in Southeast Asia. A Regional Profile of the Working Group on Community Involvement in Forest Management. Forests People and Policies. IUCN. Gland, Switzerland.

Ramitanondh S. and Somswasdi V., 1992 Impact of deforestation and reforestation programs on household survival strategies and women's work: the case of Karen and Lisu Tribe in the villages of Northern Thailand, Chiang Mai, Thailand.

Royal Forest Department, 2001. Forestry statistics of Thailand. Bangkok. Thailand. 156 p.

RFD, 1992/1. Forest fire control in Thailand. Bureau of Forest Fire Control and Rescue, Royal Forest Department, Bangkok.

RFD, 1992/2. Forest statistics of Thailand 1991. Planning Division, Royal Forest Department, Bangkok.

Siamwalla, Ammar et.al. "Chapter 2: Agriculture" in The Thai Economy in Transition, edited by Peter Warr, Cambridge University Press, 1993.

Thaiutsa, B. 1988. Industrial Plantation of Fast-Growing Trees. A paper submitted to TDRI, Bangkok 36 p.

TFSMP, 1992. Modeling Deforestation in Thailand. Thai Forestry Sector Master Plan Forest Products Marketing Sub team. Bangkok Thailand.

TFSMP, 1993. Thai Forestry Sector Master Plan Volume 6 Subsectoral Plan for Production and Utilization Bangkok.

Thaiutsa, B. 1988. Industrial Plantation of Fast-Growing Trees. A paper submitted to TDRI, Bangkok 36 p.

Watanaprateep, Apichart. 1999. Paper presented in Regional Workshop on Participatory Watershed Management Policies in Asia. Chiang Mai, Thailand.

Forest Rehabilitation in Vietnam

by

Nguyen Hoang Nghia[1]

PART A
STATUS OF LAND USE AND FOREST (AND LAND) DEGRADATION

1. Forest Land Use and Land Use Change

Vietnam is a tropical country, located in the Southeast Asian region with a total land area of about 330,000 square km, extending from latitude 8°N to 23°N. Forest land covers 16 million hectares accounting for 48.3% of the total land area (Ministry of Agriculture and Rural Development, 2001). Vietnam has an abundant and diverse forest flora, largely understudied. According to Flore Generale L'Indo-Chine (Lecomte, 1907-1958), there are more than 7,000 plant species which belong to 1850 genera and 290 families. Recent studies by Nguyen Nghia Thin (1997) reported that Vietnam possesses 11,373 plant species of 7 phylla, 378 families and 2524 genera and the total number of plant species may even exceed 15,000 species (Table 1).

Table 1. ***Species composition of plant phylla in Vietnam (Nguyen Nghia Thin, 1997)***

	Phyllum	Number of		
		Families	Genera	Species
1	Bryophyta	60	182	793
2	Psilotophyta	1	1	2
3	Lycopodiophyta	3	5	57
4	Equisetophyta	1	1	2
5	Polypodiophyta	25	137	669
6	Gymnospermae	8	23	63
7	Angiospermae	299	2175	9787
	Total	**378**	**2524**	**11,373**
	Percentage of endemics	***0%***	***3%***	***20%***

Over a long period, forest resources in Vietnam continuously declined in terms of area and diversity. Especially during the 1980s, the forest area reduction is estimated at about 100,000 ha per year. However, because of forest rehabilitation and reforestation programmes since the beginning of the 1990s until to date, forest resources in Vietnam have steadily increased. The change of forest cover in Vietnam from 1943 to 2005 is presented in Table 2.

[1] Forest Science Institute Vietnam

Table 2. ***Changes of forest areas and forest cover between 1943 and 2005 (MARD, 2004; 2005; 2006a, 2006b; Vietnam Government, 2001)***

Year	Natural forest	Planted forest	Total forest area	Forest coverage %
1943	14,300	0	14,300	43
1976	11,077	92	11,169	33
1990	8,430	745	09,175	27
1995	8,252	1,050	09,305	28
1999	9,444	1,471	19,915	33.2
2000	9,865	1.919	11.785	35
2003	10,004	2,089	12,094	36.1
2004	10,088	2,218	12,306	36.7
2005	10,283	2,333	12,616	37

Note: *Unit = 1000 ha*

In 1943, the total forest area of Vietnam was about 14.3 million ha or 43% of the total land area, but had declined by 1990 to only 9.2 million ha or approximately 27%. By 2005, the forest area in Vietnam had recovered to 12.6 million ha, or 37%, of the total area of the country. In 1943, there were no planted forests in Vietnam but in 1995, the area of planted forests had reached about 1 million ha and this figure increased to more than 2.3 million ha in 2005.

Regarding timber production capacity, the total growing stock in Vietnam in 2004 is estimated at 813.3 million m^3, of which 764 million m^3, or 94%, are from natural forests while 49 million m^3, or 6%, are available in planted forest areas. In addition, the total bamboo resources in Vietnam are estimated at more than 8.5 billion stems. The average growing stock is 76.5 m^3/ha for natural forests and 40.6 m^3/ha for plantations. Based on the above-mentioned figures, the average forest area and standing timber volume per person in Vietnam is 0.15 ha and 9.16 m^3, while these indicators for the whole world are 0.97 ha/person and 75 m^3 timber/person, respectively (Ministry of Agriculture and Rural Development, 2006b). By comparison, Vietnam has currently a rather meager forest resource base in terms of forest area coverage and standing timber volume.

2. Status of Forest (and Land) Degradation

At present, the forest area of Vietnam is grouped into three main forest categories as follows:

- Protection forest (including forests for watershed management, windbreak and seawave-break forest),
- Special-use forest (including national parks, nature reserves) *and*
- Production forest.

These forest categories have evolved over time as a response to the changes in function and role of forests. As a consequence, the areas of protection and special-use forest have remarkably expanded in recent years due to the increasing awareness of people and the international community of the role of forests in environment protection and biodiversity conservation.

With regard to the standing timber volume of forests, the total area of rich and average forests has decreased rapidly (up to 1976 by about nearly 1 million ha) with an average stocking in rich forests of more than 200 m^3/ha and over 150 m^3/ha in average forests. At present, these figures are about 150 m^3/ha and 100 m^3/ha, respectively, and the area of these two types of forest amounts to only half a million hectares. Thus, areas of poorly stocked forest and natural regenerating forests have considerably increased. In 1990, this area was more than 7 million ha, and increased up to more than 9 million ha by 2002 accounting for 80% of the total forest area of Vietnam.

3. Causes of Forest (and Land) Degradation

It is commonly recognized that human activities are playing a key role in the destruction and decline of forests in the region. Therefore, it is important to critically analyse the various reasons of forest degradation so as to obtain a complete picture and recommend suitable solutions. There are two kinds of reasons: indirect and direct (Nguyen Van San and Don Gilmour, 2000).

3.1. *Indirect Reasons*

The main indirect reasons why forests are being degraded include:

- *Poverty in rural areas*. Because cash income of local people in remote areas is very low, mostly under 100 USD/yr, poor local people tend to use forests unsustainably for subsistence and by selling forest products to satisfy the ever increasing demand by the market. Local people collect fuelwood for heating and cooking all year round and also collect food and other NTFPs including medicines to meet their daily needs.

- *Lack of land for crop cultivation*. At present the population of Vietnam is more than 80 million with about 25 million people living within and in the vicinity of forests. According to recent studies, the population of Vietnam will reach 100 million in 2020 with an estimated annual population increase of 1.5% during 2001 – 2010 and 1.3% during 2011 – 2020. Population growth is higher in rural, mountain areas than in cities, thus pressure on forests and land for cultivation will increase.

- *Forest tenure and management*. Until recently, forests were considered as free resource for everybody, so that local people could go in and collect forest products at any time without limitations and payments. Forest land allocation has not yet been completed and appropriate policies and incentives for sustainable forest management are still lacking. Systematic forest planning is not applied in practice with only few local communities participating in forest management. Capacity for management at various levels (e.g. commune, district, province and forest enterprises) is also limited and cannot not meet the higher standards required by modern forest management systems. These constraints are further aggravated by an incomplete legal document system and lack of enforcement of laws and regulations.

3.2. *Direct Reasons*

The main direct causes of forest degradation include:

- *Impact of armed conflict:* In the course of development and protection of the country, Vietnam's forests had been severely destroyed by defoliants (primarily in Central Vietnam, Western Highlands, Southeast Vietnam and Mekong River Delta), bombardment and excessive forest exploitation for the construction of military installations such as roads and other related structures. It has been estimated that about 13 million tons of the defoliant “Agent Orange” were used in the war in South Vietnam destroying some 4.5 million hectares (World Bank, 1995).

- *Over-exploitation of forest:* The primary cause leading to degradation of forest resources is the application of unsuitable forest exploitation practices. Instead of an integrated land-use and harvesting based on socio-economic and environmental values, the tropical forests were mainly exploited for their rich timber resources. Destructive harvesting methods lead to a decline in biodiversity and other forest ecosystem services. Besides timber, many other NTFPs such as honey, wildlife (e.g. snake, gekko, turtle) for food and medicine have been collected from the forest. According to estimates, 90% of the energy consumption originates from biomass such as fuelwood, agricultural residues and charcoal. Vietnam’s fuelwood consumption is more than 20 million tons per year (Nguyen Van San and Don Gilmour, 2000). About 2,300 forest species have been exploited for their timber and NTFP values, the latter including flower, leaf, bark, root, branch, resin and essential oils.

- *Shifting cultivation:* Vietnam is a densly populated developing country with limited agriculture land. About 25 million people live in and around forest areas. A considerable number of these forest dwellers practice shifting cultivation. In the past, mountain areas were not densely populated, so that shifting cultivation could be practiced at long intervals of 5-7 years or more after the first burning. In contrast, because of high population pressure to date the shifting cultivation cycle is considerably shortened to only 2-3 years, leading to a rapid increase of degraded forest land.

