Restoration of degraded forest ecosystems in Southeast Asia

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Background

Problem analysis

The geophysical and climatic conditions of the Association of Southeast Asian Nations (ASEAN) region have allowed a rich endowment of natural resources. The judicious use of these resources would contribute to the continued well-being of its people. ASEAN member countries are committed to achieving the Millennium Development Goals (MDGs). Although it is the responsibility of national governments to take proper action to address and manage environment and associated problems such as poverty and health, regional collaborative partnerships such as the ASEAN-Korea Environmental Cooperation Project (AKECOP) could effectively provide synergistic benefits in addressing common problems on environmental issues to improve the quality of life in the region as well as in the rest of the world.

Total forest cover in the ASEAN Countries in 2005 was 203 million hectares which is 45 percent of the region's total land area (FAO 2006). ASEAN's forests are important not only for their rich biological diversity but for their economic value in timber and non-wood forest products as well. In many ASEAN countries, however, resources in terrestrial and coastal ecosystems are under increasing stress due to the growing population and the extension of agricultural lands into forest and other ecologically sensitive areas. In 1990, about 55 percent of the land area of the region was still covered by forests but this decreased to only 45 percent in 2005. The average annual rate of deforestation in the region from 2000 to 2005 was 2.75 million hectares or 1.35 percent, compared to the world average of 0.2 percent.

Mangrove forests are found in all ASEAN member countries except for Lao PDR and play important ecological functions by preventing coastal erosion and saltwater intrusion; they also support economically important fisheries by providing habitats and food for the conservation of biological diversity. Despite the socio-economic and ecological importance of mangroves, it was only in the last several decades that concern for them began to emerge and their sustainability was widely discussed. However, mangrove forests in many ASEAN member countries have decreased and some species are in danger of extinction due to coastal development.

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Justification

ASEAN countries continue to cope with the challenge of balancing environmental concerns with the imperatives of development. Successful management of the forest environment in the ASEAN region depends heavily on the capacity of concerned countries to tackle various complex problems on policy, economy, institutional capacity, technology and human resources associated with forest management. Thus, one key component for the sustainable management of the forest environment is to strengthen the human and/or institutional capacity of forest ecosystem management in ASEAN member countries.

The project Restoration of Degraded Forest Ecosystems in the Southeast Asian Tropical Region was a flagship ASEAN project supported by the Republic of Korea (ROK). AKECOP accumulated significant knowledge and sufficient experience through its cordial and firm partnership among key ASEAN and ROK forest research organizations during Phase 1 (1 July 2000 to 30 June 2005), Phase 2 (1 July 2005 to 30 June 2008) and will continue to do so in Phase 3 (1 July 2008 to 30 June 2011). Its research findings have led to an effective and efficient restoration of degraded tropical forests in ASEAN member countries.

Project goals and strategies

AKECOP's main goal is to enhance the capacity of member countries in the ASEAN region in managing their forest ecosystems in a sustainable manner for an improved regional and global environment. AKECOP has implemented appropriate activities related to sustainable forest ecosystems, which are intended to:

- Enhance the capacities of ASEAN member countries, institutions and people to manage existing and emerging issues on sustainable forest ecosystems in terrestrial and coastal environments.
- Produce high impact knowledge, information and technology and generate lessons that could improve sustainable management policy, extension and practices.
- Enrich biodiversity and restore forest ecosystems.
- Alleviate the poverty of community forests, thus leading to food security.

To maximize the impact of the project, the following strategies and tactics have been adopted in formulating and implementing details of the activities. Figure 1 provides a schematic diagram of project strategies and goals.

Strategy 1: A multisectoral, multidisciplinary and holistic approach for national programmes on sustainable forest management with special emphasis on people's well-being

Tactic 1 Critical and strategic assessment of national programmes on sustainable forest management to extract lessons and establish guidelines for future programmes. This process identifies gaps in information, technology and policies that help in formulating improved national programme activities.

Tactic 2 Conduct multisectoral forums involving policy-makers, administrators, scientists, academics, NGOs, the private sector and forest dwellers to address and discuss key national issues on sustainable forest management.

Tactic 3 Publication of a state-of-the-art review report on the assessment of national programmes on sustainable forest management and the proceedings of multisectoral forums on related issues.

Tactic 4 Development of general guidelines for policy and practice in sustainable forest landscape restoration.

Tactic 5 Participatory planning and evaluation of supplementary research project activities. This has been done by holding consultative visits and onsite review and evaluation of projects by multisectoral committee members.

Strategy 2: Enhancement of national capacity in dealing with existing and emerging issues on sustainable forest ecosystem management

Tactic 1 Conduct complementary research and development activities in model forests to best strengthen the ongoing high priority national project. These R&D activities will fill information, technology and policy gaps in national programmes. They could also include *ex-post* analysis on the sustainability of national programmes.

Tactic 2 Conduct common research on regional concern such as the valuation of mangrove forests using a uniform research methodology.

Tactic 3 Provide short-term training on major or priority topics and graduate study including research grants for theses in respective countries.

Tactic 4 Organize conferences or workshops to enhance the technical communication and research management skills of the participating countries.

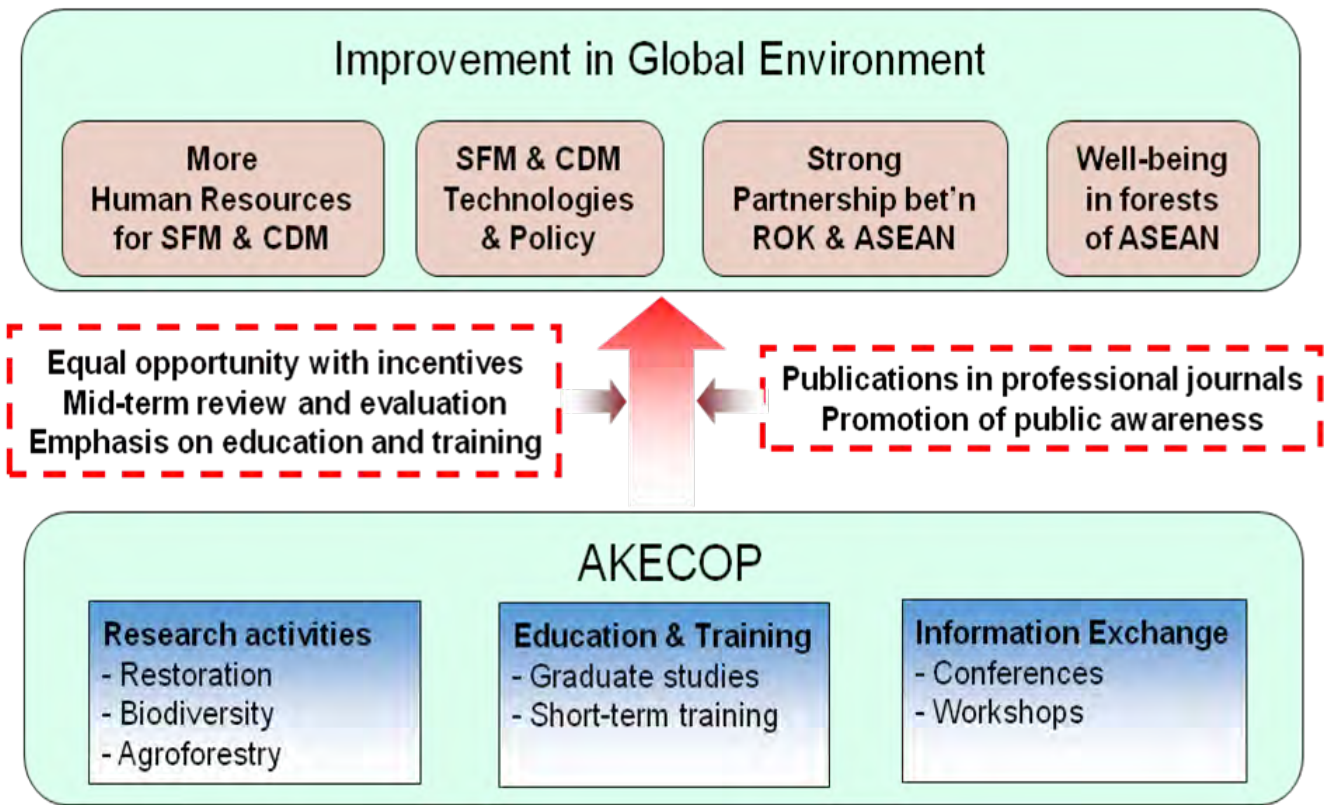

Figure 1. Schematic diagram of project goals and strategies

Main achievements of the AKECOP project

Selected countries with an adequate infrastructure and technical capacity carry out regional research on relevant issues, which complement national programmes of high priority. *Ex-post* research in model forests where national programmes have been conducted in the past is preferred. The onsite field research is carried out by ROK scientists in the Philippines. Research results and findings from the basic and applied research are utilized for ecological restoration of degraded forests, sustainable forest management and agroforestry techniques in needed areas as well as for formulating policies and extension activities.

The education and training component of the project consists of short-term training activities and graduate study for master or doctoral degrees in forestry or other related fields in ROK and some leading ASEAN forestry institutions. The short-term training programme provides hands-on experience, practical information and skills necessary for the immediate needs of individual research and development organizations. Advanced techniques and new areas of science and technology are introduced using modern equipment and facilities at the National Instrumentation Center for Environmental Management (NICEM) and other research institutes in ROK. A total of 152 applicants from 9 countries have participated in the short-term training. Research grants for master or doctoral theses are expected to be available in some countries. Nineteen graduate students (5 doctoral and 13 masters) have already finished or are pursuing their degrees. The yearly financial support for graduate study includes stipends, tuition fees and research support.

The project organizes conferences or workshops to provide a forum for interaction among participating scientists. Two conferences (90 participants from 12 countries) and five workshops (216 participants from 10 countries) have been held. They allowed participating researchers to improve specific research skills and to share knowledge on tropical forests through exchange of experiences and field visits. The meetings were organized by the ASEAN-Korea Environmental Cooperation Unit (AKECU) in close collaboration with the participating institutions in ASEAN member countries. The workshops dealt with specific issues related to tropical forests in order to introduce new concepts and to share in-depth knowledge on specific fields of science.

Assisted natural regeneration in the AKECOP project

In 1989, the concept of assisted natural regeneration (ANR) was formally instituted through the Department of Environment and Natural Resources of the Philippines (DENR). As a part of AKECOP projects, ANR has been conducted in the Mt. Makiling Forest Reserve of Los Baños and the La Mesa Dam Watershed of Rizal in the Philippines in 2004 and 2005 (AKECU 2005). The focus of ANR is restricted to rehabilitation of grasslands, brushlands, scrublands, or barren areas because potentially different management interventions are called for in these areas as opposed to rehabilitation of degraded forest areas. Bringing back forests on grasslands, brushlands, scrublands, or barren areas could be important in helping to reduce degradation pressures on existing forests. Usually, the reasons for failure in reforestation efforts are legion, ranging from the technical to the social. Poor species-site matching, inadequate maintenance, corruption and social conflict are just some of the major reasons. As ANR is based on natural resources, it can present an attractive alternative to conventional reforestation techniques. However, at present, there is still no evaluation of the success or failure of ANR in the limited area where it has been tried. Therefore, further efforts for appropriate evaluations of ANR should be conducted as part of future AKECOP activities.

Expected outputs

AKECOP as a catalyst for attaining sustainable forest management in the region has become prominent and relevant. Being a regional collaborative partnership, it has supported ASEAN member countries in generating scientific knowledge, sharing information and experiences and enhancing human and institutional capacity during Phase 1 and Phase 2.

The major research and development activities of the project will focus on a critical and strategic assessment of national programmes on sustainable forest management in the past and present in order to extract lessons and identify gaps in information, technology and policies for forest restoration in ASEAN member countries. This will produce a state-of-the-art national report on forest restoration in ASEAN member countries, and will serve as a basis for formulating improved and effective mid- and long-term national plans. The project will establish and operate a viable multisectoral forum

on forest consisting of key policy-makers and administrators, researchers, NGOs and local community leaders of forest dwellers to address jointly key national issues on the sustainable management of forest. The project will also conduct complementary research in model forests that will fill technical gaps as well as serve as a venue for extension and training activities. Regional research on mangrove forests in coastal environments will be conducted using a uniform research format. The project will also continue various forms of training activities related to human resource development.

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The rehabilitation of degraded tropical forest based on secondary succession

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Forest condition and rehabilitation of degraded land

The two major factors that have induced decreasing and degraded forest area are forest harvesting and land-use changes. Commercial and large-scale illegal logging as well as human-induced fire hazards have also seriously threatened forest conditions. Forest degradation and decrease of forest area impact negatively on cultural aspects, ecological services and socio-economic conditions (Kobayashi 2007). Degraded and decreasing forest areas need to be rehabilitated to recover lost benefits. Natural secondary succession processes provide important information for the application of techniques to rehabilitate degraded tropical forests. The influence and role of vegetation types on secondary succession in the contexts of facilitation or competition processes have been described by Holmgren *et al.* (1997) and Li and Wilson (1998); Callaway and Walker (1997) reported on their interaction.