- *Forest land conversion:* Rapid socio-economic development also resulted in the conversion of forest land to aquaculture (e.g. Mekong river delta), construction of infrastructure (i.e. mainly national irrigation works, establishment of hydro-electric power plants and transportation systems), plantations of agro-industrial crops such as coffee, cashew nut, rubber, tea, and pepper mainly in the Central regions, Western Highland and Southeast of Vietnam and food production including fixed paddy rice, hill rice, maize, sugarcane, and cassava.

- *Increasing demand of forest products:* This is a major cause of forest degradation in Vietnam due to the increasing demand for timber and non-timber forest products. In the beginning of the 20th Century, demand for forest products could be satisfied. However, to date, demand by far exceeds supply thus leading to an accelerated decline in forest resources.

A survey by the Ministry of Science, Technology and Environment (1998, cited from Nguyen Van San and Don Gilmour, 2000) shows the range of causes of forest destruction in the different regions of Vietnam (Tab 3).

Table 3. ***Causes of forest loss in Vietnam according to their importance (in %) (Ministry of Science, Technology and Environment, 1998)***

Regions of Vietnam	Over-exploitation	Shifting-cultivation	Conversion for crops	Free migration	War	Exploitation for other purposes
Red river delta	12		17	41	9	21
Northwest Vietnam	27	29	11	7	8	18
Central part of North Vietnam	29	27	16	9	5	23
Northwest Vietnam	11	36	12	11	3	27
North of Central Vietnam	34	21	14	6	14	11
South of Central Vietnam	28	17	11	9	29	6
Western Highland	31	24	21	5	17	2
Southeast Vietnam	29	15	13	9	24	10
Mekong river delta	19	4	19	21	31	6

4. Impacts of Forest (and Land) Degradation

Forest degradation in Vietnam had its most severe visible impact on the standing timber volume. Previously, timber-rich forests with more than 200 m^3/ha at present show only a growing stock of about 150m^3/ha while average forests at best are stocked with 100m^3/ha.

There are no official statisitics on non-timber forest products (NTFP) but it is well established that both the quantity and quality of NTFP species and products have decreased significantly (e.g. rattan, shellac, benzoin, agarwood, resin, forest bee honey, Ngoc Linh ginseng, and medicinal plants). Only cinamon trees (*Cinnamomum cassia*), star anise (*Illicium verum*), some bamboos (*Dendrocalamus barbatus, Phyllostachys edulis*) and a few other species have been planted on a larger scale due to the demand by well-established markets.

Table 4. ***Amount of some NTFPs exploited for processing (Luong Van Tien, 1992)***

NTFP	Unit	1986	1987	1988	1989	1990
Agarwood	ton	78.5	81.7	45.4	36.9	20.0
Oil of Alerites	ton	150	90	60	10	10
Forest bee honey	ton	351	277	108	na	na
Shellac	ton	89	143	92	na	na
Cinamon bark	ton	1520	1450	1080	1901	2100
Anise flower	ton	1500	1310	1305	4323	2500
Big bamboos	million stems	135.2	121.9	133.2	128.7	132.7
Slender bamboos	million stems	179	155.7	177.1	149.5	147.9

Note: na = not available

Other floral and faunal forest resources, precious and rare species have also decreased noticeably. During the Vietnam War the number of elephants, tigers, panthers and other animals was still abundant, but today, the quantity of these animals has severely decreased. Precious timber species such as the four "Iron woods" namely *Erythrophloeum fordii, Markhamia stipulata, Madhuca pasquieri* and *Vatica* spp. as well as some others like *Dalbergia bariensis, Sindora tonkinensis, Aquilaria crassna* etc. can still be found in very limited areas.

The Red Book of Vietnam, Volume 2: Plants (MOSTE, 1996) lists 356 species of which 231 species belong to *Magnoliopsida* Class (Dicotyledones) of *Magnoliophyta*, 74 species of *Liliopsida* (Monocotyledones) and 27 species of *Pinophyta* (Gymnospermae). In order to avoid the cutting of threatened tree species, the Vietnamese Government issued Decree No. 32/2006/ND-CP on 30 March 2006 (replacing the old one issued 10 years ago) which provides for two additional important lists. The list IA includes the names of 15 forest plant species (and species groups such as *Anoectochilus* spp. and *Paphiopedilum* spp.) which must not be exploited and the list IIA includes the names of 37 forest plant species (and species groups such as Cycads, *Asarum* spp., *Stephania* spp., *Nervilia* spp.) of which the amount of exploitation from natural forest must be limited (Table 5 and 6).

Table 5. ***The list IA, the species which must not be exploited***

	Species name		Species name
1	*Cupressus torulosa*	9	*Berberis wallichiana*
2	*Taiwania cryptomerioides*	10	*Diospyros salletii*
3	*Xanthocyparis vietnamensis*	11	*Dalbergia tonkinensis*
4	*Abies fansipanensis*	12	*Coptis chinensis*
5	*Pinus kwangtungensis*	13	*Coptis quinquesecta*
6	*Taxus wallichiana*	14	*Anoectochilus* spp.
7	*Glyptostrobus pensilis*	15	*Paphiopedilum* spp.
8	*Berberis julianae*		

Table 6. ***The list IIA, the species for which exploitation is limited***

	Species name		Species name
1	*Cephalotaxus mannii*	*20*	*Codonopsis javanica*
2	*Calocedrus macrolepis*	21	*Garcinia fagraeoides*
3	*Calocedrus rupestris*	22	*Dalbergia cochinchinensis*
4	*Fokienia hodginsii*	23	*Dalbergia oliveri*
5	*Keteleeria evelyniana*	24	*Pterocarpus macrocarpus*
6	*Pinus dalatensis*	25	*Cinnamomum balansae*
7	*Pinus krempfii*	26	*Cinnamomum glaucescens*
8	*Taxus chinensis*	27	*Cinnamomum parthenoxylon*
9	*Cunninghamia konishii*	28	*Coscinium fenestratum*
10	*Cycas* spp.	29	*Fibraurea tinctoria*
11	*Panax bipinnatifidum*	30	*Stephania* spp.
12	*Panax stipulenatus*	31	*Thalictrum filiolosum*
13	*Panax vietnamensis*	32	*Excentrodendron tonkinensis*
14	*Asarum* spp.	33	*Disporopsis longifolia*
15	*Markhamia stipulata*	34	*Lilium brownii*
16	*Afzelia xylocarpa*	35	*Poligonatum kingianum*
17	*Erythrophloeum fordii*	36	*Dendrobium nobile*
18	*Sindora siamensis*	37	*Nervillia* spp.
19	*Sindora tonkinensis*		

PART B
IMPLEMENTING OF FOREST RESTORATION/REHABILITATION

1. History of Restoration/Rehabilitation

1.1 *Paul Maurand's Trials in 1920s with Native Tree Species in South Vietnam*

In the 1920s, the French forester Paul Maurand undertook attempts in the Trang Bom Silvicultural Experimental Station (Dong Nai province, Southern Vietnam) to introduce *Dipterocarpus alatus* and *Hopea odorata* from natural forests into forest plantations, by testing the following three approaches (Nguyen Hoang Nghia, 2003):

- *Single-tree plantation with a density of up to 20,000 trees/ha:* Close spacing of planted trees in this method proved to be a disadvantage, leading to heavy competition among the trees. The necessary thinning operations were hardly carried out on a larger scale;

- *Line planting in disturbed natural forests (1931):* The trees grew poorly because of competition by natural forest trees and insufficient light. Thus, line planting could only be applied for shade-tolerant species with regular silvicultural treatments aiming at widening the planting lines to suppress competing vegetation.

- *Planting with support tree species such as Indigofera teysmanii and Senna siamea (Cassia siamea):* The role of these species was to rapidly cover bare soil, inhibit weed invasion, provide shade for trees in the first years as well as create a mixed forest and gradually wither when target trees reached maturity. *Indigofera teysmanii* coppicing was very strong and they could be cut annually, creating favorable conditions for the growth of dipterocarp trees while the soil was still covered and weed suppressed.

Later on, dipterocarp species and some other native tree species were planted as trial plantings for many years in single-tree plantations (*Manglietia conifera, Styrax tonkinensis, Cinnamomum cassia, Illicium verum, Aquilaria crassna, Chukrasia tabularis*) or under canopy of support trees such as *Acacia auriculiformis, A. mangium, Leucaena leucocephala,* or mixed with other tree species such as *Anacardium occidentale*, coffee, or used as enrichment planting species in degraded natural forest (*Michelia mediocris, Erythrophloeum fordii*).

1.2 *Other Planting Experiments in Vietnam with Native Species*

Several trial plantings in Southeastern Vietnam were established using commercial dipterocarp species, especially those of the moist tropical forests such as *Dipterocarpus dyeri, D. alatus, Hopea odorata, Anisoptera costata, Shorea roxburghii*. These species are adapted to the regions with an annual rainfall over 1800 mm, mean temperatures of between 23° and 24° C, and with a rainy season starting in April or May coinciding with the fruit ripening season. The above-mentioned species grow naturally on yellowish or reddish yellow feralit soils on meca-schist, basalt, old or new riparian alluvial soils. The soil layer is still thick with good moisture retention capacity in the dry season. *D. alatus* and *A. costata* prefer light soil texture. *Hopea odorata* grown in single tree plantations shows more drought and water-logging tolerance than *D.alatus*.