This study aims to clarify the initial phase of vegetation recovery through facilitation or competition processes for secondary succession and to discuss the final rehabilitation outputs.

Survey locations and methods

Species composition and the biomass of undergrowth plant populations were examined in relation to logging intensity, land form and soil conditions at one and several months after forest harvesting, fire events, enrichment planting and mixed planting. Surveys were carried out in mixed dipterocarp forest in Samarinda, East Kalimantan, Indonesia; mixed dipterocarp forest in Pasoh, Malaysia**;** mixed deciduous forest in Maeklong, Thailand**;** peat swamp forest in Belait, Brunei Darussalam; abandoned pasture in Pucallpa, Peru; subtropical moist forest in Misiones, Argentina; and a teak plantation in Thom Pha Phun, Thailand. Fixed quadrates were set ranging from 2x2 metres to 10x10 metres and vegetation changes were monitored using the methods of Braun-Blanquet (1964).

The secondary succession process

The study examined the initial phases of vegetation recovery 2 and 14 months after gap and line planting in mixed dipterocarp forest in Pasoh, Malaysia (Figure 1).

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Species composition of the undergrowth was measured using quadrats of 2x2 metres at 5 quadrats/hectare. Dominance and height were measured using the Braun-Blanquet method. Intensive forest clearing for enrichment significantly affected vegetation recovery at the initial phase. Vegetation types were classified into grasses and ferns, *Melastoma*-dominated woody shrubs and *Dipterocarpacea* during the initial phase, based on species composition and dominance value. Grasses and ferns were associated with the competition process because they had the smallest species number without tree species. Vegetation suppressed in the competition process will require rehabilitation treatment (enrichment and planting). *Dipterocarpacea* belonged to the facilitation process because of their high species number and considerable recruitment of woody shrubs and *Dipterocarpacea*. Under the facilitation process, vegetation is expected to follow its natural course of secondary succession but may sometimes need treatment to accelerate natural regeneration.

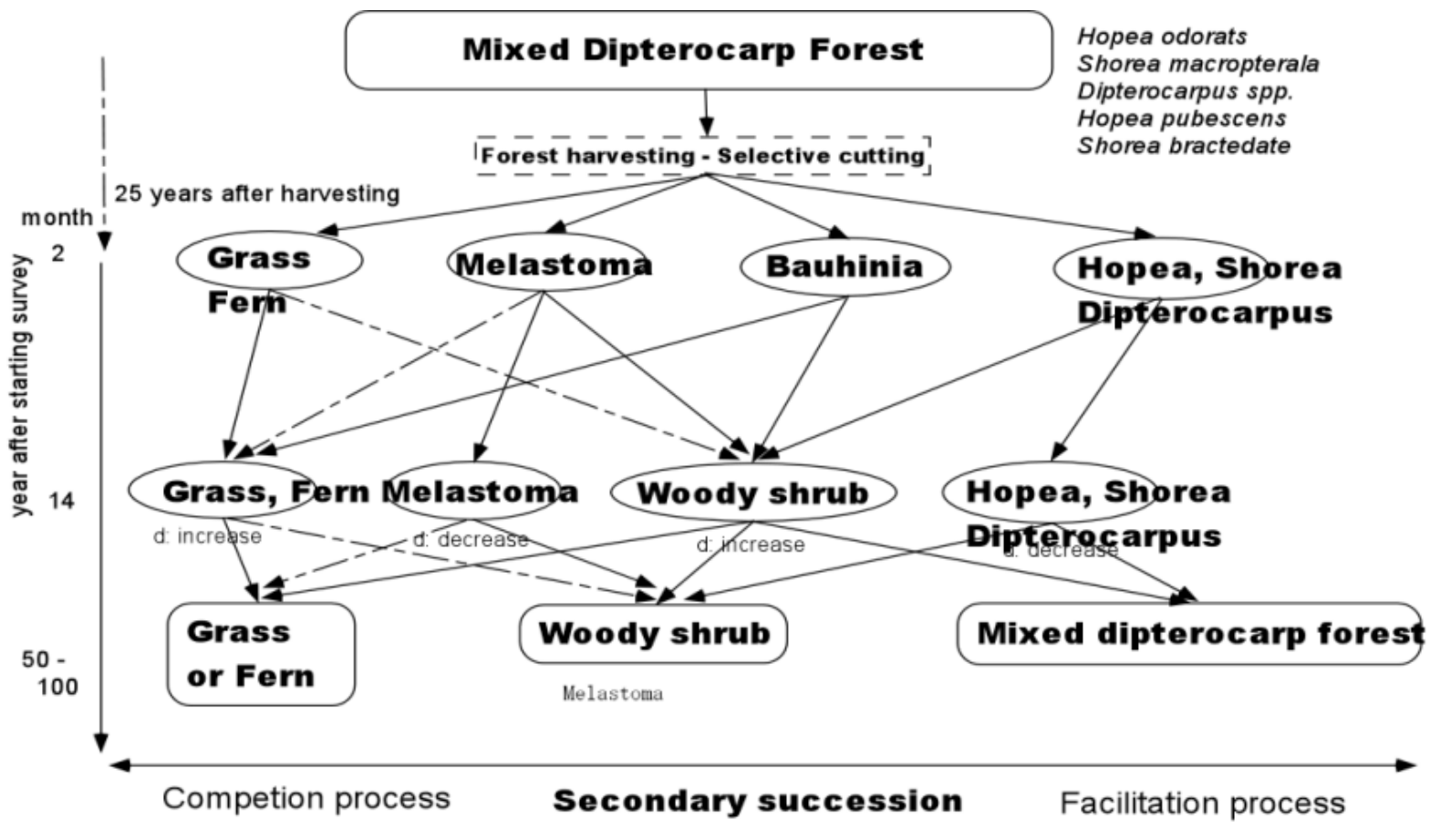

Figure 1. Secondary succession in mixed dipterocarp forest of Pasoh, Malaysia

Similar processes were also observed in mixed dipterocarp forest in Samarinda, East Kalimantan, Indonesia; mixed dipterocarp forest in Pasoh, Malaysia**;** mixed deciduous forest in Maeklong, Thailand**;** peat swamp forest in Belait, Brunei Darussalam; abandoned pasture in Pucallpa, Peru; subtropical moist forest in Misiones, Argentina; and a teak plantation in Thom Pha Phun, Thailand (Kobayashi *et al.* 2001; Kobayashi 2004; Kobayashi 2007). Figure 2 summarizes factors analysed at all study sites. The facilitation process must be applied to accelerate natural regeneration and enrichment planting (Kobayashi 2004). The competition process can be introduced in large-scale and catalytic plantations (Nambiar and Brown 1997).

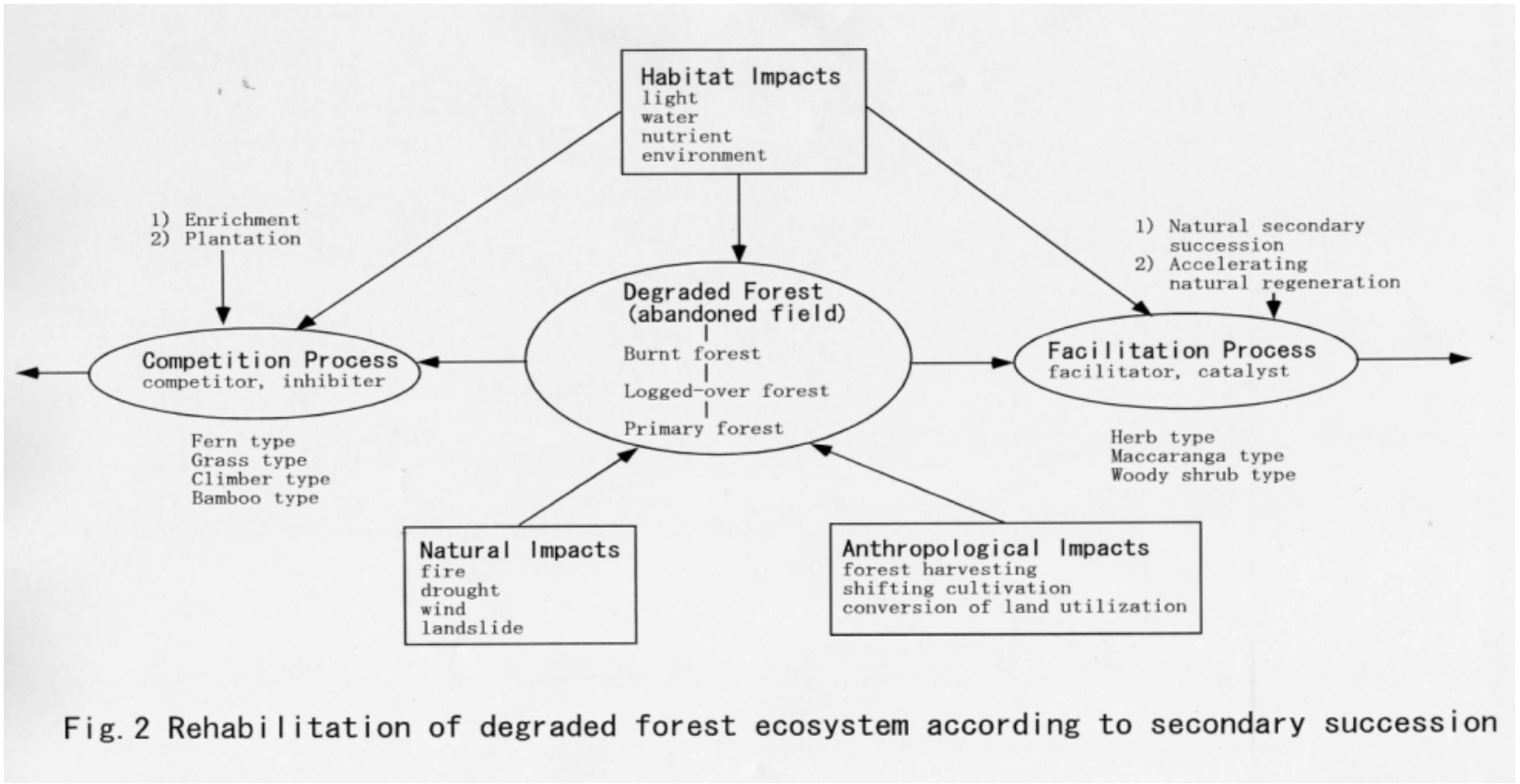

Figure 2. Rehabilitation of degraded forest ecosystems according to secondary succession (Kobayashi 2004)

Rehabilitation of degraded forest using secondary succession related to assisted natural regeneration

We classified undergrowth vegetation types in logged-over tropical lowland mixed dipterocarp forest and for evaluating the influences and roles of vegetation types on secondary succession. Grasses and ferns were associated with the competition process because they retained 100 percent composition of their type, the smallest species number and the smallest recruitment of woody shrubs 14 months after fire events (fern cover was thick and the soil was dry).

Dipterocarpacea were associated with the facilitation process because of higher species number and the highest recruitment of woody shrubs (relatively light cover and wet soil). This supports the diversity–productivity hypothesis (Tilman *et al.* 1996), but does not support the statement “species-rich sites were more resistant to invasion” (Tilman 1997). Woody shrubs and ferns will be classified into lower criteria after further monitoring. For rehabilitation, vegetation associated with the facilitation process can be applied to accelerate natural regeneration or for monitoring purposes. Conversely, vegetation associated with the competition process must be applied for enrichment planting, mixed plantation and catalytic plantation.

Accelerated natural regeneration methods have been developed such as ‘umbrella’ natural regeneration, ‘side-effect’ natural regeneration and forest patch improvement; these are closely related with assisted natural regeneration (FAO-RAP 2003). Enrichment planting techniques such as line planting and gap planting have been studied (Kobayashi 2003; Chan *et al.* 2008). The catalytic effects of large-scale planting using site matching, direct sowing and mixed planting can be anticipated.

We addressed not only technique development but also local community incentives. Forest recovery takes a long time and fires and illegal logging will occur during this period. Local community incentives should focus on forest ecological resources (fallow products and non-wood forest products) on which forest dwellers depend (Figure 3). Local communities can utilize these resources during the facilitation process in secondary succession.

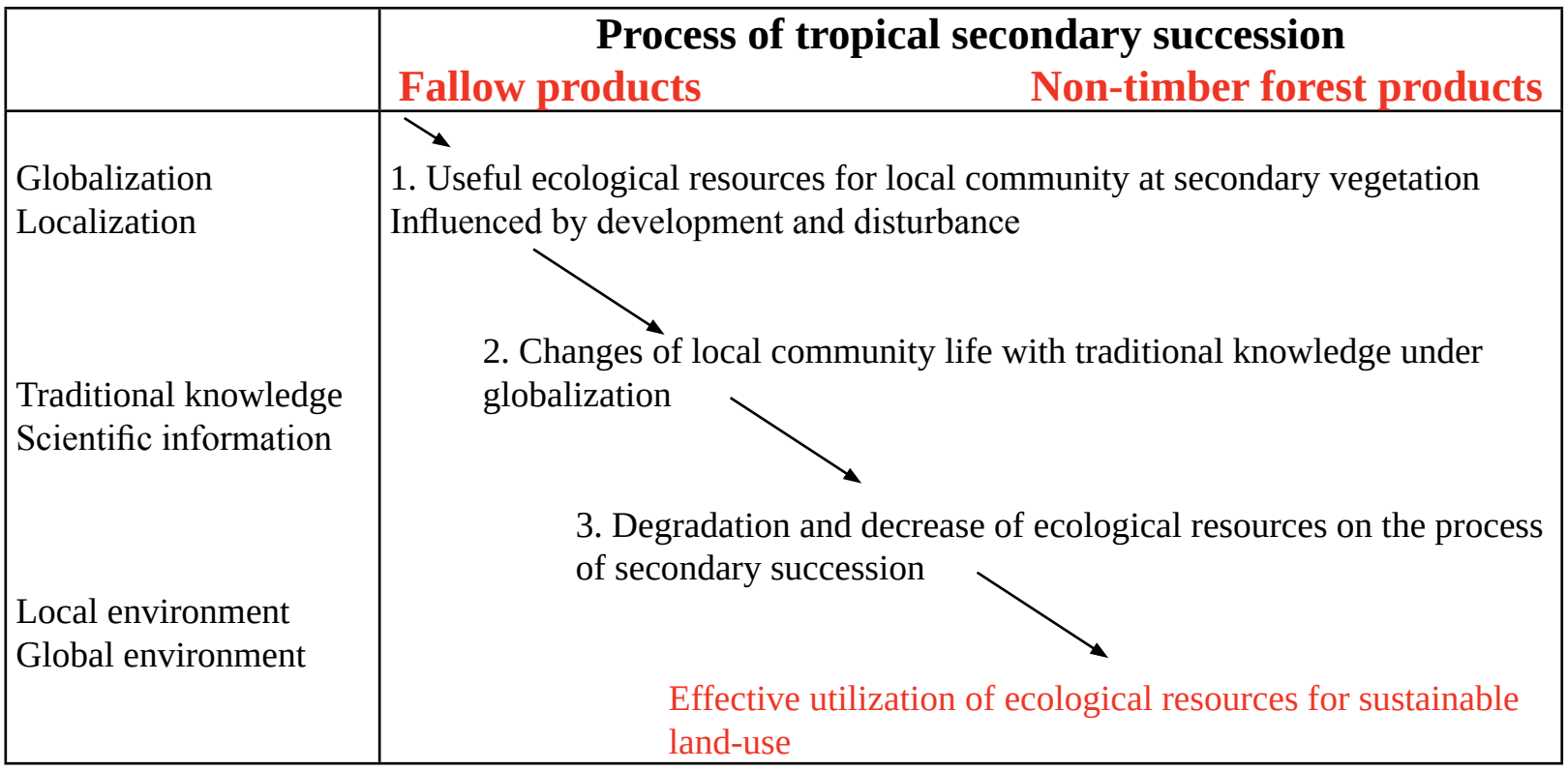

Figure 3. Relationship between secondary succession process and factors affecting forest management.

Concluding remarks

Secondary forests comprise diverse species and structures that, if disturbed, can be replenished by secondary succession, either via facilitation or competition processes. The rehabilitation site must be determined based on secondary succession that employs these processes and be managed with adequate rehabilitation techniques. Sustainability is more important than productivity; after evaluation of ecological resources, management techniques that conserve biodiversity and non- timber forest products during secondary succession will provide local communities with incentives for sustainable land use.

Acknowledgement

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FORRU: bringing back the forest in northern Thailand

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If we continue at the current rate of deforestation and destruction of major ecosystems like rainforests and coral reefs, where most of the biodiversity is concentrated, we will surely lose more than half of all the species of plants and animals on Earth by the end of the 21st Century. E.O. Wilson, the renowned biologist who popularized the term 'biodiversity'

Introduction

Deforestation is a serious environmental problem, particularly in the tropics, causing poverty, loss of biodiversity, floods and drought. Natural tropical forests are declining at a rate of 14.2 million hectares annually (approximately 0.7 percent per year), approximately the same rate of decline during 1980 to 1990 (FAO 2001). Thailand has lost more than half of its natural forest cover since 1961; existing cover is about 24 percent. Despite a ban on commercial logging since 1989, forest area continues to diminish and large areas of forest within existing national parks and wildlife sanctuaries have been degraded. Overall, since 1961, Thailand has lost nearly two-thirds of its forests (Bhumibamon 1986).

Forest has a natural capacity for self-recovery. This can take centuries under natural conditions, but by understanding and enhancing the natural processes of forest regeneration, it can be completed in just a few years. The Forest Restoration Research Unit (FORRU) was founded to develop effective methods to accelerate natural forest growth and research was initiated to develop these methods in the conservation area of Doi Suthep-Pui National Park (DNP) in northern Thailand.

FORRU was established in 1994 in collaboration with the DNP and the Biology Department of Chiang Mai University (CMU) by Dr Vilaiwan Anusarnsutorn and Dr Stephen Elliott. FORRU aims to restore original levels of species diversity, ecosystem structure and ecosystem function by planting tree species that were present before deforestation was manifested. The planted trees are the drivers for restoring natural forest ecosystems and their associated biodiversity. They also encourage wildlife to return which facilitates forest restoration. The basic principle is to harness the natural mechanisms of forest regeneration, recreating the complex webs of relationships

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among species that are essential for the recovery of biodiversity.

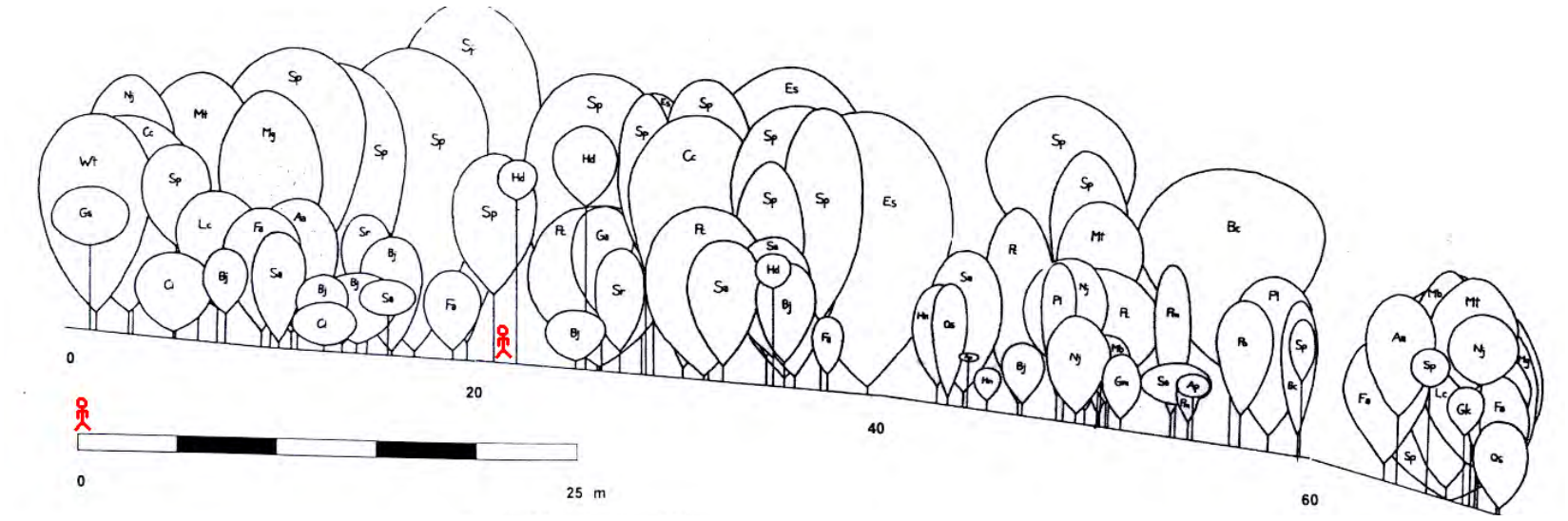
One of the most fundamental constraints to forest ecosystem restoration is lack of knowledge on how to ensure and integrate the natural diversity of tree species that comprise most tropical forest ecosystems. The need to complement forest protection with forest restoration is now widely acknowledged, but how can this be achieved?

Plate 1. Left, a degraded site after burning before planting of framework tree species; right, the non-planted site in the same area after six years, dominated by grasses and herbaceous weed cover

The 'framework tree species' method involves planting a minimum number of indigenous forest tree species during a single planting event for maximum ecological benefit. Framework species are selected for their potential to accelerate biodiversity recovery and enhance natural regeneration, creating a self-sustaining forest ecosystem for wildlife conservation and environmental protection within protected areas. The framework species method has been adapted to local conditions on degraded sites in northern Thailand. The method was first conceived in northern Queensland, Australia to repair damaged tropical rain forest (Goosem and Tucker 1995; Tucker and Murphy 1997); a mixture of 20 to 30 indigenous pioneer and climax forest tree species were planted. Framework tree species are successful in arresting weed problems in deforested sites after clearing, where grasses and herbaceous weeds can predominate. Planted trees 'recapture' the site by shading out herbaceous weeds, re-establish a multilayered forest canopy and restore forest productivity and nutrient recovery. In addition, framework tree species flower and fruit soon after planting, thus providing food to attract wild animals that disperse the seeds of diverse non-planted tree species throughout the planted site; this creates excellent competition-and free conditions for tree seedlings to germinate. Conditions are also enhanced by the nutrient cycle in the carpet of leaf litter as well as cooler, more humid and weed-free areas.

FORRU now has an office and a research tree nursery at the park's headquarters, a community nursery and field plots at the Hmong village of Ban Mae Sa Mai and an education unit in the herbarium building of CMU's Biology Department. FORRU's primary task is to carry out scientific research to develop effective techniques for

restoring biodiversity on degraded land that are not expensive and acceptable for the local people. An education unit disseminates and interprets this research to those who are interested in forest restoration such as students, teachers, ecotourism guides, villagers, NGOs, forestry staff and university researchers. The education unit is responsible for disseminating FORRU's information both in Thai and English and inside and outside of Thailand.



A six-year-old planted site with framework trees species, showing a multilayered canopy of pioneer and climax tree species planted at the same time in the rainy season of 1998. The diagram was created by FORRU students

Research work

Much research has been devoted to answering the question **How can forest be replanted according to its original state before degradation occurred?** The FORRU approach started by screening more than 660 indigenous tree species in the DNP (Maxwell and Elliott 2001) for their ability to act as framework species; tree phenology was observed to reveal seasonal patterns of fruiting and a seed collection schedule was developed for planning of nursery and planting work. The nursery research continued to determine which treatments resulted in the healthiest seedlings and those that were cost effective (Incomserb 1994; Kopachon 1995; Zangkum 1998; Jitlam 2001; Philachanh 2003). Field trials followed at the Hmong village to determine the survival and growth rates of each species, as well as their ability to shade out weeds and recover after a (preset) fire; they revealed varieties that could serve as framework species (Elliott *et al*. 2003). The sites recaptured 70 percent of canopy closure and shaded out weeds within four years. Planted trees were checked regularly for production of any resources that might attract birds or mammals (e.g. fruit, flowers, nectar etc.). Fourteen trees species out of 29 framework trees species produced flowers and fruit that tempted wildlife to return to FORRU's plots within three years after planting. Various silvicultural treatments to maximize field performance of the planted trees were also tested, such as different weeding methods, mulching and fertilizer regimes (Elliott *et al*. 2000); new methods were tested to improve and to reduce the cost of forest restoration such as perching (Scott *et al.* 2000; Gale *et al.* 2002), use of wildlings (Kuarak 2002) and direct seeding (Woods and Elliott 2004; Tunjai *et al.* 2005).

Biodiversity recovery is the most important outcome of FORRU's activities. Wildlife use the 44 framework tree species for food sources, nesting or perching sites, roosting or for sleeping.

The seed disperser helped to increase the recruitment of 72 non-planted seedling species eight years after planting (Sinahseni 2008). Bird varieties rose from 34 to 88 species after six years; bird population density was concentrated more in the oldest plots that resembled their former forest habitats rather than younger planted or non-planted control plots (Chantong 1999; Toktang 2005). Mycorrhizal fungi varieties increased from six to 21 species and both mychorrhizae and lichen were twice as abundant as those in the secondary forest nearby. Small mammals (Thaiying 2003) and signs of medium-sized mammals including the hog badger, pangolin, barking deer, wild pig and red jungle fowl as well as other bird species were recorded at the planted site. These results demonstrate the effectiveness of framework tree species in restoring biodiversity.