Researchers of the Forest Science Sub-Institute of Vietnam (Vu Xuan De, 1985) recommend site-species matching for dipterocarps as follows:

- Riparian old and new greyish alluvial soils: *D. alatus, Hopea odorata, A. costata*;
- Yellowish or reddish yellow feralit soil on mica-schist: *D. dyeri, Shorea guiso, D. alatus, Hopea odorata, A. costata*;
- Shalow basalt tuff soil: *Hopea odorata*, selected leguminous species; *and*
- Black basalt soil (Binh Duong, Binh Phuoc provinces): *D. costatus, Hopea odorata*.

The results of planting dipterocarp species in South Vietnam are shown in Annex 1 (Nguyen Hoang Nghia, 2003). Various trials combined mixed species planting with agricultural crops and shade trees, leading to some growth limitation which, however, could be overcome. In the earlier years *Hopea odorata* and *D. alatus* planted with coffee showed very good growth performance, but as they have a large crown and give much shade, local people usually pruned off all twigs hindering the trees to further develop. In the option of planting dipterocarps with *A. auriculiformis*, it was found that by early thinning and cutting of the acacias, the growth of *Hopea odorata* and *D. alatus* was rather good. On the contrary, if thinning or pruning of acacias was not done, the growth of dipterocarps was very poor, a clear disadvantage for stand management.

A typical example of a *D. alatus* plantation without support trees has been established in Duong Minh Chau (Tay Ninh province, Southern Vietnam, in 1984. Ten years later the trees grew very well and the plantation was recognized as seed stand.

The forest plantation in Xuan Son (Ba Ria – Vung Tau province, Southern Vietnam) is also considered a fine model for *Hopea odorata* planting. 20 years after planting both diameter and height increments were rather satisfactory, 1.4 cm/yr and about 1 m/yr respectively.

Three main systems for plantation establishment have been used in Southern Vietnam and include:

- Single-tree planting with or without agricultural crops (coffee, cashew nut),
- Mixed planting with or without agricultural crops, *and*
- Planting with support tree species (*A. auriculiformis*).

Planting density varied considerably from 200 trees/ha to 5000 trees/ha depending on the planting system. The results obtained are summarized as follows:

- In general, trees planted at high density (> 1600 trees/ha) usually showed average or poor results while in low density plantings tree growth was much better.
- *Hopea odorata* and *D. alatus* plantations at densities 416 trees/ha (*Hopea odorata*) and 312 trees/ha (*D. alatus* mixed with agricultural crops), respectively, grew well 15 years after planting. Mean annual increments for height and diameter were about 0.78-0.95 m/yr and 1.10-1.92 cm/yr, respectively for *Hopea odorata* and 1.13 m/yr and 1.63 cm/yr for *D. alatus*. The height growth of *Hopea odorata* is poorer than that of *D. alatus*. Growth performance in general is encouraging.
- As regards *Hopea odorata* and *D. alatus* plantations with *A. auriculiformis* as support species, a problem to be resolved arises from the need of cutting acacia trees on time. Where acacia trees were cut, the increment of *Hopea odorata* and *D. alatus* plantations remained high while the increment was poor where acacias were maintained. Therefore thinning and cutting at the right time of acacias or other support trees proved to be a technically compulsory requirement.
- *Hopea odorata* and *D. alatus* mixed planted with *Anacardium occidentale* and coffee attained a rather good growth rate in the early stage (e.g. planted in the years from 1991 to 2001) but in older trials the growth rate declined considerably due to many reasons, such as prunning at various intensities, sometimes rather heavy so that successful dipterocarp plantations could not be established.

In the last 50 years, two main enrichment planting systems in degraded forest were tested and widely used as described below:

1) *Line planting:*

Usually, trees are planted along narrow lines of 2 - 3 m width. Since tending operations were not applied or not done appropriately on time, natural vegetation started to compete for light with the planted commercial trees. The failure was not because of inappropriate techniques but of inappropriate management. Some important lessons learned from these trials are as follows:

- *Silvicultural treatments:* Tall, unhealthy trees along the planting lines should be thinned or pruned to give more light to the main species planted. Physiological studies showed that most of the tropical tree species from natural forest require light shading in the first 2 – 3 years, but after that they cannot tolerate shading. Most of the tall, mature trees belonging to the upper canopy layers require full sunlight for their satisfactory growth.

- *Width of line:* Usually not less than 2 m and not more than 5 m in order to keep species diversity and keep enough space for the planted species to grow.

- *Spacing between lines:* Generally, lines should be 10 m apart; within each line, tree spacing should be about 3 x 3 m. This will result at mature age in about 150-170 stems per hectare of main commercial species.

- Seedling size for planting: Should be of big size (up to 1 m high or more), so that in the first years young trees will not be affected by surrounding trees and climbers.

- Tending: Should be applied in the first 3 years and includes climber cutting on main trees or removal of surrounding trees that give too much shade.

2) Strip planting:

This system should be used in agroforestry projects. Planting strips must not be more than 30 m wide while the width of area untouched between strips should not be more than 20 m wide. Other species can be planted together with the main species to provide shade, but they should be eliminated in time to provide for enough space for good growth performance of the main species.

2. Forest Rehabilitation Status

After many years of forest development, the forest plantation area of Vietnam has exceeded 2.3 million ha with both exotic and indigenous tree species. Statistical data on the plantation area by species was found only before 2000 (Vietnam Government, 2001), for 5 exotic and 28 native species or species group including bamboos and palms.

Table 7. ***Area of forest plantation of exotic and native tree species by December 1999 (Vietnam Government, 2001)***

Species	Area (ha)	Remarks
Eucalyptus spp.	348,001	On the national scale
Acacia spp.	228,073	On the national scale
Casuarina equisetifolia Forst.	43,884	On the national scale
Tectona grandis L.	11,583	On the national scale
Khaya senegalensis L.	4,777	On the national scale
Dipterocarp plantation	26,924	On the national scale
Pure Dipterocarp plantation	16,064	On the national scale
Mixed Dipterocarp plantation	10,860	On the national scale
Dipterocarpus alatus Roxb.	4,908.8	Southeastern Vietnam
Hopea odorata Roxb.	9,651.3	Southeastern Vietnam
Shorea roxburghii G.Don	140	Southeastern Vietnam
Pinus spp.	218,056	On the national scale
Melaleuca cajuputi Powell	114,837	On the national scale
Rhizophora apiculata Blume	80,216	On the national scale
Bamboos	73,852	On the national scale
Styrax tonkinensis Craib. ex Hardw.	64,734	On the national scale
Manglietia conifera Dandy	50,023	On the national scale
Cinnamomum cassia Presl	27,270	On the national scale
Illicium verum Hook.f.	18,085	On the national scale
Cunninghamia lanceolata Hook.	13,866	On the national scale
Senna siamea Irwin & Barneby	10,163	On the national scale
Chukrasia tabularis A.Juss	9,044	On the national scale
Vernicia (Aleurites) spp.	9,146	On the national scale
Melia azedarach L.	8,354	On the national scale
Palms	7,766	On the national scale
Bruguiera spp.	5,156	On the national scale
Avicennia spp.	5,107	On the national scale
Sonneratia spp.	4,700	On the national scale
Canarium album Raeusch.	2,502	On the national scale
Afzelia xylocarpa Craib.	2,467	On the national scale
Tarrietia javanica Blume	972	On the national scale
Camellia sasanqua Thunb.	645	On the national scale
Fokienia hodginsii Henry & Thomas	335	On the national scale
Erythrophloeum fordii Oliv.	309	On the national scale
Castanopsis spp.	307	On the national scale
Liquidambar formosana Hance	92	On the national scale

2.1 *Selection of Species for Forest Rehabilitation*

In Vietnam, forest managers and producers are allowed to use any species, including native and exotic ones for forest rehabilitation. However, the selection of species will depend on many factors such as the objective of the planting, rotation, site conditions, financial and technological situation etc. Some important criteria for the selection are listed below (Nguyen Hoang Nghia, 2002; 2004):

- Site and climatic conditions;
- Objectives of forest rehabilitation (e.g. timber production fodder, fire wood, conservation etc.);
- Type of benefits for local people, private sector;
- Market conditions for intended products;
- Availability of seed and propagation techniques; *and*
- Availability of planting and tending technology.

For success of forest rehabilitation, planters must answer the following questions:

- *Why:* objectives of planting
- *Where:* where to be planted; where to process and sell forest products
- *Which species*: based on species/site matching
- *When*: select suitable time for planting and harvesting
- *What technique*: select suitable technique for planting, harvesting, processing
- *Who*: who will plant, process, sell and consume the products.

After planting, the species selected should be re-evaluated according to key criteria whether or not they can meet the requirements. If they cannot meet local people's requirements, they will not be widely accepted.

2.2 *Silvicultural Problems*

Many native tree species have been planted successfully on a large scale, in home gardens or in farm forests by farmers and enterprises. Among a hundred species suggested for forest rehabilitation, only some dozen species have technical guidelines for planting such as *Manglietia conifera, Styrax tonkinensis, Tectona grandis, Pinus merkusii, P. kesiya, Eucalypts, Acacias, Casuarina equisetifolia*. Based on large scale planting, only 31 species have been evaluated and concluded for wide-scale planting (Do Dinh Sam and Nguyen Hoang Nghia, 2003). There are some silvicultural problems relating directly to the success of plantings as follows:

- Some species proved to be successful such as *Manglietia conifera*, but they require better soil for growth, so that planting scale is limited, therefore they could not be planted on poor soils and in single-tree plantations.

- Some other species such as *Styrax tonkinensis*, have high productivity in the first rotation. Because of reduced productivity in subsequent rotations, they require suitable silvicultural interventions to maintain soil fertility and increase productivity.

- Some native species such as *Canarium album, Chukrasia tabularis* and *Toona surenii*, have been attacked by insects in the first years causing significant problems for the planters. If these problems could be overcome, growth is expected to be satisfactory.