Plate 2. Aquilaria crassna, one of the non-planted tree species dispersed by animals over >8 km from the forest near to the planted site

Education work

The five years of research that FORRU-CMU has been conducting for establishing the best methods and tree species for forest restoration has generated a wealth of information that must be disseminated so people can implement them properly. An education unit was set up under a grant from the United Kingdom's Darwin Initiative to implement a three-year project called Education and Training for Restoring Tropical Forest Biodiversity, with British partner East Malling Research (EMR, formerly known as Horticulture Research International) in 2002.

Community outreach work was continued with funds from the Eden Project (by the Trees for Thailand Project) until the middle of 2008 via technical assistance and seed grants; this motivated 12 communities in northern Thailand to establish framework tree nurseries and initiate forest restoration projects in their own villages. International outreach, within the Indochina region, includes work with the People's Republic of China, Cambodia and Lao PDR, with support from the Darwin Initiative. Under this project, the book *How to plant the forest?* was translated into Thai, English, Chinese, Lao, Khmer and Vietnamese to help these countries understand this method easily. The new book *Research for restoring tropical forest ecosystems – a practical guide* that incorporates FORRU-CMU's 15 years of experience is also available in English, Thai, Chinese, Lao, Khmer and Indonesian. All FORRU-CMU information can be

downloaded on PDF files through FORRU's Web site at www.forru.org; books, proceedings, research papers, student abstracts, newsletters, images and teaching modules to promote and disseminate the knowledge and ideas generated by FORRU-CMU are available.

Recent work

Currently, FORRU is continuing both research and education by collaborating with many organizations and expanding forest restoration work. FORRU-CMU is studying how to restore the lowland forest at Huay Tung Tao, Chiang Mai Province under a grant from Biodiversity Research Thailand. Lowland forests have very different conditions compared to upland forests because of higher degradation. They are more densely populated resulting in more intense human impact. Field trials and propagation of threatened species are being carried out under another research grant from the International Foundation for Science to increase the potential to conserve threatened species by integrating them among framework species for planting in forest restoration projects.

FORRU-CMU is collaborating with different organizations in western and southern Thailand to provide technical assistance for establishing local forest units in different types of forest. FORRU-CMU is working with the Elephant Conservation Network to establish a community nursery and restore the Asian elephant's habitat in Kanchanaburi Province, western Thailand; this project is supported by the Keidenaren Nature Conservation Foundation of Japan. In southern Thailand, FORRU-CMU is working with the UK's Royal Society for the Protection of Birds and the Oriental Bird Club, to develop effective methods to restore lowland tropical rain forest in Krabi Province, the habitat of Gurney's Pitta, the most endangered bird species of Thailand. Suitable framework tree species were selected to restore the area and a small assisted natural regeneration (ANR) experimental plot has been established to test the technique; the site has many natural regeneration sources such as tree stumps, seedlings, saplings and natural seed banks; fertilizer application and weeding encourage their growth. Plate 3 shows how the site has been transformed through canopy closure.

Plate 3. Tropical lowland evergreen forest, Krabi Province, southern Thailand. Left, the ANR experimental plot in May 2007 after mulching, weeding and fertilizer application; right, the same area in November 2007 six months later – canopy closure is well underway

The education unit continuously works with communities to provide technical training and support. In Doi Mae Salong, Chiang Rai Province, 13 communities are involved in restoring an area of 1 440 hectares near the Thai-Myanmar border, in partnership with the Plant a Tree Today Foundation, the World Conservation Union (IUCN) and Thailand's Supreme Command. FORRU-CMU has also hosted workshops on nursery techniques and forest tree seedling propagation – the Trees Bank Project – for local people who are members of the Bank for Agriculture and Agricultural Cooperatives. The concept of this project was to increase the number of trees in Thailand by stimulating farmers to plant trees who would then be refunded each year depending on tree species and tree age. FORRU-CMU also works on ecotourism development with different tour agencies by transferring knowledge to tour guides on topics such as forest ecology, forest tree species, nursery work to produce indigenous tree species for forest restoration projects and plant/wildlife association. Most ecotourism guides involved in the training are local people from many villages in northern Thailand. FORRU-CMU has also collaborated with the conservation club of Ban Mae Sa Mai of the Hmong hilltribe for more than ten years to help plant and take care of demonstration plots, carry out weeding and prevent fires locally. The villagers plan to develop ecotourism projects in their natural forest and FORRU-CMU's planted plots; they are willing to use ecotourism to protect their forest. The FORRU-CMU partnership with the DNP and the Ching-Cha volunteer group provides training to children and adults to become ecotourism guides in their own villages.

FORRU-CMU has also established successful collaboration with a private company in Chiang Mai, Trisila Company Ltd., of the City Life Magazine, to develop a 'Go Carbon Neutral' carbon offset campaign; the sum of 240 000 baht was allocated for planting 1 625 indigenous trees at FORRU's site in 2008.

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Strategy and challenges for natural forest restoration in Lao PDR

Saysamone Phothisat[1]

Introduction

Lao PDR is landlocked country with the People's Republic of China to the north, Cambodia to the south, Viet Nam to the east, Thailand to the west and Myanmar to the northwest. The total land area is 236 800 km^2. Seventy percent of the total land area is mountainous terrain, forest cover is 41.5 percent nationwide and the population totals 5.5 million people (2008 estimate). Lao PDR's climate is tropical monsoon with the rainy season extending from May to October and the dry season from November to April.

Developmental goals have often taken precedence over forestry, particularly in relation to revenue-generating activities such as mining, hydropower generation and logging. The direct impacts of economic development on forests include deforestation and land conversion as well as forest depletion due to poorly regulated legal and illegal logging[2]. The future forestry situation in Lao PDR is likely to be mixed, with grounds for both optimism and pessimism in relation to economic development and sustainable natural resource management.

In response to the Lao Government's realization of the alarming forestry situation and its commitments to sustainable forest management, the Forestry Strategy 2020 (FS 2020) has been developed and launched. This official guiding document is an effort by the Lao Government and international donors to comprehensively assess forestry-related status, issues and policy and also matters associated with implementation as well as monitoring and evaluation.

The government is promoting collaboration with domestic and international players in several focal areas including plantation development, wood processing, non-wood forest products (NWFPs), forest resource conservation and ecotourism.[3]

Trends in forest resources

Lao PDR's terrain is characterized by three distinct formations: mountains, plateaus and plains. Mountains, at an average height of 1 500 meters, dominate the northern region. The Phou Luang or Annamite Range cuts through Indochina forming a spine

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2. Forestry Sector Country Outlook for Lao PDR, 2008.

3. National Socio-Economic Development Plan, 2006-2010.

adjacent to the Lao PDR and Viet Nam border and claiming a small area in northern Cambodia. The plains region consists of large and small plain areas distributed along the Mekong River. Three plateaus comprise the Xiengkhouang Plateau in the north, the Nakai Plateau in the central region and the Bolivens Plateau in the south.[4]
The main forest types in Lao PDR are:

- Dry evergreen in the northern region;
- Tropical montage evergreen along highland areas of the Annamite Mountains and Bolivens Plateau;
- Lowland semi-evergreen Dipterocarp on the Mekong River Plain;
- Tropical montage deciduous scattered in the northern region.
- Dry Dipterocarp in the southern region;
- Mixed deciduous in the southern region;
- Pine forest in the Annamite Mountains, Xiengkhouang and Nakai Plateau; and
- Subtropical montane in the northern region.

Figure 1. Topographical map of Lao PDR and surrounding countries

Source: GLOBE (2008).

4. Forestry Sector Country Outlook for Lao PDR, 2008.

Forest land-use change

Three forest categories were established under the Forestry Law No. 06/NA, 24 December 2007 – protection forest, conservation forest and production forest. A high rate of forest loss has seen forest cover figures fall from 70 percent in 1940 to 64 percent in the 1960s, 49 percent in 1982 and 47 percent or 11.2 million hectares in 1992. In 2002, the forest area was 9.8 million hectares or 41.2 percent. It is estimated that about 134 000 hectares[5] of forest *per annum* are being lost or 0.6 percent of the total land area. The government acknowledges that deforestation attributable to unsustainable shifting cultivation, uncontrolled logging, conversion to agricultural land and other land, weak law enforcement and rapid population increase is responsible for widespread poverty.

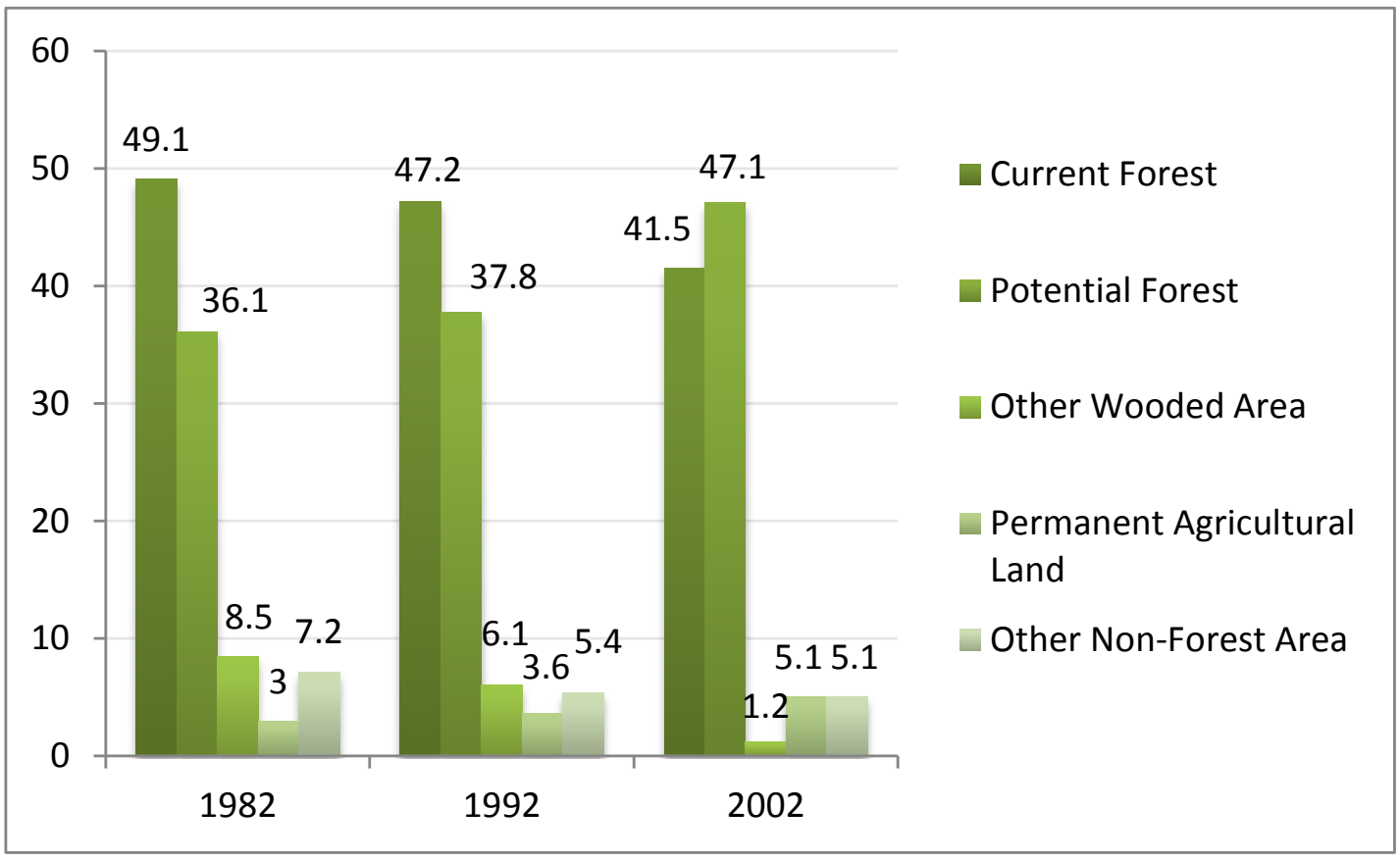

Figure 2. Changes in forest and land use during 1982, 1992 and 2002

Rubber plantations began as a modest way for northern upland Lao farmers to supplement their incomes and they have blossomed into a fast-expanding agro-industry. Major expansion of the crop began around 2002, with substantial foreign commercial interest making inroads into northern Lao PDR. Forest areas across the country are being cleared in ever-increasing volumes to make way for new plantations.

The main drivers of deforestation are:

- Encroachment into the forest for permanent cultivation;
- Shifting cultivation (northern region);
- Commercial timber logging (central and southern regions);
- Forest fires (uplands); and
- Large infrastructure development projects (southern region).

5. Report on the Assessment of Forest Cover and Land Use during 1992-2020, July 2005.

National forest policy

Lao has a short history of implementing its 1996 Forest Law (renewed in 2007) and the 2007 Wildlife and Aquatic Law. The FS 2020, which is endorsed by the government, is the official document guiding development of the forestry sector in line with overall national plans and strategies for socio-economic development and environmental conservation, including the National Growth and Poverty Eradication Strategy.

The Ministry of Agriculture and Forestry (MAF) has adopted a 5-year Agriculture and Forestry Development Plan (AFDP) 2006-2010, which has four targets and 13 measures. Concrete targets for forestry include:

- Forest management programme:
  - Increase forest cover from 9 million hectares (42 percent) to 12 million hectares (53 percent) by 2010;
  - Increase forest cover to 70 percent of the total land area or 16.5 million hectares through management of existing forest and restoration of forest by 6 million hectares by 2020;
  - Restoration of forest by 2.55 million hectares by 2010 and 3.9 million hectares by 2015;
  - Continue detailed forest survey and classification for management according to scientific principles, available technology and current policy and regulations;
  - Ground-level identification of water resource protection and a protection forest management plan of around 8.2 million hectares;
  - Systematic establishment of management plans for 4.7 million hectares of National Biodiversity Conservation Areas (NBCAs) or conservation forest;
  - Acceleration of ground-level identification of production forests with an area of around 3.09 million hectares;
  - Environmental protection for other sectors.
- A shifting cultivation stabilization programme.
- Land-use planning and land allocation programmes.
- Forest law enforcement and governance.

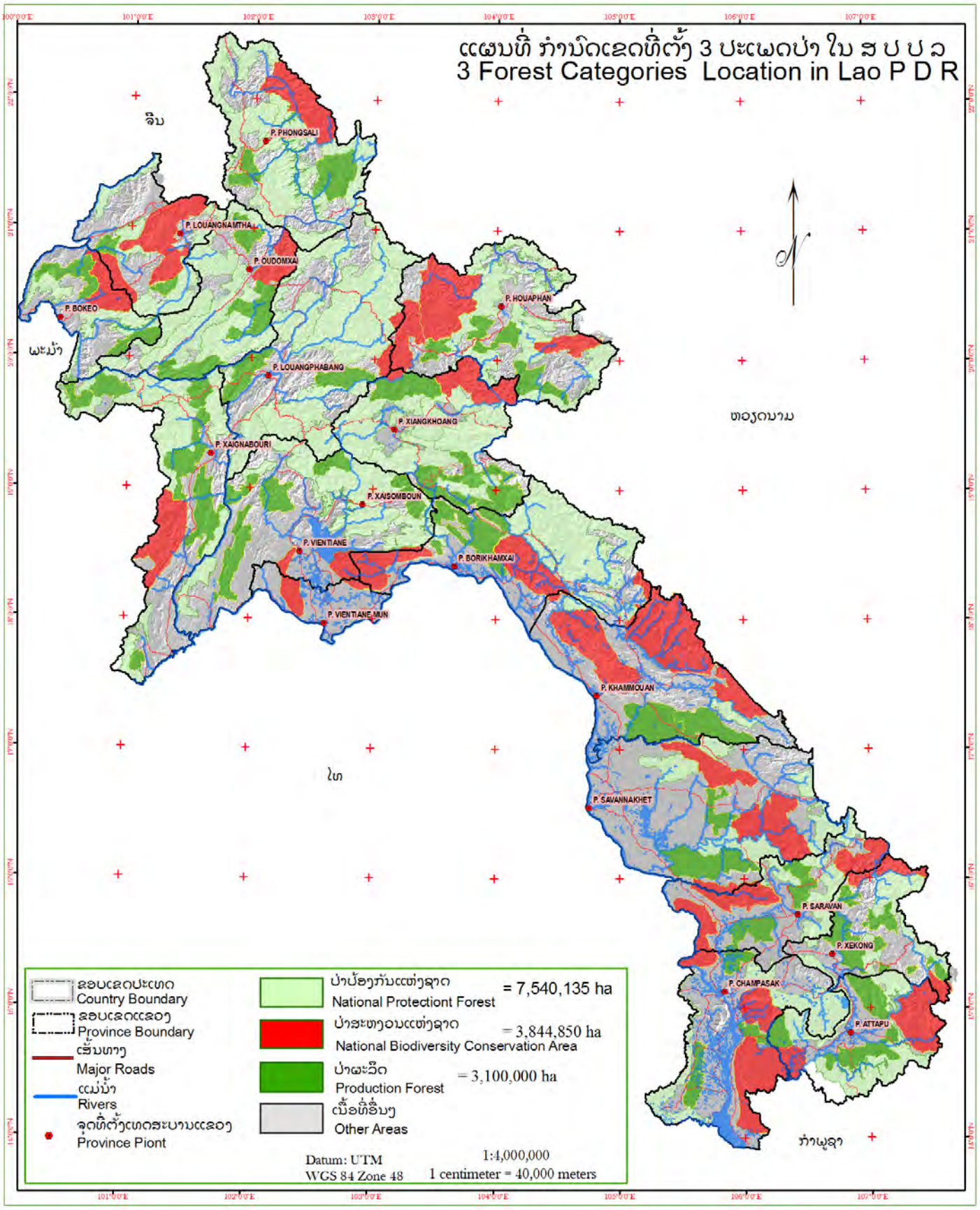

Figure 3. Three types of forest cover in Lao PDR. Protection Forest (blue and brown), Conservation Forest (red and yellow) and Production Forest (green)

Source: PSFM Description (2008).

Forest regeneration

Regeneration Forest is the term for forest areas in a degraded condition that have been designated for regeneration such as young secondary forest regenerating from old fallow forest.

Forests in Lao PDR are important for supplying clean water, supporting conservation, preserving biodiversity and acting as buffers against natural disasters. Water is particularly important for irrigation and hydropower in Lao PDR. Developing a

competitive irrigation system is a major government objective to guarantee subsistence in rice production and food security for rural households. In recent years, public investment in the irrigation sector has equaled between 40 and 50 percent of total public investment in the agriculture and forestry sectors. Potential protection forests for 51 watershed areas along main Mekong tributaries and 25 existing and proposed hydropower dams have been preliminarily identified on maps. Water supply is closely linked to forest area.[6]

A forest regeneration policy shall be promoted for individual households and organizations via incentives to regenerate degraded natural forest and young fallow forest areas through supplementary tree planting to increase forest density.

Main objectives

- To preserve and develop national forest resources to meet the demand for timber and other forest products in a sustainable manner.
- To preserve water resources, soil, aquatic life, wildlife and maintain environmental equilibrium.
- To rehabilitate forest and forest land areas to their former natural condition.

Work implementation

1. Regeneration through natural means: This is natural regeneration of vegetation via seeds of various tree species growing in the forest regeneration zone after ground clearing and thinning.
2. Regeneration through supplementary planting: This is supplementary planting of tree species that are suitable for forest regeneration in natural forest areas, especially in areas with low tree density where natural distribution of various tree species is scattered and irregular, or some of the original species are close to extinction or disappearing.
3. Seed planting: Planting of quality seeds in barren forest lands.

Forest regeneration activities

Forest regeneration activities have been implemented irregularly on an annual basis but have been unable to meet set targets (Table 1).

6. Forestry Strategy to the Year 2020 of the Lao PDR, 2005

Table 1. Forest regeneration activities, 1998 to 2008

Year	Action plan (ha)	Activities (ha)
1998-2000		21 600
2000-2001		8 596
2001-2002	161 000	4 083
2002-2003	161 000	155 319
2003-2004	161 000	89 941
2004-2005	161 000	60 687
2005-2006	200 000	62 090
2006-2007	629 000	84 500
2007-2008	629 000	127 000
Total	**2 102 000**	**613 816**

Source: Final Report on Forest Rehabilitation of Department of Forestry, 2008.

The implementation of natural forest rehabilitation in Lao PDR has not gone according to plan because government funding is limited and operational costs are not sufficient to implement activities at local levels. In this context, natural forest rehabilitation/ reforestation needs support from international organizations, especially with regard to protection forest management.

Implementation of forestry policy

There are two major actors:

The Department of Forestry (DOF)

The DOF is responsible for the management of forest resources, rehabilitation of degraded forest and plantations.

The FS 2020 is the guiding document for Lao forests and forestry. The government realizes the current inadequacy of forestry laws and policy implementation. The government has therefore made efforts to address outstanding issues in order to continue with its commitment to sustainable forest management. The government has adopted strategies, set targets and made ground measurements to help deliver targets contained in the FS 2020. To reflect the government's commitment to implementing sustainable forest management, progress on implementation of the FS 2020 is reported annually through stakeholder consultation.

Forestry is expected to continue to provide a range of benefits to national economic development as well as to maintenance and improvement of rural livelihoods. However, forest resources are not sustainably managed due to limited human and financial resources for enforcing laws and regulations. There is relatively weak awareness that forestry is of a social character, cutting across the geographical and legal demarcations

which frame the social and economic relationships between individuals, organizations and states.

Community forest management is considered as an important, and possibly the only, path to sustainable forest management and poverty alleviation by the government. Hence, it is crucial that an integrated management approach, incorporating links and enhancing understanding between food security, forestry and resource conservation is implemented.

Department of Forestry Inspection (DOFI)

The DOFI addresses forest law enforcement and governance (FLEG) and inspection of forests and rehabilitation efforts.

Challenges

- Lack of alternative livelihood or production systems to replace shifting cultivation in remote areas and access to markets together with lack of social services such as education and health care.
- Incomplete land-use planning including forest zoning and village-level land-use planning and land titling and insufficient resources for management of each land area or forest zone.
- Unclear resource and land tenure.
- Weak coordination between sectors.
- Weak law enforcement and governance.
- Insufficient understanding or ignorance of existing laws and regulations by entrepreneurs and local people.
- Limited human resources and limited financial support.

Assistance needed

- Capacity building at central, local and community levels.
- Information technology development (linkage between the DOF and other sectors).
- Support to the production forest management system including sustainable financial management.
- Strengthening forest ecosystem services, e.g., ecotourism, carbon market negotiation, protection forest and water resource management of hydropower projects, biodiversity conservation, etc.
- Financial support to the forest regeneration and restoration project and tree seed improvement both in terms of capacity and quality.

Conclusion

The implementation of natural forest rehabilitation in Lao PDR has not gone according to plan because government funding is limited and operational costs are not sufficient to implement activities at local levels. In this context, natural forest rehabilitation and reforestation need support from international organizations, especially with regard to protection forest management. A forest regeneration policy shall be promoted for individual households and organizations via incentives to regenerate degraded natural forest and young fallow forest areas through supplementary tree planting to increase forest density.

The Lao Government has attempted to address deforestation with policy initiatives and annual logging quotas among other thrusts. These initiatives have, however, had poor results on the ground. Lack of clarity in procedures, including those related to plantation establishment, together with limited financial resources and human capacity and weak law enforcement are major obstacles. The direct impacts of economic development on forests in Lao PDR include deforestation and land conversion as well as forest depletion due to poorly regulated legal and illegal logging. In response to the Lao Government's realization of the alarming forestry situation and its commitments to sustainable forest management, the Forestry Strategy 2020 has been developed and launched. The government is also promoting collaboration with domestic and international players in several focal areas including plantation development, wood processing, NWFPs, forest resource conservation and ecotourism.

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Operation Manual for Participatory Sustainable Forest Management in Production Forest areas, Volume 1. Participatory Sustainable Forestry Management Model (PSFM) Description, 2008.

The National Movement on Forest and Land Rehabilitation in Indonesia

Noviar[1]

The National Movement on Forest and Land Rehabilitation

Indonesia is endowed with 17 000 small, medium and large islands, spread along the equator. The land area encompasses 189.15 million hectares (Indonesia's Statistical Bureau BPS, 2007). Forest occupies 120.35 million hectares or 63.44 percent of the total land area. Indonesia's tropical rain forest, a greater portion of the forest area, serves as the world's lung; it absorbs greenhouse gas emissions and assists in balancing global ecosystems. From the domestic standpoint, the rain forest has economic, social and environmental roles for communities within and outside the forest area.

Forest utilization and industrialization have resulted in deforestation and forest degradation. The Directorate General of Land Rehabilitation and Social Forestry has indicated that critical land areas cover about 77.8 million hectares, of which roughly 47.6 million hectares is lightly critical, 23.3 million hectares is regarded as medium rate critical and about 7 million hectares are severely critical.

These critical land areas have difficulty in supporting productive economic and environmental functions, including capacity to absorb greenhouse gases, in particular CO_2. In this context, tropical forests should be returned to their original natural state through rehabilitation and pristine forests should be maintained and conserved.

In the not too distant past, Indonesian forestry culture was dominated by large-scale forest harvesting. This resulted in substantial depletion of forest quality and quantity, and generated critical land areas on a wide scale via forest degradation and deforestation. When the government formally limited the degree of forest exploitation by setting a forest-harvesting threshold, illegal exploitation took place. Thus forest degradation and destruction could not be mitigated by enacting laws and regulations, especially those that limited the exploitation rate. To overcome the problem, the government adopted a cultural approach to empower community forest management. The Government of Indonesia promulgated the Program of National Movement to Rehabilitate Forest and Critical Lands in 2003, which continues today. The target for 2003-2008 was 3 million hectares in Indonesian watersheds nationwide.