- Some species were successful when planted in home gardens, but failed when planted on a large scale such as *Artocarpus heterophyllus* and *Cleidiocarpon* spp.

- Some native species having long rotations ranging between 50 and 100 years, such as *Erythrophloeum fordii* or *Chukrasia tabularis*. Since research has not yet covered the entire rotation the results in terms of technical guidelines for planting, tending, thinning and exploitation can only serve as orientational guidelines.

- Most of the native tree species require moderate shading in the first years after planting. Therefore, they have been planted under support trees. However, at a later stage they require much light for their growth so that it will be necessary to remove the support trees in time.

Table 8. ***Criteria for selection of tree species for forest rehabilitation (Nguyen Hoang Nghia, 2002; 2004)***

Criteria	Exotics in general	Native species	1	2	3	4	5	6
Growth rate	Fast	Slow	Average	Average	Fast	Fast	Slow	Fast
Wood quality	Average	Variable	Average	Average	Average	Low	Average	Average
Stem form	Straight	Variable	Average	Straight	Straight	Straight	Straight	Straight
Seed quantity	Large	Variable	Small	Large	Large	Large	Large	Large
Seed periodicity	2-3 years	3-4 years	3-4	3-4		3-4	2-3	1-2
Storage ability	Easy	Difficult	Difficult	Difficult		Difficult	Easy	Easy
Improvement	Much work	Not much	Not yet	Yes	Yes	Yes	Yes	Yes
Adaptability	High	Average	Average	Average	High	Low	High	High
Rotation	Short	Long	Long	Average	Short	Short	Average	Short

Table 8. ***Continued***

Soil requirement	Low	High	Average	Average	Average	Average	Low	Average
Pests and diseases	High	Low	Low	Average	Average	Average	Average	Low
Economic value	High	High	High	Average	High	High	Average	High
NTFP value	Average	High	Low	High	High	High	High	Average
Environment value	Low	High	Average	High	Average	Average	High	High
Cultural value	Low	High	Average	High	High	High	High	High
Market	High	High	High	High	High	Average	Average	Average

Note: (1) *Chukrasia tabularis*; (2) *Canarium album*; (3) *Dendrocalamus barbatus* (bamboo); (4) *Cinnamomum cassia*; (5) *Pinus merkussii*; (6) *Melaleuca cajuputi*.

Table 9. ***Evaluation of successful and unsuccessful species according to key criteria (Nguyen Hoang Nghia, 2002; 2004)***

Criteria	**Successful species**			**Unsuccessful species**		
	3	**6**	**4**	**1**	**2**	**5**
Growth rate	Fast	Fast	Fast	Fast	Slow	Slow
Soil requirement	Not high	Not high	Average	Not high	Average	High
Adaptability	Good	Good	Good	Good	Good	Low
Rotation	Short	Short	Short	Average	Short	Long
Economic value	High	High	High	Not high	Not high	Average/ high
NTFP value	Very high	Average	High	Low	Low	Average/ high
Market	High	Average/high	Average/high	No market	Low	High
Seed supply	Easy	Easy	Easy	Easy	Easy	Easy
Planting technique	Available	Available	Available	Available	Available	Available

Note: (1) *Vernicia fordii*; (2) *Camellia sasanqua*; (3) *Dendrocalamus barbatus* (bamboo); (4) *Cinnamomum cassia*; (5) *Artocarpus heterophyllus*; (6) *Melaleuca cajuputi*.

Table 10. ***List of main species planted in the production forest in the 9 ecological regions of Vietnam (Department of Forestry, MARD, 2005b)***

	Name of species	Forest ecological regions								
		1	2	3	4	5	6	7	8	9
1	*Acacia auriculiformis* A.Cunn.	+	+	+	+	+	+	+	+	+
2	*A.crassicarpa* Cunn. Ex Benth.					+	+		+	
3	*A. mangium* Wild.	+	+	+	+	+	+	+	+	+
4	*A.mangium* x *A.auriculiformis*	+	+	+		+	+	+	+	
5	*Aquilaria crassna* Pierre	+				+	+	+	+	+
6	*Bambusa oldhami* Keng.f.		+		+					+
7	*Bombax malabarica* DC.				+					
8	*Calamus tetradactylus* Hance				+					
9	*Canarium album* Raeusch.	+	+	+						
10	*Casuarina equisetifolia* Forst.				+	+	+			
11	*Cedrela odorata L.*				+				+	
12	*Ceiba pentandra* (L.) Gaertn	+					+		+	
13	*Chukrasia tabularis* A.Juss	+			+	+				
14	*Cinnamomum cassia* Presl.		+			+	+			
15	*Cunninghamia lanceolata* Lamb.		+	+						
16	*Dendrocalamus barbatus* Hsueh-Li	+	+			+				
17	*Dipterocarpus alatus* Roxb.						+	+	+	
18	*Eucalyptus camaldulensis* Denhn.						+		+	+
19	*E. tereticornis* Sm				+	+	+			+
20	*E. urophylla* S.T.Blake	+	+	+	+	+		+		
21	*E.urophylla* x *E.camaldulensis*	+	+	+	+	+				
22	*Hopea odorata* Roxb.						+	+	+	
23	*Ilex kaushue* S.Y.Hu			+						
24	*Illicium verum* Hook.f.			+						
25	*Khaya senegalensis* A.Juss				+			+	+	+
26	*Litsea glutinosa* Roxb.							+		
27	*Lithocarpus fissus* Champ. Ex Ben.			+		+				
28	*Manglietia conifera* Dandy		+	+						
29	*Melaleuca cajuputi* Powell									+
30	*Melaleuca leucadendra* L.									+
31	*Melia azedarch* L.	+	+		+		+	+	+	
32	*Michelia mediocris* Dandy							+		
33	*Neolamarckia cadamba* Booser								+	+
34	*Phyllostachys edulis* H. de Leh			+						
35	*Pinus caribaea* Morelet					+	+	+	+	
36	*Pinus kesiya* Royle ex Gordon							+		
37	*Pinus massoniana* Lamb.			+						
38	*Pinus merkusii* Jungh. et de Vries					+				
39	*Rhizophora apiculata* Blume									+
40	*Sophora japonica* L.				+					
41	*Styrax tonkinensis* Craib ex Hardw		+							
42	*Tarrietia javanica* Blume					+				
43	*Tectona grandis* L.	+						+	+	
44	*Toona sinensis* A.Juss			+						
45	*Toona surenii* Blume								+	
46	*Vernicia montana* Lour.	+								
		13	13	15	14	16	14	14	16	10

Note: (1) Northwestern region,
(2) Central part of North Vietnam,
(3) Northeastern region,
(4) Red river delta,
(5) North of Central Vietnam,
(6) South of Central Vietnam,
(7) Western Highland,
(8) Southeastern Vietnam *and*
(9) Southwestern Vietnam.

2.3 *Challenges in Using Native Species for Forest Rehabilitation*

Using native species for forest rehabilitation is an imperative demand in Vietnam. However, this policy has many challenges as detailed below (Nguyen Hoang Nghia, 2002):

- *Scientific knowledge:* Foresters in the country do not yet have all the necessary knowledge and deep understanding of the functioning of the forest ecosystem, and the unique characteristics of indigenous species such as soil, climate, nutrition and light requirements in different growth periods, relationships between species within multi-species associations; potential for natural regeneration and adaptability; phenology and seed supply potential, techniques for sowing, planting and tending. Most of the native species are long-lived and have not been domesticated, thus lacking much research. Because they have only been planted on a small-scale the establishment of large scale plantations of native species should be considered.

- *Awareness:* Frequently forest managers would like to establish large-scale plantations with native species, but for investors, rotations of 50 or 100 years are too long. This is rooted in the fact that potential investors cannot obtain long-term loans from banks at low interest rates making plantations with high risk due to pests and diseases or harsh climate unattractive. Producers tend to invest into species with short rotations of 5 to 7 years, in order to obtain returns quickly. There are also still limited incentives to promote people's investment into tree planting.

- *Technology:* Indigenous species are adapted to the natural environment in terms of soil and climate and coexist with other species in a more or less stable forest plant association. We cannot bring indigenous species from a moist forest environment to barren hills and denuded lands or to large-scale monoculture tree plantations. For many reasons such as long lifespan, less knowledge on species, incomplete techniques for propagation and stand management, the establishment of large-scale plantations of native species is not an easy task. More financial support for research on native species must be made available.

- *Socio-economic aspects:* It is well established that forest rehabilitation with native species, more often than not, is implemented in remote mountain areas with harsh living conditions for poor local communities. Major constraints are related to a lack of sufficient external investments in these remote areas, difficult access through roads and attitudinal barriers preventing local people to accept new technologies.

Wood processing facilities and markets are also important factors which can affect the forest rehabilitation parctice in Vietnam. Given these constraints usually local people do not have the resources for forest rehabilitation.

3. Success Stories

3.1 *Reforestation Success with Dendrocalamus*

Dendrocalamus barbatus Munro (previously called *D. membranaceus*) is a very famous bamboo species in Vietnam that can be found naturally in the Thanh Hoa province in the Northern part of Central Vietnam. At present, this bamboo species is widely planted in some provinces in Northern Vietnam and covers some 80,000 ha (FAO, 2005). People call this bamboo "the forest species for the poor" because young shoots and stems can be exploited early, only 3 years after planting, therefore poor people can get income very early. Bamboo can be planted as monoculture plantation or in patches or belts along the foot hills.

This bamboo species was traditionally planted by rhizome. However, transportation of a million rhizomes from one province to another is very difficult, and therefore this bamboo could not be widely planted throughout Vietnam. An important contribution to this success is that the Forest Science Institute of Vietnam developed an efficient method to mass propagate planting material by air-layering of branches rather than using rhizomes. This method is very simple and easy to apply, so that local people themselves can mass-propagate bamboo by using air-layered branches for planting and selling to different provinces. This propagation method is considered as a starting point for large-scale planting of *Dendrocalamus barbatus* Munro in Northern Vietnam.