The National Movement on Forest and Land Rehabilitation was mandated by the Forestry Law of 1999. The law stated that forested area should encompass a minimum of 30 percent of the total land area. In particular, forest should protect watershed

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areas because they are important for agriculture and provision of potable water for communities. The rest of the forest should function well to develop economic, social and enviromental benefits. However field observation has indicated that in some cases, what is formally called forest, is 'barren' land, or savannah-type land where unproductive forest grows sparsely or is infested with *Imperata cylindrica*.

The National Movement specified that forest benefits should spread to other economic sectors. The multidimensional benefits of rehabilitation and rehabilitation programmes should be reaped by the parties that promote such activities. Thus, programmes are executed through closer cooperation between the government (central, provincial and district levels) and local communities. The reasons for such cooperation are based on the origins of forest loss: (1) geomorphological properties – geology, soil type, topography that determine the degree of erosion, landslides and drought; (2) climate, especially rainfall intensity; and (3) human activities (more important) including encroachment, excessive logging, setting of forest fire and land utilization that neglects conservation measures.

There are three forest and land rehabilitation systems under the National Movement program: (1) activities induced by incentives, (2) the full cost type and (3) model development, described below.

- The first system is adopted by communities outside forest areas. The community participates in rehabilitation activities. The government provides high quality seeds and funds for conservation structures. The main attributes are stakeholder participation, provision of adequate supplies of high quality seeds and established organizations that can run the project independently. The system is used for the rehabilitation of community forests as well as environmental enhancement such as the creation of urban forests, trees along highways and soil conservation.
- The second system is used for forest under the management of the Ministry of Forestry – conservation, protection and production forest areas. The activities are fully funded by the government, including the provision of seeds and seedlings, planting, maintenance of juvenile plants and construction of conservation structures; it involves communities within and adjacent to forest areas.
- The third system is a movement to increase forest productivity and participation of the community. It is basically an endeavour to find techniques for land management and community participation. This is fully funded by the government. The funds are channeled to the stakeholders through block grants to farmers' groups for the conservation of rare species and the application of intensive silviculture, rehabilitation of critical lands using the potting system, the development of seed production areas, social forestry and community business partnerships.

Given current problems, these systems should be adopted by future forestry programmes to address forestry development holistically. Forestry development needs to create a favourable investment climate that enables the business sector to stimulate economic growth (Pro-growth).

Directly or otherwise, high economic growth created by the National Movement on Forest and Land Rehabilitation is a safety valve for high unemployment in Indonesia. The National Movement, as a forestry programme, is not only capital-intensive but also very suitable in the context of Indonesian demographics that constantly require job opportunities. The National Movement has been a buffer for the Indonesian economy (Pro-job).

The National Movement needs to enhance people's prosperity further. Lessons learned from 1965 to 1997 indicated that economic growth and job creation failed to improve people's lives due to the absence of distribution effects. Trickle-down effects created better conditions for only a limited number of people. The National Movement needs to ensure that benefits are distributed evenly, especially for the poor (Pro-poor).

To evaluate National Movement performance vis-à-vis Pro-growth, Pro-job and Pro-poor, a review was conducted in 31 watersheds throughout Indonesia. Based on 2003-2007 data, the review revealed:

1. Pro-job: The National Movement could absorb on average 35,785 persons/year for 31 watersheds; Indonesia's overall absorption is 1,109,335 persons/year.
2. Pro-poor: The National Movement improved family income on average by 16.91 percent (from Rp.4.32 million/family/year to Rp.5.09 million/family/year).
3. The National Movement also achieved participation of 30,721 forest farmers' groups (1.54 million families). At four people per family on average, the National Movement recruited 6.1 million people.
4. The absorption of labor and development of institutions are expected to support economical growth of people (Pro-growth)

To increase its success, the future trend of the National Movement should consider the following options:

1. Optimizing the National Movement by creating multiyear contracts, incorporating state and private forestry companies especially in forest and land rehabilitation.
2. Utilizing global tools for rehabilitation such as the Clean Development Mechanism and Reducing Emissions from Deforestation and Forest Degradation.
3. Providing credit for communities that create plantations inside forest areas.
4. Direct investment in industrial forest plantation.
5. Developing partnerships between the private sector and communities (that own lands) as well as partnerships between estate holders, local governments and the forestry sector.
6. Rehabilitation by expanding community forest activities.

BirdLife Indonesia's Forest Restoration Program[1]

In 2004, the Ministry of Forestry issued a policy decision (No. 159/Menhut-II/2004) which allowed degraded forests to be managed for ecological restoration. After three years, the Forestry Minister issued the first ever 'License for Management of a Production Forest for Ecosystem Restoration' in August 2007.

The restoration policy does not just open up a new way of managing forests, it has attracted a whole new type of investor into the forestry sector. Conservation and environmental funds have until now been used in trying to persuade or force the government and logging companies to do a better, more responsible job of managing the forest estate. Now there is a tantalizing prospect of doing something much more concrete with scarce conservation funding – getting hold of a concession and proving how management for restoration can be good for the forest and good for local communities and economies.

The Ministerial Decision on Ecosystem Restoration in Production Forests defines restoration as management with the objective of returning the biological (trees, wildlife) and non-biological (water cycling, carbon recycling) elements of the forest to their natural balance. According to the policy, any production forest reserve can be designated for restoration. Forest restoration can be as simple as protecting the forest from further damage, or it can include planting native species or management to encourage regeneration. It may include returning watercourses to their natural state and management to nurture specific habitats required by endangered, forest-dependent species. It allows for use of non-wood forest products by local communities, but forbids the commercial extraction of timber.

The area identified for restoration was a production forest covering 101 000 hectares on the border between Jambi and South Sumatra. The licence was presented to PT Restorasi Ekosistem Indonesia, a company created to hold the licence by the BirdLife consortium – Burung Indonesia, the Royal Society for the Protection of Birds and BirdLife International.

The first action of the new management was to stop the logging that had been conducted in the forest. This action will be continued until the natural balance of the ecosystem has been restored. Otherwise, to accelerate natural regeration in the restoration areas, more than 37 000 endemic seedlings were planted, such as meranti, bulian, durian hutan and dan merpayang tree species.

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1 Sourced from interviews and Indonesia Forestry Magazine, 2008, XI Edition, Jakarta. Also: www.burung.org/detail_txt.php?op=news&id=259; www.burung.org/detail_txt.php?op=news&id=257; www.burung.org/detail_txt.php?op=news&id=255; www.burung.org/detail_txt.php?op=news&id=247

In the future, BirdLife Indonesia has a plan to expand forest restoration throughout Indonesia's production forest. It will develop 1 million hectares of forest restoration until 2020.

From the lessons learn by PT Restorasi Ekosistem Indonesia, next year the Ministry of Forestry will develop 100 000 hectares throughout Indonesia's conservation forest. The Ministry of Forestry believes that forest restoration is the best choice to overcome forestry problems in Indonesia.

Recent forest restoration initiatives in Sabah, Malaysia

Robert C. Ong[1]

Introduction

The forest industry

Throughout the 1970s and 1980s, revenue generated from forests consistently accounted for more than 50 percent of the annual state government revenue. The emergence of the industry to such prominence was nurtured by abundant timber supplies from the natural forests in the past. Despite the gradual decline of this contribution in the 1990s, forestry remains a significant sector of Sabah's economy, contributing 22 percent (or RM510 million) of the total government revenue in 2008 (Sabah Forestry Department 2009). Ironically, the heavy dependence and tremendous capacity of the industry to generate individual wealth and government revenue has led to the rapid decline and degradation of forest resources. Today, the future of the industry is shrouded with uncertainty, due to drastically declining domestic timber supplies, particularly from the natural forests. But despite declining timber output, forestry remains a dominant land use in Sabah.

Forest resource administration

A noteworthy feature of forest resource administration in Malaysia is that all matters pertaining to land, including forestry, fall under the jurisdiction of the respective states. As such, the states maintain full rights over the management of their forest lands, and are empowered to enact laws and form forestry policies independently. The three principal agencies entrusted with forest resource management in Sabah are the Forestry Department, the State Parks and the Wildlife Department.

Forested lands, including both natural and planted forests, are found mainly within areas designated by law as Forest Reserve, State Park, or Wildlife Sanctuary. Together, these three classes of forest lands account for 52 percent (3.87 million hectares) of Sabah's landmass and are collectively referred to as Permanent Forest Estate (PFE) (Sabah Forestry Department 2005). Few native forests are left outside the boundaries of the PFE.

Management

The PFE is managed for multiple uses, i.e., timber production, recreation, biodiversity conservation and ecosystem services. In terms of management, Sabah's PFE can be broadly categorized according to two management functions (Table 1).

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Table 1. Permanent Forest Estate according to management function in Sabah

	Area (ha)	% of total land area
Conservation		
- with legal status: 1 182 208 ha	1 377 208	18.6
- production forests designated for		
- conservation: 195 000 ha		
Production		
- natural forest management: 2 039 480 ha	2 489 480	33.6
- tree plantations: 450 000 ha		
Total	**3 866 688**	**52.2**

Forest restoration/rehabilitation initiatives

More than 90 percent of Sabah's production forests have been logged or burned, leaving behind residual forests with varying levels of disturbance to regenerate. In addition, some 35 000 hectares throughout the state have been illegally occupied for agricultural crop cultivation. Over the last three years, the Forestry Department has taken drastic action to reclaim encroached lands. Today, forest restoration is a key agenda of the Sabah Forestry Department. Generally, forest restoration and rehabilitation efforts take two forms: 1) for commercial production of timber; and 2) for conservation.

Restoration for commercial production

As timber resources from natural forests decline, tree plantations are expected to become increasingly important as a source of raw material supply for the wood-based industry. About 450 000 hectares within the PFE have been designated for timber production by the intensive cultivation of short-rotation (<15 years) timber trees (Ong and Sinajin 2003). Areas approved for tree plantations are mainly areas where the forest has been determined to be degraded or poorly-stocked. As of December 2008, the total area of established tree plantations was about 200 000 hectares (Sulaiman *et al.* 2007). Such restoration efforts are largely undertaken by private companies as commercial ventures on a relatively large scale (usually exceeding 1 000 hectares). Therefore, they are also funded privately. These companies have concession rights ranging from 50 to 100 years. Commonly planted species are:

Facaltaria moluccana	Batai
Acacia spp.	Acacia
Hevea brasiliensis	Rubber
Anthocephalus cadamba	Laran
Octomeles sumatrana	Binuang

Assisted natural regeneration (ANR)/timber stand improvement: This activity is largely carried out in areas managed directly by the Forestry Department. Since 2006, the

department has consistently treated about 10 000 hectares a year. ANR in this respect entails the cutting of vines (particularly climbing bamboo) and the selective liberation of potential crop trees. The cost of ANR ranges from RM250-350 (US$70-100) per hectare.

Restoration for conservation

Over the last two years, there has been increasing interest in restoring forest for conservation purposes. Such efforts largely receive external funding (Table 2). They mostly focus on the restoration of critical wildlife habitat, particularly for orangutans. Forest restoration in this respect involves the planting of a mix of native species, including the planting of selected native fruit trees that may later serve as a source of food for wildlife. Such plantings cost about RM3 500 (US$1 000) per hectare. The government has also taken bold measures to destroy structures and crops established illegally within forest reserves. Here, reforestation activities are promptly conducted to deter any further encroachment.

The catastrophic Indian Ocean tsunami of December 2004 triggered renewed interests in the protection and management of mangroves. The federal government subsequently allocated substantial funds for the restoration of mangroves (Ong and Petol 2007). However, Sabah's mangroves are largely intact. Not more than 1 500 hectares have been identified for restoration. Therefore, the restoration of mangroves is not considered a critical issue in forestry.

Table 2. Financial allocation for restoration purposes, 2003-2008

Funding agency	US$ million
Sime Darby	6.0
NewForest	5.0
World Wide Fund for Nature	1.0
HSBC	0.6
IKEA	2.0
Innoprise-FACE Foundation	2.5
Government funding	6.0
Others	0.5
Total	**23.6**

Constraints and opportunities

Political support

Political support, as well as support from the highest levels of government administration, is seen as an important determinant of success for any forestry projects. Politicians are key decision-makers, particularly in the approval or allocation of large parcels of land for restoration, as well as the approval of funds. In order to get this support, the Forestry

Department has to be seen as a highly credible and relevant government agency that reflects government policy in action. For example, engaging local communities in restoration contracts is a positive way of rallying political support.

Procurement of planting material

The procurement of planting material, both in terms of quantity and quality, can be a limiting factor in large-scale restoration projects, particularly for native species. In an effort to promote and support the planting of native species, the Sabah Forestry Department has initiated the establishment of seed orchards of native trees. In addition, the fruiting of trees in the wild is also being continuously monitored. Where possible, the Forestry Department buys seedlings from nurseries operated by rural communities. The department also gives special permission to local communities to collect seeds and wildlings from selected forest reserves.

Supervision

Most planting failures can be traced to poor field supervision. Therefore, good supervision is perhaps one of the most important factors in determining the success of any restoration efforts. Supervision at all levels is necessary, from the hardening and selection of seedlings, through to the planting and tending stages.

Establish and maintain good models

Models serve to showcase good forest management and are useful tools for demonstrating the viability of forest restoration projects, especially to policy-makers and prospective financiers. Models should be developed to demonstrate the various technical and functional aspects of forest restoration in an operational scale, e.g., timber stand improvement, enrichment planting, forest plantations and local community participation.

Funding

Forest restoration is a costly endeavour and funding can be a crucial factor in determining the success of any restoration project. Before embarking on any restoration projects, it is important to ensure that there are sufficient funds to tend and maintain plantings until they are fully established. The Forestry Department continues to explore innovative means of financing forest restoration. One recent initiative is an agreement with a USA-based company, NewForest, to establish the 'Malua Bio-Bank' covering the entire Malua Forest Reserve. The idea is to sell so-called biodiversity credits (expressed in units of 100 m^2) over the entire reserve.

Fires

Fires can be a serious threat to forest rehabilitation efforts, particularly in *Acacia* plantations. Since most fires are induced by humans, public awareness and enforcement measures during periods of drought are important. Since the last El Niño event in 1998, the department has run an active training programme in fire prevention and control. At the same time, most forestry districts are equipped with the necessary firefighting equipment.

Conclusion

The tasks of restoring degraded forests are confronted by many challenges. However, the fact that trees are renewable resources, presents a basis and an opportunity for sustainable management. For any restoration project to be successful, security of land tenure is imperative, especially because this aspect is also a key criterion for forest certification. Therefore, for permanent land use, there must be a firm government resolve to recognize forestry as a legitimate and permanent use of land, either by legislative decree or through strict forest policies, thereby removing the option for conversion. But amidst the mounting pressure for land, the challenge will be to convince the public, as well as policy-makers, to maintain the status quo in the area of forest reserves designated for forestry use (particularly timber production), and to recognize that this particular class of land as an asset will remain more valuable under forest cover as opposed to other forms of land use.

Funding forest restoration is a central issue for forestry in Sabah today. Should funds be made available, timber-related activities in natural forests would best focus on timber stand improvement and restoration. For purely economic reasons, it appears more than likely that forest plantations will eventually replace natural forests as the principal source of commercial timber in Sabah. Given sufficient time, natural forests can still be expected to contribute to timber production as their timber productivity is gradually restored. However, production from natural forests will probably be best managed for high value timber crops on long cutting cycles of not less than 35 years, and any timber stand improvement activities in logged forests would best be considered as a restorative measure rather than an economic venture. For timber production, the forest management model most likely to succeed in the future would be a combination of intensively cultivated forest plantations and extensively managed natural forests. In addition, provisions for environmental services, as well as recreational use, are expected to become a more prominent aspect of integrated forest management.

How to add socio-economic value to degraded forests, even during a prolonged cessation of timber production, is the challenge confronting forestry in Sabah. The importance of a highly innovative and effective forestry department in surmounting such a challenge cannot be overemphasized. The ultimate test of competency for the

Forestry Department in Sabah will include influencing land-use policy and public opinion in support of forestry, sourcing of badly needed funds for forest restoration and adapting to the changing values of a society that is becoming increasingly influential in decision-making.

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Forest resources and regeneration in the People's Republic of China

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Basic forest resource information

Vast in area, China is endowed with favourable geographical and climatic conditions. Its territory extends from north to south crossing many types of climatic zones. Distributed from north to south are coniferous forest, mixed coniferous and broadleaf forest, deciduous broadleaf forest, evergreen broadleaf forest, monsoon rain forest and rain forest. The rich varieties of plants and forests have formed unique, diversified and colourful forest landscapes.

The country has 169.02 million hectares of forested land, including 142.79 million hectares of forest stand, 21.39 million hectares of economic forest and 4.84 million hectares of bamboo forest.

The area of natural forest totals 115.76 million hectares, of which forest stand covers 110.49 million hectares, economic forest 2.08 million hectares and bamboo forest 3.19 million hectares. Human-induced forest covers an area of 53.26 million hectares, of which forest stand is 32.30 million hectares, economic forest 19.31 million hectares and bamboo forest 1.65 million hectares.

The forest stand's timber volume is 84.73 m^3 per hectare; natural forest stand timber volume is 95.87 m^3 per hectare; and in plantations it is 46.59 m^3 per hectare. The average yearly growth of forest stand comes to 3.55 m^3 per hectare, the average crown closure is 0.54 and the average diameter at breast height (DBH) is 13.8 cm.

The geographical distribution of forest is closely related to natural conditions, social and economic development. As a result of human activities and natural calamities over a long period of time and unbalanced economic development among different regions, the geographical distribution of forest is extremely uneven in China.

The drainage area of the seven major rivers constitutes nearly 50 percent of the total national land area. The total forest area and stocking volume account for more than 70 and 60 percent of the country's total respectively. The area and stocking volume of the forest in the drainage areas of the Heilongjiang River and Yangtzi River constitute about 50 percent of China's total forest area respectively (Table 1).

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Table 1. Forest distribution by river valleys

Unit	Forest coverage (%)	Forest area (10 000 ha)	Forest stocking volume (100 M m^3)
Yangtzi River	30.53	5 495	31.68
Helongjiang River	45.29	3 866	32.06
Zhujiang River	39.91	1 765	6.96
Yellow River	13.62	1 025	4.10
Liaohe River	23.50	516	1.37
Haihe River	11.40	299	0.50
Huaihe River	11.41	307	0.87

The land area covered by the five major forest regions makes up 40 percent of the country's total, the forest area accounts for nearly 80 percent of the country's total forest area and the stocking volume more than 90 percent of China's total (Table 2).

Table 2. Forest distribution by five major forest regions

Unit	Forest coverage (%)	Forest area (10 000 ha)	Forest stocking volume (100 M m^3)
Northeast Inner Mongolia Forest Region	62.17	3 778	31.56
Southeast Low Mountain and Hilly Forest Region	48.18	5 358	21.03
Southwest Mountains Forest Region	20.69	3 911	49.13
Northwest Mountains Forest Region	36.81	479	4.90
Tropical Forest Region	38.91	1 030	9.03

The Sixth National Forest Inventory results show that great changes have taken place in China's forestry. The forest area and stocking volume have presented an increasing trend, the coverage of forest has steadily increased, the forest structure has further improved and forest quality has also been enhanced. Forest conservation and development have now entered a new historical stage.

Forest regeneration in China

In the National Standard Code of Forest Harvesting, there are three kinds of forest regeneration as follows:

Artificial regeneration

Artificial regeneration is used in the following situations:

- Changing species composition.
- Clear-felling of sites.

- Renovation of low-yield (low-benefit) forest after clear-felling.
- Where there are skid tracks, landings, temporary camps and quarries after clearing for forest rehabilitation.
- In areas for regeneration of industrial raw material plantations and economic forests.
- At sites damaged by improper or illegal harvesting.
- At sites relatively difficult to regenerate by natural means, or difficult to regenerate to the required standard in a specified period.

Artificial assisted natural regeneration

At the following sites where the regeneration standard cannot be reached by natural means in a specified period, artificial supplementary measures should be taken to promote natural regeneration:

- Shelter-wood harvested sites.
- Low-yield (low-benefit) forest land for enrichment or integrated renovation.
- Harvested areas with many reserved natural seedlings and young trees of target species, which are unevenly distributed or difficult to regenerate to the required standard within the specified period.

Natural regeneration

Natural regeneration is used where there is:

- A harvested area after selection cutting and shelter-wood cutting.
- Low yield (low-benefit) forest land after selection cutting.
- A harvested area with many reserved natural seedlings and young trees of the target species, which are evenly distributed and can reach the regeneration standard within the specified period.
- A harvested area with many reserved, evenly distributed seed trees for natural seedlings, or with trees of good sprouting capacity, which can reach the regeneration standard in the specified period.
- A harvested area to be kept as a natural stand, in good condition, with sufficient rainfall and capacity for natural seedlings and sprouting.

At sites where the regeneration standard cannot be reached by natural means in a specified period, artificial supplementary measures should be taken to promote natural regeneration, i.e., in:

- Harvested areas with many reserved natural seedlings and young trees of the target species, which are unevenly distributed.
- Other harvesting areas that suit natural regeneration.
- Low-yield (low-benefit) forest land for enrichment or integrated renovation.

Regeneration requirements

- Forest management units (enterprises) should plan for regeneration of unregenerated cut-over areas, burnt-over areas, open land in forest and barren areas suitable for afforestation. These areas should be regenerated within a specified period.
- The survival rate is generally more than or equal to 85 percent of the same year for artificial regeneration; in northwest China and areas with annual mean precipitation of 400 mm or less it is more than or equal to 70 percent; for promoted natural regeneration it is more than or equal to 85 percent.
- The survival rate in clear-felling harvested areas is more than or equal to 80 percent; in northwest China and areas with annual mean precipitation of 400 mm or less it is more than or equal to 65 percent.
- The regeneration frequency should be more than or equal to 60 percent in harvested areas of selection cutting, and more than or equal to 80 percent for the shelter-wood cutting area.
- The regenerated area with a qualified survival rate in the first year should reach 95 percent of the total harvested area. The regenerated area with a qualified preservation rate in the third year should reach 80 percent of the total harvested area.
- Appropriate regeneration methods should be selected for forest regeneration by scientific selection of tree species, mixture of suitable sites, use of superior seeds and seedlings, good site preparation, proper density, careful stewardship and timely tending. For details, refer to the National Norms GB/T15776, GB/T15163 and GB/T18337.3.

Forest management policies in China

China is a country deficient in forest resources. To increase them, improved afforestation and forest maintenance nationwide are proceeding at an accelerated pace. At the same time, a series of measures have been taken to reduce the consumption of forest, mainly based on the annual allowable cut. China's forest management system includes forest harvesting, timber transportation and timber processing.

Management system for forest harvesting

According to the provisions of the Forest Law and Regulations on Implementation of Forest Law, the management system for forest harvesting includes the annual allowable forest cut system, the licence-based harvest system and the annual timber production planning system.

Annual allowable forest cut system

Article 29 of the Forest Law stipulates that in compliance with the principle that the

consumption of timber shall be lower than growth, the state shall impose strict controls over the annual forest cutting volume. In the formulation of annual cutting quotas, state-owned enterprises, institutions, farmland, factories or mines shall be calculated as units for state-owned forests and trees, and the county as a unit for collectively used forests and trees and privately owned trees. The competent forestry authorities at the provincial, autonomous region and directly administered municipality levels shall compile a summary sheet, which shall be submitted to the State Council for approval after examination by the people's government at the same level.

Article 28 of the Regulations on Implementation of Forest Law stipulates that the annual cutting quotas approved by the State Council shall be verified every five years.

Since its implementation in 1987, the annual allowable forest cutting quota system has played a significant role in protecting forest resources, curbing consumption of forest resources and cracking down on illegal logging; it has been improved through practice. During the 8th Five-year Plan period commercial timber, farmers' timber for private use, timber for the cultivation industry and fuelwood were all included in the annual forest cutting quota; thus, management of the gross volume of forest cutting and control over each subquota are undertaken for forest resource consumption and its structure. During the 9th, 10th and 11th Five-year Plan periods, a subquota based on the category of harvest was added, thus making the annual forest cutting system more scientific and standardized.

Licence-based forest harvest system

This is an important measure to ensure the implementation of the annual forest cut quota system and an effective way to curb unwise consumption of forest resources, sustain their growth and prevent deforestation.

The Regulation on Protecting Forest and Developing Forestry issued by the State Council makes it clear that the licence-based forest harvest system shall be implemented across the country. According to the Forest Law, to cut trees, it shall be necessary to apply for a cutting licence and conduct the cutting according to the provisions of the licence. The issuing authorities for cutting licences include competent forestry authorities or other authorized sectors or institutions. Cutting licences cannot be issued for the following situations:

- Harvest of shelterbelts and forests for special use for non-tending or non-regenerating purposes; or cutting of trees during mountain closure of trees during mountain closure periods or in closed mountains.
- Reforestation tasks have not been fulfilled following harvest in the previous year.
- Preventive and remedial measures have not been taken when significant deforestation, forest fires or pests and diseases have occurred in the previous year.

Management system for timber production planning

Article 30 of the Forest Law provides that the national government develops the annual production plan, which shall not exceed the approved annual allowable cut. Article 29 of the Forest Law provides that cutting of forest and trees for sale must be included in the national annual timber production plan.

Article 39 of the Forest Law provides that cutting of forest and trees in excess of the timber production plan shall be punished as is done for deforestation.

The management system is in line with the reality and forest situation of China. It is among the legal means for the government to control and regulate the annual volume of commercial timber and to ensure that the annual cutting of commercial timber shall not exceed the cutting quota. The annual timber production plan as well as the legal criteria for timber production are developed by the State Council.

Management system for licence-based timber transportation

This is a management system for forest resources, in parallel with the annual allowable cut and the licence-based timber harvest system. It is an important measure to maintain discipline in normal timber transportation and prevent illegally cut timber from entering circulation.