3.2 *Enrichment Success with Michelia*

Among 31 forest tree species listed in a book edited by Do Dinh Sam and Nguyen Hoang Nghia (2003) on evaluation of indigenous species in forest rehabilitation in Vietnam, *Michelia mediocris* Dandy showed promising results after 20 years. *Michelia mediocris* Dandy is a tree species found in natural forests and was tested in trial plantings in wide bands or strips within a matrix of residual vegetation.

In 1980 in Nghe An province, *Michelia mediocris* was planted employing the following spacings:

- *Line planting:* 5 m wide lines, left-over strip is 10 m wide;
- *Improved line planting:* 5 m wide lines, trees with height over 5 m in left-over strips were cut;
- *Strip planting:* 20 m wide strip, left-over strip is 10 m wide.

The growth performance of *Michelia mediocris* in the two planting trials is summarised in Tables 11 and 12.

Table 11. ***Growth of Michelia mediocris in Nghe An province (Sam and Nghia, 2003)***

Planting system	Planted in 1980, measured in 2000			
	$D_{1.3}$ (cm)	H (m)	V/ha (m^3)	Survival (%)
Line planting	24.3	17.5	121.7	65
Improved line	25.3	18.1	136.5	63
Strip planting	22.1	15.7	90.33	62
Mixed with *Chukrasia*	23.1	16.2	119.3	61

Table 12: ***Growth of Michelia mediocris in Kon Ha Nung (Gia Lai province) (Sam and Nghia, 2003)***

Year of planting	Planting strip/left-over strip (m)	Measured in 2000			
		Number of stems	$D_{1.3}$ (cm)	H (m)	Survival (%)
1982	5/10	330	14.6	15.7	65
1982	10/10	350	16.2	17.3	62
1985	5/10	330	12.4	14.3	60
1989	5/10	330	7.8	9.2	
1993	5/10	330	4.8	5.6	75

4. Forest Germplasm Supply

Germplasm is of importance in planting programmes including production forest, protection forest, special-use forest and scattered tree planting. In order to carry out effectively the “5 Million Hectare Reforestation Programme” (5MHRP), Vietnam’s major forest rehabilitation initiative until 2010, several national germplasm programmes have been proposed and developed to ensure a regular supply of high quality germplasm. The programme aims at increasing the diversity of germplasm and at eliminating those with unknown origin, thus increasing the future commercial productivity of forests.

According to the detailed plans of the 5MHRP, in the period from 1999 to 2000 on average 300,000 ha were planted annually, 368,000 ha in the period 2001 to 2005, and 470,000 ha are planted in the period from 2006 to 2010. If 1,000 seedlings are planted on one hectare plus additional seedlings in scattered tree plantings, there will be the need to produce billions of seedlings in the nurseries. A large-scale and efficient nursery system must be established on the national scale in order to supply seedlings for key planting areas and for farm forests.

One of preconditions for the 5MHRP to be successful is the management and supply of sufficient and high quality germplasm. This is a heavy task including planning of germplasm production areas (i.e., seed stands, seed orchards), collection, storage, pre-processing, transportation, supply, and production of seedlings.

Estimates showed that seeds collected from seed production areas satisfy only 15-20% of the actual demand for seedlings. The remaining supply is collected from natural forests or scattered

trees of unknown and uncontrolled provenance. As a consequence there are low germination and survival rates. This will – in the long run – lead to low quality and productivity of plantation forests.

Many years ago there was little understanding for proper seed production and management and thus germplasm activities were not given appropriate attention. Some seed production areas were not properly maintained because of little demand for seed. Increasing demand for seed of some species could not be satisfied because of the lack of seed production areas. Meanwhile for some of the other species thousands of hectares of seed production areas have been established, exceeding the demand for seed by far.

One of the earlier shortcomings in germplasm activities in many localities was that local forerst managers were not familiar with the exact requirements for the establishment of germplasm and seed production areas. Generally, the seed production areas were not different from commercial forests in terms of financial investment and techniques applied. In some areas, seed of unknown origin collected by local people were purchased at low prices. At present, the Central Forest Seed Company (CFSC) has established 73 ha of clonal seed orchards, 906 ha of seedling seed orchards and 1,200 ha of seed production areas. Since 1994, areas for seed production have been maintained for some of the main commercial tree species, i.e., 1,000 ha for *Pinus kesiya*, 400 ha for *Pinus merkusii*, and 160 ha for *Tectona grandis*. However, the proportion of these trees species compared to total forest plantation establishment is not very high. Therefore, these seed production areas thus far did not play a major role in the country's planting programmes.

Apart from seed production areas that have been planned by the central government, some provinces have been assigned the task to undertake the seed production for some of the species. However, these projects have many shortcomings. For *Pinus merkusii*, for example, the demand for seedlings has not been very high, but the provinces have established too large an area for seed production, thus exceeding the demand for planting material in their respective provinces. Since other provices did the same, the excess in seed supply cannot be sold in other provinces. Moreover, the objective defined for *Pinus merkusii* is on resin production but the existing seed production areas did not focus on trees with increasing resin yield.

Using rooted-cuttings of high productivity of *Eucalyptus* clones and *Acacia* hybrid clones in planting forests is a favourable measure which brings remarkable results. Many producers in Vietnam have shifted from seed supply to rooted-cuttings supply. They established nurseries to produce rooted-cuttings and applied the advanced technology for mass production. This technology is very popular throughout the whole country.

In order to improve the situation of seed supply the Minister for Forestry in 1993 has issued a Directive No. 08 on germplasm in order to establish seed production areas (according to Decision No. 327). Many germplasm projects have been approved and carried out and have brought initial results. Awareness on germplasm has increased. Germplasm supply is not restricted to seed, seed production areas and seed orchards, but has expanded to new concepts such as establishment of production units for cutting techniques, production of hybrids and tissue culture techniques. Besides the focus on germplasm production for planting new forests, localities also focus on gene resources conservation areas to promote rare and valuable species. However, species with high conservation potential have not yet been planted on a large scale.

5. Species/Provenance Trial, Tree Breeding and Propagation

Before 1975, about 20 *Acacia* and 50 *Eucalyptus* species have been imported into Vietnam and planted in some locations. However, these plantings were not designed and managed for species trials. Since 1970s, complete sets of seedlots have been imported and many organisations established species and provenance trials for *Eucalyptus* (120 provenances of 15 main *Eucalyptus* spp.), *Acacia* spp. (70 provenances of 5 lowland species; 15 provenances of 10 dry-zone species; and 20 provenances of 20 highland species), *Casuarina* (international provenance trial), *Pinus caribaea* (10 provenances of 3 varieties: var. *hondurensis, bahamensis* and *caribaea*), *Azedirachta indica* (international provenance trial), and *Melia* spp. (international provenance trial).

Provenance trials for indigenous tree species have not been established on a larger scale in Vietnam, but some work was started with *Pinus merkusii, Pinus massoniana, Pinus kesiya , Manglietia conifera, Styrax tonkinensis* and *Chukrasia tabularis*. Breeding activities for indigenous species are still restricted to *Pinus merkusii* (for resin yield), *Pinus massoniana, Pinus kesiya* and *Manglietia* (for growth performance). At the same time, many other important species have not been tested in tree improvement programmes and trials.

In the past, germplasm supply had to rely on natural forests, newly established seed production areas and seed orchards. At present, very effective technologies include cutting propagation and a new advanced technique in tissue culture. The latter technique has been employed in Vietnam for species such as *Eucalyptus, Acacia, Casuarina* (mainly for cutting and partly for tissue culture). Many species have been successfully propagated by the cutting technique and include *Camellia sasanqua, Calocedrus macrolepis, Fokienia hodginsii, Dacrydium elatum, Cinnamomum balansae, Podocarpus imbricatus, Rhodoleia championii, Taxus chinensis, Taxus wallichiana*.

6. Current Policies Governing Land Use and Restoration/Rehabilitation

Over the past 15 years several major national forest sector policies have been elaborated and implemented. These include amongst others the Tropical Forest Action Plan (1991), the Law for Forest Protection and Development (issued in 1991 and revised in 2004), the Forestry Development Strategy (2001-2010), the Five Million Hectare Reforestation Programme, 1998-2010, and the National Forestry Strategy (2006 -2020).

In early 1990, Vietnam's forest sector evaluation started with the development of the Tropical Forest Action Plan which was completed in 1991. In this process, Vietnamese and overseas experts worked together on an analysis and evaluation of the forestry conditions and elaborated guidelines for future forestry development in the country. Many important decisions were made to promote decentralization of managment, participation of local people in forest management, institutional changes, public awareness on environmental protection, and initiatives to enhance the livelihood of people living in or in the vicinity of forests. The forest sector stepped into a transition process from "centralized forestry" to "social forestry". This period was very important for the Forestry Sector. While clearly recognising the degradation of natural forests the Government tried to act on both policy and practice in order to effectively address the problem. More funding coupled with more appropriate policy pursued by the government provided a good basis for forestry development.

The legal system also evolved rapidly. The Law on Forest Protection and Development (issued in 1991 and revised in 2004) and the Land Law (issued in 1993 and revised in 2003) allowed land

allocation to farmers, households and organizations for long-term utilization within the framework of the forestry development goals.

During the late 1990s, the Ministry of Agriculture and Rural Development with the help of forestry experts formulated a Forestry Development Strategy, for the period 2001 - 2010. This strategy was issued in 2001 (Ministry of Agriculture and Rural Development, 2001) providing the following objectives of forestry development until 2010 (Table 13):

Table 13: ***Main area targets for forestry development during 2001-2010 (Ministry of Agriculture and Rural Development, 2001)***

Targets	2001 - 2005	2006 - 2010
The national forest cover	39%	43%
Protection forest	5.4 million ha	6.0 million ha
Special use forest	1.6 million ha	2.0 million ha
Production forest	6.2 million ha	8.0 million ha

Another programme called “Programme 327” was started in 1992 by the Decision No. 327/CT and approved by the Prime Minister. This was the first attempt by the Government to mobilize nationwide efforts towards forest protection and development. This program concentrated on rehabilitation of special-use and protection forests with financial support from the Government.

Within the programme contracts were signed with farmers to protect forests and compensating them with 50,000 VND per ha per year for 5 years. For the establishment of the plantation, the programme supported 1,500,000 VND per ha for the first year and another 500,000 VND per ha for the second year as well as 50,000 VND per ha for protection (1 USD equals approximately 16,000 VND). Besides the obligation to establish at least 40% long-lived native species in protection forests, this programme also allowed to plant 60% other species such as fast growing species (*Acacia mangium, A. auriculiformis*) as well as fruit and industrial species either in plantations or agroforestry systems.

The Five Million Hectare Reforestation Programme (5MHRP) was approved by the National Assembly in 1997, followed by the Government Decision No. 661/QD-TTg in 1998 to guide the objectives, tasks, policy and implementation of the programme for the period from 1998 to 2010 (Department of Forestry, MARD, 2005).

The main objectives of this programme include

- To establish 5 million ha of forest to obtain a national forest cover of 43% aiming to ensure environmental security, reduce natural disasters (droughts, floods), and protect biodiversity;

- To use barren hills and denuded land for reforestation so as to create jobs, reduce poverty, settle agricultural cultivation and increase income for local people living in remote mountain areas; *and*

- To supply forest products, especially timber for the wood industry, for both domestic consumption and export in order to increase the forest sector contribution to the country’s economic development.

The five million ha forests to be established will be divided as follows:

- Special-use forest and protection forest: a total of 2 million ha as follows:
    - One million ha by natural regeneration and enrichment planting;
    - One million ha by newly established plantation in sensitive areas such as riverbasin, coastal areas, and steep slopes.
- Production forest: a total of 3 million ha as follows:
    - Two million ha planted with industrial tree species such as acacias, pines, eucalypts, bamboos and other valuable commercial species;
    - One million ha with industrial crops such as rubber, tea and fruit trees.

The Programme will be implemented through projects with participation of local people, so that local people will be the main actors for protecting the forests, promoting natural regeneration and tree planting. Local people will also be the main beneficiaries of the forestry activities.

Similarly to the Programme 327, the 5MHRP also applied 50,000 VND per ha and year for forest protection activities. However, it was recognized that this amount is too low and should be doubled in future. Financial support for the establishment of plantations in the 5MHRP was much higher than in the Programme 327.

After 5 years of implementing the 5MHRP, the Ministry of Agriculture and Rural Development requested experts to formulate a new strategy, called “National Forestry Strategy, 2006 - 2020”, with a longer vision and more effective approaches (Ministry of Agriculture and Rural Development, 2006). Although the formulating process has not been completed the preliminary targets have been identified as presented in Table 14.

Table 14: ***Orientation for forest land planning (million ha) (Ministry of Agriculture and Rural Development, 2006)***

Forest land categories	2004	2010	2020
Total forest area	16.2	16.2	16.2
1. National forest area	12.3	14.0	14.3
a. Protection forest	5.9	5.7	5.7
b. Special-use forest	1.9	2.3	2.3
c. Production forest	4.5	6.0	6.3
2. Forest area for other production purposes	-	-	1.9
3. Forest land without forest	3.9	2.2	0
Forest cover	**36.7%**	**43%**	**43%**

The development of a national nature conservation strategy is important to Vietnam’s Government and will contribute considerably to the conservation of biodiversity as well as of genetic resources in Vietnam. Forest rehabilitation is also carried out as part of the nature conservation strategy particularly in areas where forests have been destroyed before the forest was reserved for conserva-

tion. The areas with conservation function as well as future conservation targets are presented in Table 15.

Table 15. ***Present national nature conservation areas (Government of Vietnam, 2003)***

Category	Number	Area
I. National Park	**27**	**957.330 ha**
II. Nature Conservation Reserve	**60**	**1.369.058 ha**
II.a. Nature Reserve	49	1.283.209 ha
II.b. Species/habitat reserves	11	85.849 ha
III. Landscape reserve	**39**	**215.287 ha**
Total	**126**	**2.541.675 ha**

Table 16: ***Government target for National Nature Conservation Areas (Vietnam Government, 2003)***

Category	Number
I. National Park	32
II. Nature Conservation Reserve	52
III. Species/habitat Reserve	28
IV. Landscape Reserve	21
Total	**133**

7. Forest Restoration/Rehabilitation Initiatives

7.1 *Programme 327 (1993 - 1997)*

From 1993 to 1998, the Vietnam Government invested 2,987 billion VND or 185 million USD into Programme 327. Major achievements include (MARD, 1998):

- Signed contracts with farmers to protect 1.6 million ha of forests,
- 1,368,618 ha forest rehabilitated, of which 638,500 ha were newly established plantations and 748,118 ha by natural regeneration
- Industrial and fruit tree planting was 119.939 ha including 19,744 ha rubber; 7,588 ha tea; 28,186 ha other industrial crops; 26,733 ha fruit trees and 31,223 ha home gardens.
- Animal husbandry: 53,025 animals.
- Resettlement to project areas: 92,420 households.
- Infrastructure: 5000 km road, construction of 86,405 m^2 building sites for schools, hospitals.

7.2 *Five Million Hectare Reforestation Programme*

After 7 years of implementation of the 5MHRP, the Government organized a meeting to discuss the results obtained in the programme and to provide a guide for the next five years of work as shown in Table 17.

Table 17. ***Results of the 5MHRP during 1998-2005 (Department of Forestry, MARD, 2005a)***

Task	Objective to 2010	Objective to 2005	Result during 1998-2005	Compared to 2005 objective	Compared to 2010
1. Contract to forest protection	2,000,000 ha	2,000,000 ha	2,263,361 ha	113%	113%
2. Special-use & protection forest	2,000,000 ha				
2.1 Natural regeneration	1,000,000 ha	1,000,000 ha	723,450 ha	72%	72%
2.2 New planting	1,000,000 ha	610,000 ha	631,317 ha	103%	63%
3. Plantation	3,000,000 ha	2,000,000 ha	1,401,667 ha	70%	47%
3.1 Production forest	2,000,000 ha	1,390,000 ha	683,369 ha	49%	34%
3.2 Industrial crops	1,000,000 ha		86,954 ha		9%

From the above-mentioned achievements it can be seen that forest protection and management activities have obtained good results. Thus, the annual destroyed forest area could significantly be reduced, and the livelihood of local people living in or around the forests could be improved. However, the amount of 50,000 VND per ha and year for forest protection was too low and was not an attractive incentive for local people.

The funding provided by the Central and Provincial Governments was sufficient to reach the plantation targets for the special-use and protection forests. However, the area established as commercial plantations remained very small. The reason for this is that the funding for planting production forests was to come entirely from the private sector. Obviously, for private sector companies it was too risky to invest their own resources or taking commercial bank loans.

8. Assessment of Existing Capacities of Stakeholders' Involvement

Since 1987 the Government is implementing the so-called "renovation policy" aiming at the transition from a centralized economy to a market economy. This policy is based on the following fundamental principles (Nguyen Van San and Don Gilmour, 2000):

- Appreciate private sector contributions to the country's economy;
- Accept and highly appreciate household economy;
- Promote investment by the private sector and from overseas;
- Eliminate most of the subsidies for State's enterprises;
- Allow farmers to decide about production and marketing, *and*
- Keep prices close to market levels.

Based on the above-mentioned policies, various stakeholders including the private sector are able to participate actively in forest protection and development. Also local people play a central role in the implementation of the Programme 327 and the 5MHRP as well as in many other programmes for reducing poverty such as the Programme 135, and the Programme for settled farming.

PART C
FUTURE ACTIONS FOR ENHANCING RESTORATION/REHABILITATION

1. Improving/Revising Policies

1.1 *State Forest Enterprises (SFEs)*

The State Forest Enterprises (SFEs) have played an important role in forest rehabilitation in Vietnam. SFEs are state management organizations that operate at three levels: the central, provincial and district level. In the early 1990s there were 413 SFEs of which 138 SFEs operated at district levels, 199 at the provincial level and 76 at the central level. They managed more than 6 million ha of forests.

According to the new guidelines (Prime Minister Decision 187/1999/QD-TTg issued in September 1999, and Political Bureau Resolution 28-NQ/TW issued in June 2003), SFEs should be reformed into the following four organizational types:

- Forest service enterprises;
- Forest exploitation and processing enterprises;
- Forest industry enterprises; *and*
- Environmental protection enterprises.

In 2002, there were still 241 SFEs that had logging permits, but only 107 had forests where they could log between 1000-2000 m^3 per year. Some 90 SFEs have been able to invest in plantations using their own resources. At the same time at least 120 SFEs depend entirely on Government funding to stay operational (Wil de Jong, D.D.Sam and T.V.Hung, 2006).

1.2 *Benefit Sharing*

According to the new policies, local people (i.e. individuals and households) have the right to a forestland allocation for 50 years. Under this arrangement a farmer signs a contract for forest protection and receives support of 50,000 VND per year. He is also allowed to harvest some forest products and thus obtains additional benefits from the allocated forest (Decision 178). At present, the implementation of Decision 178 is under consideration with the aim to increase the benefits for local people.