Article 37 of the Forest Law provides that transportation licences issued by forestry authorities are mandatory for transporting timber out of the forest, except for timber allocated by the national government. Article 35 of the Regulations on Implementation of the Forest Law provides that the timber transportation licence shall be valid from the source to the destination and must accompany the timber. No institution or individual can be a carrier without a timber transportation licence.

There are two categories of timber transportation licences: (1) between provinces; and (2) within a province. The timber transportation licence between provinces shall be designed and printed out by the forestry authority of the State Council. The timber transportation licence shall be issued by the forestry authority at the provincial level or by other authorized institutions.

The timber transportation licence within a province shall be issued and printed out by the provincial forestry authority at or above the county level.

Management system for timber processing

All of the aforementioned systems have given rise to an integrated management system. Article 34 of the Regulations on Implementation of the Forest Law provides

that timber processing in forest areas must gain the approval of forestry authorities of the people's government at or above the county level. No institutions or individuals are allowed to purchase timber logged without cutting licences or from other illegal sources. The licence-based system for timber processing is implemented across most provinces. Institutions or individuals engaged in timber processing must apply for and receive the timber-processing licence from forestry authorities at or above the county level before applying for the business licence from industrial and commercial authorities. Otherwise the industrial and commercial authorities shall not issue the business licence.

Opportunities for including ANR in reforestation in China

Before the 1990s, most of the plantations in China comprised one-species forest and were human-induced. Now, with more and more attention being paid to ecological benefits and the environment, natural forest, semi-natural forest or unevenly aged and mixed-species forest are receiving more and more attention. In this context, the Chinese Government is revising old or devising new administration policies, technical standards or related regulations. This will motivate forest managers to use natural elements to build or rebuild forests. Consequently, ANR will become increasingly more important in forestry production and will play a greater role in reforestation schemes.

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Advancing the application of assisted natural regeneration for low-cost forest restoration in Viet Nam

Vo Dinh Tuyen[1]

Forest status and forest degradation in Viet Nam

The forests of Viet Nam have dramatically decreased during the last 60 years, even though there has been an increase in their area recently. Before 1945, when Viet Nam was under French colonial rule, forests had been harvested heavily for timber and poles as well as for rubber and coffee production. However, at that time the forest area was still considerable as it covered around 43 percent of the country. From the early 1960s to 1975, the forests of Viet Nam were severely damaged by the long war with the United States, overexploitation and shifting cultivation. By 1976, the total area of forests had been reduced to 11.2 million hectares (covering 33.8 percent the country), of which only 10 percent remained intact. Since 1976, forests have continued to be destroyed for many reasons. As a result, forest cover had declined to an estimated 30 percent in 1985, and 27.7 percent in 1995.

In 1998, the 5 Million Hectare Reforestation Programme (5 MHRP) was launched with a target to plant 5 million hectares of forests by 2010, restoring the forest cover to 43 percent. The programme has aimed not only to reforest, but also to protect existing natural forests. As a result, the forest cover of Viet Nam has gradually increased. In 2008, the forest area of Viet Nam was over 13 million hectares, of which over 10 million hectares were natural forests and over 2.5 million hectares were plantation forests, resulting in forest cover of 38.7 percent.

Planted forests in Viet Nam are distributed unequally, due to the different land conditions. The Red River Delta Region and Central Highlands have less planted forest compared to other regions of the country. The Northeastern Region, the Northern Central Region and the Coastal Plains Region have numerous plantation forests. In these areas, the wood-processing sector has developed and made a notable contribution to the local economy.

Overview of policy-level instruments for forest restoration and rehabilitation

The National Assembly of Vietnam has ratified the Law of Forest Protection and Development. This law has concretized the allocation of forest-planting land to organizations, individuals, households and communities in the form of leasing the forest and forest land over a long-term period to make good profits from forestry production.

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The state gives priority to the allocation of land and forest to local communities, cooperatives and householders for management purposes and to derive long-term benefits from definitive planning by jurisdictional levels from central to provincial areas. This encourages the establishment of intensive plantations in many forms, for example households and individuals lease or merge their own stocks, including forest and forest land under their tenure after leasing from the government. These changes have informed public opinion and enhanced local awareness on the value of planting forests. The Government of Viet Nam (GoV) acknowledges the role of different economic sectors in forest protection and development. This facilitates the policy of developing a multisector commodity economy and fosters a market-oriented mechanism under the management of the GoV. It has generated many good results. The National Forest Strategy, 2006-2010 has been approved to help development of the forest sector and has mobilized overseas investment in this context.

There are also several policies related to landownership, forest management, finance, science and technology that help to encourage stakeholders to invest in the forest sector.

Recent efforts at the national level for promoting natural forest restoration and rehabilitation

From 1992 to 1998, the GoV initiated two forest planting programmes to address environmental problems related to deforestation: Programme 327 and the 5 MHRP. Programme 327 was launched for watershed protection. The 5 MHRP has wider scope aiming at establishing forests of every category.

Programme 327 – Watershed Protection Programme (1992-1997)

A precursor of the 5 MHRP – Greening the Barren Hills, also known as Programme 327 – was initiated in 1992. Originally the programme had a wide range of objectives ranging from “re-greening the major part of the degraded hills” to “creating incomes to the State and consolidating the national security”. Later, in 1996, the programme was re-emphasized to concentrate on the protection and re-establishment of watershed and special-use forests.

The programme had a strong top-down and state control emphasis. All financing took place through state farms and enterprises. In areas where such institutions did not exist, they were formed for the sole purpose of obtaining financing for plantation projects. Project approval was also a complex process initiated at the district level. Final decisions were, however, always made at the central level. Neither were there specific practical project-planning guidelines – project planning was carried out based on an ad hoc interpretation of various decrees and circulars. However, the recipient communities were not involved in the planning processes.

The areas where project money was to be used included:

- Infrastructure, scientific and technical facilities.;
- Public welfare;
- Reforestation and seed production;
- Subsidies to families wishing to reclaim unused land; and
- 40 percent of the financing could be used for interest-free loans to project area households.

Revenue originating from project support was shared between individual households (50 percent in planted forests, 25 percent in the case of protecting existing forest) and the GoV (50 and 75 percent respectively).

Large-scale plantation programmes such as Programme 327 and possibly the 5 MHRP tend to have notable problems in their implementation. The ones specific to Programme 327 were identified in a World Bank review:

Top-down approach, bureaucracy and lack of participatory approaches

- Constantly changing objectives, and insufficient and erratic financing.
- Problems in land allocation.
- Many projects were developed purely to support ailing state forest enterprises.
- Poor quality in seeds, seedlings and implementation work.
- Lack of knowledge on species selection and silvicultural methods and approaches.
- No market orientation in commercial activities.
- Many projects were considered alien by the local communities; poor households give higher priority to food security than to wood production.
- Long-term viability of the plantations remains to be seen.

The review concluded that the shortcomings identified jeopardize achieving the broad objectives of the programme.

The 5 MHRP is viewed as a continuation of Programme 327. Some, but by far not all, problems identified in 327 have been corrected in the new design. However, the top-down approach and the lack of community participation as well as inadequate social and biological knowledge – the most notable issues – have not been tackled. The most apparent modification in project approach is the switch from protection to production forests. The households will also be entitled to a higher share of logging revenues (up to 100 percent).

Five Million Hectare Reforestation Programme (1998-2010)

After this programme has been completed in 2010, most natural forests will be 'closed', i.e. logging will be disallowed. The programme includes both reforestation and 'active protection' of existing forests. The objective is that by 2010, forests will cover 14.3 million hectares.

Sixty percent of the plantations were established for production purposes, one-third for watershed protection and the remainder for the protection of coastlines, flood control, etc. The production plantations are classified by the end-use of the wood; most of them use fast-growing exotic species for pulp production including some bamboo plantations. The furniture wood plantation category also includes 120 000 hectares of rubber plantations, rubber often being classified as an agricultural product.

Participatory approach to involve all stakeholders including indigenous people

Land-use planning is carried out with the full participation of different stakeholders who are entitled to allocated land and who live in local villages or communes. Participatory and rapid rural appraisal approaches need to be used to encourage local people's participation. Land-/forest land-use planning and allocation have strong cooperation from state officers and technicians from various levels who visit villages and communes for allocation purposes.

There is a need to ensure specialized cooperation among agroforestry, land administration and other relevant units. District and management officers need to support people in communes or villages in preparing land-/forest land-use planning and allocation plans, to assist them in understanding relevant policies and mechanisms, to provide them with technical guidance and to facilitate administrative procedures during the implementation process.

The GoV has initiated plantation programmes to replace the closed forests. Based on previous experiences from plantation programmes, the 5 MHRP may possibly not meet all, or even most, of the expectations. There is need for a detailed analysis of the demand–supply projections and redesigning parts of the wood supply strategy, particularly in view of declining imports from neighbouring countries.

The following issues should be addressed in the development of a national wood supply strategy:

- Redrafting the 5 MHRP taking into consideration the problems identified in Programme 327, and re-analyse the wood supply potential.
- Assessing the feasibility and need for 'closing the forests'; will the logging ban

be respected and would strict, but feasible, management provide better results with lower economic costs?
- Curtailing illegal logging by both effective on-site and transport control, and chain-of-custody monitoring.
- Rural communities both as suppliers and consumers of wood.

Main opportunities and challenges at national, regional and community levels for forest restoration and rehabilitation

Perceived strengths in planted forest management

The GoV has striven to develop planted forests in the country, for example the 5 MHRP. Recently, it has introduced the Forest Development Strategy for 2006 to 2020, in which planted forest development will play a very important role in the forest sector. Otherwise, the GoV has launched many programmes and projects aiming to increase planted forest area nationwide and to improve living standards and infrastructure in rural areas for local people. Planted forest plays an important role in terms of protecting the environment and improving local livelihoods. Silviculture has also been introduced with new and suitable species as well as innovative techniques. The media network is helping local people to acquire and apply knowledge and techniques. The market for planted forest products has developed considerably putting greater demand on the development of planted forests at the moment and in coming years.

Many foreign and private companies and enterprises are very interested in finding suitable forest land for establishing new plantations. A number of international customers are now requiring that products from planted forest should have international certificates. This is forcing central and provincial governments and also many large forestry companies who own forest plantations to improve their forest management techniques in order to meet international standards.

Perceived weaknesses in planted forest management

There are several weaknesses in planted forest management:

- Investment in planted forests is low, especially funding to protect forests. This hinders the establishment of quality forest in terms of seedling selection, thinning/ pruning and other necessary silvicultural practices.
- The minimum rotation for a planted forest to provide a better yield is more than eight years; but due to financial stringencies, some plantation owners or local farmers are cutting at years 6-8 or even earlier to get some return from their investment because of high interest rates from the bank. They cannot afford to wait longer even if they realize that they will achieve greater benefits from their plantations. At this stage the young and small diameter logs are only suitable for

pulp and paper production. This is a common situation in all plantations owned by local farmers who used their own money to establish their plantations; the GoV has little control in terms of area, species and the time for harvesting. There is little information at the provincial level for the planted area owned by local people, species composition, annual yield and what volume to be extracted per hectare due to the poor reporting system at the provincial level.

- There is a limited understanding, especially among local farmers, on planning the density of their plantations and how to conduct activities such as thinning during the rotation.
- There is lack of information on the market both for domestic and export purposes, especially for local farmers who live in rural areas with no access to useful information.
- The markets are open, but not very stable for local people. In many areas such as the Southeastern Region, planted forests have to compete with species such as rubber and pepper. It is difficult for planted forests to develop without suitable policies from the GoV.

Potential threats in planted forest management

- There is intense competition between wood chip and paper production in the national furniture industry. This has a significant influence on how stakeholders decide to cultivate their land. For example, only a few species from planted forests have market demand such as *Acacia*, *Eucalyptus* and *Pinus*. Native species such as *Styrax* and *Manglietia* in plantations are now gradually being replaced by *Acacia*, mostly in the northern provinces, due to less demand.
- New and exotic tree species that are being explored will run the risk of diseases and pests.
- As planted forest areas are developing very quickly, owners do not pay much attention to protecting the environment. This leads to soil erosion and degraded land, which impede cultivation.

Potentials for other forms of forest restoration

In order to supplement forest plantation establishment, especially in those areas that have important biodiversity or are watershed areas, other forms of silvicultural techniques could be applied, which focus on supporting natural succession and local species.

One successful example is planting multipurpose trees around schools, villages, offices and different public areas; in the past 50 years this has shown significant results. These types of activities could help in the increased involvement of local people and especially can contribute to fire prevention.

However, the main objective of reforestation needs to be considered as well as the available funding. It is important to learn more about the benefits of forest restoration and to invest more in research that will promote different aspects in order to make forest restoration activities applicable at a large-scale level.

Appendix 1: List of Participants

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Assisted natural regeneration (ANR) is a forest restoration and rehabilitation practice successfully used for converting *Imperata cylindrica* and other grass-dominated areas into productive forests. It is a simple, inexpensive, and effective technique that relies on the natural processes of plant succession. ANR application is based on fire prevention and management, control of grazing, suppression of grasses, and nurturing of seedlings and saplings of indigenous trees.

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