2. Building Research and Education Capacities

2.1 *Forestry Research Strategy, 2006 – 2020*

During the last two years the Forest Science Insitute of Vietnam collaborated with other institutions and experts to formulate a new research strategy for the period 2006 to 2020. This strategy provides guidelines for research directions as well as capacity building. The final draft of the strategy was submitted to the Ministry of Agriculture and Rural Development for approval and includes the following 7 research fields (Forest Science Institute of Vietnam, 2006):

Forecast, Planning, Monitoring and Evaluation

- Forecast the trends in forest development in each period (demand, market, supply capacity),
- Base for determination of the national forest area and three forest types,
- Macro land-use planning, selection of priority region for development,
- Criteria for evaluating and monitoring forestry sector development,
- Role of forestry sector in poverty reduction and its contribution to the country's economy.

Policy and Institutional Issues in Forestry

- Lessons learnt from practice: policy and project implementation,
- Land allocation, credit loan and environmental services,
- Benefit sharing suitable for three forest types,
- Policy for multi-component development,
- Forest valuation: legal base and practice,
- Forestry management system of State.

Sustainable Forest Management

- Types for management and development: households, management boards, SFEs, joint management, management of community forests;
- C&I for sustainable management: natural forest and plantation.

Environment and Biodiversity

- Role of forest and water regime,
- Valuation of forests for environment and landscape,
- Determination of baseline standards for forest environment,
- Management of natural disasters, risks, environment,
- Biodiversity in natural forest and increasing biodiversity in plantations,
- Conservation and use of wildlife and rare, valuable plants,
- Methods for evaluating environments which support biodiversity conservation,
- Urban forestry development.

Silviculture

- *Natural forest*
    - Characteristics of main natural forest ecosystems and value of main animal and plant species,
    - Silvicultural technical systems to increase the quality of degraded natural forest towards intensive cultivation,
    - Sustainable harvesting techniques and forest rehabilitation after harvest.
- *Plantation*
    - Scientific base for determining main economic species for each ecological region,
    - Tree improvement for main planting tree species (productivity and resistance),
    - Intensive cultivation of economic plantation (small and sawn logs),

- Integrated measures combining planting and natural regeneration for some special ecosystems (mangrove, dry deciduous dipterocarp forest),
- Measures for pests, diseases and fire management and control.

- *NTFPs*
  - Evaluating NTFP resources,
  - Sustainable exploitation and development of NTFPs at household and farm level,
  - Planting, processing and storage of valuable and potential NTFPs.

Wood Utilization and Forest Products Processing and Preservation

- Evaluating market and development trends,
- Evaluating development potentiality of timber and NTFP sources. Diversifying use of material sources,
- Potential of forest products processing at small and average scale; improvement of techniques for product processing,
- Research on new goods for domestic and export market. Standardization of processed products,
- Measures for enhancing competiveness of processed products (by scientific, institutional management measures or marketing).

Collaborating Research, Education and Extension

- Evaluating effectiveness of research, education, training and extension,
- Measures to increase quality of research, education and extension.

2.2 *New Policies on Research*

The Government Decree No.115/ND-CP issued in September 2005 allows R&D institutions to finance their operations through governmental research grants and science and technology businesses. The Government will provide more funding through research projects based on competitive bidding and R&D institutions will have more autonomy on institutional, financial and personnel matters.

3. Reconciling Global and National Policies

The Government of Vietnam gives high priority to forest rehabilitation. This is demonstrated by the many policies formulated over the past 20 years (Table 18).

Table 18. ***National policies affecting forest rehabilitation in Vietnam***

YEAR	NATIONAL POLICY
1984	National Nature Conservation Strategy
1991	Tropical Forest Action Plan
1991 and 2004	Law for Forest Protection and Development
1993 and 2003	Land Law
1995	Biodiversity Action Plan
1992	Programme 327 (1993-1997)
1998	Five Million Ha Reforestation Programme (5MHRP)
1994	Government's Decree 02/CP on the mechanisms of forestland allocation to organizations, households and individuals
1995	Government's Decree 01/CP on the allocation through contract for the purpose of agriculture, forestry and aquaculture.
2001	Decision 178 about Rights and Duties of households and individuals with forest allocation (Benefit Sharing)
2007	Biodiversity Law (in preparation)

The Government Decree 02/CP provides the opportunity for local farmers to obtain extensive rights over forest land which include rights to exchange, transfer, lease, mortgage and inherit. The duration of these rights is 50 years. This forest land allocation policy is based on the realization that forest land must have an owner in order to promote sustainable forest management.

The Government Decree 01/CP allows individuals, households and household groups to sign a contract for the management and protection of forest. This is a very good way for local people to participate actively in forest protection because they also have some limited rights to harvest forest products.

For many years Vietnam has invested considerable amounts of funds in forest rehabilitation, especially since the 1990s. The national investments have been complemented with important international support (Wil de Jong, D.D.Sam and T.V.Hung, 2006). Proof for the commitment of the Vietnam Government is the amount invested into the 5MHRP over the last years. According to the Forestry Department (MARD, 2003) between 1998 and 2003, a total amount of 3,848 billion VND (about USD 256 million) was allocated to this programme. State budget funds accounted for 63.5%; loans for 24%; donors for 6% and self-finance by the private sector for 4.3% (Table 19). This means that the Government contributed the largest part to the implementation of the 5MHRP (mainly for special-use forest and protection forest). The second largest investment could be mobilized through loans, mainly invested in production forests.

Table 19. ***Investments from Government and other sources for the 5MHRP***

Origin of funds	Amount (million VND)	USD Equivalent (million USD)
State budget	2,443,970	163
Credit loans	920,664	61
Overseas funds	279.558	15
Self-finance of enterprises	164,913	11
Other sources	87,250	6
Total invested funds	**3,848,355**	**256**

PART D
MISCELLANEOUS

1. Regional Collaboration

During the 1990s, through the FAO's Programme "Forest Research Support Programme for Asia and the Pacific" (FORSPA), FSIV was involved in a regional forest rehabilitation network. With financial support from FORSPA, forest rehabilitation experiments have been established in Kon Ha Nung station (Gia Lai province, Western highland).

In three years from 2001-2003, the Japanese International Cooperation Agency (JICA) supported FSIV in establishing some trials relating to forest enrichment planting as well as publishing a book titled "Use of Native Tree Species in Reforestation in Vietnam" (Do Dinh Sam and Nguyen Hoang Nghia, 2003). The book includes 31 tree species which were used in many trial plantings in Vietnam showing promising results.

During 2003-2005, FSIV was the main collaborator of the ASEAN-Korea Environmental Co-operation Project (AKECOP) titled "Restoration of Degraded Forest Ecosystem in Southeast Asian Tropical Regions" in Vietnam. The support included trial plantings in some areas, organising meetings and a Master training programme.

Currently, the FSIV carries out a 5-year project with the title "Rehabilitation of Natural Forest in Degraded Watershed Area in the North of Vietnam" (RENFODA, 2003 - 2008) supported by JICA. The project site is in the watershed area of Hoa Binh Dam (Hoa Binh province, North Vietnam), where measures for natural forest rehabilitation are being tested.

2. Pests and Diseases, Exotics

During the 1980s, only one promising provenance of *E. camaldulensis* (Petford) was imported for large-scale planting in Vietnam. In the late 1980s and early 1990s, the disease called "die back" occured on extensive areas in Southeastern Vietnam and caused serious damage for eucalypt plantations in that region. The disease is caused by several fungi of which the most common one is *Cylindrocladium quinquestatum*) as presented in Table 20.

Table 20. ***Fungi investation of eucalypts in Vietnam***

Name of pathogens	***Eucalyptus* species**
Ralstonia solanacearum (Yabuuchi & al. 1995) Smith	*E. urophylla*
Cryptosporiopsis eucalypti Sankaran & B. Sutton	*E. camaldulensis* *E. urophylla*
Phaeophleospora destructans (M.J. Wingf. & Crous) Crou, Ferreira & Sutton	*E. urophylla*
Phaeophleospora epicocoides (Cooke & Massee) Walker, Sutton & Pascoe	*E. camaldulensis, E. exerta,* *E. urophylla*
Mycosphaerella marksii Carnegie & Keane	*E. camaldulensis*
Pestalotiopsis sp	*E. camaldulensis*
Coniella australiensis Petr.	*E. camaldulensis*
Coniella fragariae (Oudemans) B. Sutton	*E. camaldulensis*
Cylindrocladium quinqueseptatum Boediji & Reisma	*E. camaldulensis*
Aulographina eucalypti (Cooke & Massee) Arx & Mull	*E. camaldulensis*
Cryphonectria cubensis (Bruner) Hodges	*E. urophylla*
Cryphonectria gyrosa (Berk & Br.) Sacc.	*E. camaldulensis*
Coniothyrium zuluence M.J. Winf., Crous & Coutinho	*E. camaldulensis*

Some plantations of *Acacia* species (*A. mangium*, *A. auriculiformis* and acacia hybrids) were also attacked by some fungi, of which the most serious one is *Corticium salmonicolor*. *Pinus merkusii* (a native pine species) plantations are prone to serious attacks by *Dendrolimus punctatus* (leaf eaters) at 2-3 years' intervals. Pine trees will not die but their growth and resin production is reduced considerably.

3. Invasive Species

Mimosa pigra is an especially dangerous invasive plant species in Vietnam. The species has its origin in tropical America and invaded into Vietnam in the middle of 20th Century, first along the rivers in Southwestern Vietnam, then to the big lakes of Southeastern Vietnam and to North Vietnam. The species has caused big problems for natural water environments in national parks in South Vietnam where important native and migrant birds could not find food (freshwater fishes) for their living. *Mimosa pigra* can regenerate very easily and quickly and in the absence of effective control measures the species will cover thousands of hectares in nature reserves.

REFERENCES

Department of Forestry, MARD, 2005a. Five million ha reforestation programme. Hanoi, 2005, 154 pp.

Department of Forestry, MARD, 2005b. List of main planting species for production forest in 9 forest ecological regions of Vietnam. Hanoi, 2005, 68p.

Do Dinh Sam and Nguyen Hoang Nghia, 2003. Use of indigenous tree species in reforestation in Vietnam. Agricultural Publishing House, Hanoi, 188pp.

FAO, 2005. Helping forests take cover (compiled by David Lamb). RAP Publication 2005/13. Bangkok 2005, 21pp.

Forest Science Institute of Vietnam, 2006. National Forest Research Strategy. Hanoi, 2006, 40pp.

Lecomte, H., 1907 – 1958. Flore Generale l'Indo-Chine. Paris.

Luong Van Tien, 1992. Forest special products of our country. Forest Scientific, Technical and Economic Information, Ministry of Forestry, No.4, 1992, 3 – 6.

MARD, 1998. Report on technical evaluation of program 327 implementation. Hanoi, October 1998.

MARD, 2001. Forestry Development Strategy, 2001 - 2010.

MARD, 2004. Decision No. 1281/QD/BNN-KL dated May 17, 2004 on statistics of forest area in 2003.

MARD, 2005. Decision No. 1116/QD/BNN-KL dated May 18, 2005 on statistics of forest area in 2004.

MARD, 2006a. Decision No. 1970/QD/BNN-KL dated July 7, 2006 on statistics of forest area in 2005.

MARD, 2006b. National Forestry Strategy, period 2006 – 2020. (Draft No.4).

MOSTE, 1996. The Red Book of Vietnam, Volume 2. Plants. Science and Technics Publishing House, Hanoi, 1996, 484 pp.

Nguyen Hoang Nghia 2002. Planting native tree species in Vietnam: Obstacles, changes and potentiality. Journal of Agriculture and Rural Development, Special No., 2002, 28 – 30.

Nguyen Hoang Nghia 2003. Dipterocarp species in Vietnam. In: H. Aminah, S.Ani, H.C.Sim and B.Krishnapillay (eds), “Proceedings of the Seventh Roundtable Conference on Dipterocarps, 7-10 October 2002, Kuala Lumpur, Malaysia”. APAFRI, Kuala Lumpur, Malaysia 2003, 73-79.

Nguyen Hoang Nghia, 2004. Science and Technology for Farm Forest. Journal of Agriculture and Rural Development, No.2/2004, 247 - 249.

Nguyen Nghia Thin, 1997. Manual on Biodiversity. Agricultural Publishing House, Hanoi, 224 pp.

Nguyen Van San and Don Gilmour, 2000. Policy and practice of forest rehabilitation in Vietnam. In: Policy and practice of forest rehabilitation in Vietnam, IUCN-GTZ-DFD-WWF. 4 – 34.

Vietnam Government, 2001. Decision No. 03/2001/QD-Ttg dated January 5, 2001 on statistics of forest area by December 1999.

Vietnam Government, 2003. Strategy for Management of Nature Reserve System in Vietnam. Hanoi, 2003.

Vu Xuan De, 1985. Some preliminary research results for planting dipterocarps in Southeast Vietnam. Forest Scientific and Technical Information, Forest Research Sub-Institute of South Vietnam, 1985, 1-4.

Wil de Jong, D.D.Sam and T.V.Hung, 2006. Forest rehabilitation in Vietnam: History, realities and future (final draft).

World Bank, 1995. Vietnam: Environmental program and policy priorities for a socialist economy in transition. Document of the World Bank. Report No. 13200-VN.

ANNEX 1

Increment of some indigenous dipterocarps planted in Southern Vietnam in mixture with different forest and industrial tree species (*Khaya senegalensis*, *Acacia auriculiformis*, *Tectona grandis*, Cashew, Coffee) (Nguyen Hoang Nghia, 2003)

Location	Species	Planted in	Density	D (cm)	H (m)	D cm/n	H m/n
Xuan Loc	*D.alatus* + coffee	1984	280	30.20	17.34	1.78	1.02
Thong Nhat	*H.odorata*	1981	1660	16.27	13.57	0.85	0.71
	H.odorata + cashew	1986	416	6.62	6.26	0.47	0.32
	H.odorata	1982	2500	14.55	16.46	0.81	0.91
Long Thanh	*H.odorata* + acacia	1985	5000	7.46	6.69	0.49	0.46
	H.odorata + acacia	1985	416	19.67	10.72	1.31	0.72
	H.odorata + cashew	1984	416	17.04	11.31	1.06	0.71
	H.odorata	1985	416	16.55	11.68	1.10	0.78
La Nga	*H.odorata*	1987	416	21.91	12.47	1.68	0.95
	H.odorata	1987	416	24.96	12.29	1.92	0.94
	D.alatus + coffee	1993	280	20.40	12.60	2.55	1.57
	D.alatus	1983	312	29.76	20.38	1.63	1.13
	D.alatus + cashew	1993	185	19.83	16.60	2.48	2.08
Ma Da	*H.odorata* + acacia	1982	416	11.7	8.23	0.65	0.45
	H.odorata + acacia	1984	416	6.88	6.26	0.43	0.39
	D.alatus + cashew	1985	416	5.94	3.67	0.37	0.24
Hieu Liem	*D.alatus* + acacia	1986	416	8.58	6.43	0.61	0.45
	D.alatus + cashew	1995	300	5.02	4.47	1.00	0.95
Tan Phu	*H.odorata*	1984	1160	15.72	14.58	0.98	0.91
	H.odorata + teak	1981	416	21.24	14.21	1.12	0.75
SFE 600	*H.odorata* + cashew	1991	200	12.22	7.43	1.36	0.82
	H.odorata + cashew	1993	200	8.99	6.73	1.28	0.96
	H.odorata + cashew	1996	200	4.43	2.69	1.11	0.67

Table continued

Tan Uyen	*H.odorata* + acacia	1982	416	24.17	11.34	1.34	0.63
	H.odorata + acacia	1984	416	17.23	9.57	1.07	0.60
	H.odorata + acacia	1984	416	13.73	8.28	0.86	0.52
Phu Binh	*D.alatus* + *Khaya*	1999	416	2.47	1.95	1.23	0.98
	D.alatus + *Khaya*	1998	416	4.42	2.96	1.47	0.98
	Khaya + *D.alatus*	1999	416	5.84	3.62	2.92	1.81
Binh Long	*H.odorata* + acacia	1994	416	4.12	3.39	0.69	0.56
	H.odorata + acacia	1995	416	4.05	2.86	0.81	0.57
Bu Dang	*D.alatus* + cashew	1995	625	5.01	3.68	0.83	0.61
Nghia Trung	*D.alatus* + acacia	1990	550	13.35	10.73	1.21	0.97
	D.alatus + cashew	1996	550	6.45	4.52	1.29	0.90
	D.alatus + cashew	1996	400	8.26	5.45	1.65	1.09
Thong Nhat	*D.alatus* + cashew	1985	370	11.54	7.0	1.92	1.16
	D.alatus	1990	416	14.5	9.43	1.32	0.86
Dong Xoai	H.odorata	1982	1250	25.80	18.46	1.35	0.97
Minh Duc	*D.alatus* + *Khaya*	1995	250	15.73	6.56	2.62	1.09
Loc Ninh	*D.alatus* + acacia	1990	416	14.66	8.43	1.33	0.77
Duong Minh Chau	*H.odorata* + acacia	1998	416	4.49	2.93	1.49	0.97
	H.odorata + cashew	1995	200	9.36	3.0	1.56	0.50
	D.alatus	1984	416	22.37	13.49	1.32	0.79
	D.alatus + acacia	1993	500	6.24	4.58	0.78	0.57
	D.alatus + acacia	1993	200	14.08	6.58	1.76	0.82
Tan Bien	*D.alatus*	1984	1000	17.24	13.38	1.01	0.79
	D.alatus	1988	1000	15.25	10.69	1.17	0.82
	D.alatus + acacia	1994	500	7.95	5.14	1.14	0.73
Dau Tieng	*Khaya* + *H.odorata*	1997	416	11.48	6.28	2.87	1.57
Chau Duc	*H.odorata* + acacia	1981	500	24.82	20.54	1.30	1.08
	H.odorata + acacia	1982	500	25.07	16.82	1.39	0.93
Xuyen Moc	*H.odorata* + cashew	1982	2500	14.74	15.77	0.82	0.88
	H.odorata	1982	1100	18.69	17.27	1.04	0.96
	H.odorata	1983	2200	19.28	19.12	1.13	1.12
	D.alatus + cashew	1987	550	20.14	12.06	1.44	1.50
	D.alatus	1987	1100	19.93	11.67	1.42	0.83
Tanh Linh	*Shorea* + cashew	1988	312	13.06	7.71	1.00	0.59
	H.odorata + cashew	1984	416	14.46	7.2	0.9	0.454
Ham Thuan Bac	*H.odorata* + *acacia*	1996	416	3.36	2.19	0.84	0.54
	H.odorata in lines	1994	250	9.16	6.77	1.53	1.13

Dong Nai province: Ma Da, Hieu Liem, SFE 600, Tan Phu, Xuan Loc, Long Thanh, Thong Nhat and La Nga Forest Enterprise.
Binh Duong: Tan Uyen, Phu Binh.
Binh Phuoc: Binh Long, Bu Dang, Nghia Trung, Dong Xoai, Minh Duc, Loc Ninh.
Tay Ninh: Duong Minh Chau, Tan Bien, Dau Tieng.
Binh Thuan: Tanh Linh, Ham Thuan Bac.
Ba Ria - Vung Tau: Xuyen Moc, Chau Duc.