

Status of forest genetic resources conservation and management in Lao PDR

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Introduction

The Lao People's Democratic Republic (Lao PDR) is a landlocked country covering an area of 236 800 km². Lao PDR is in the watershed of the Mekong River, which forms about half of the country's border with Thailand. In 1997, the per capita GNP was only US\$ 414, though the GDP grew at an annual rate of 6.5% (FAO 2001) and population reached 5.4 million in 2001 (MAF 2001). The country is predominantly mountainous, with 80% of its land area consisting of hills and mountains rising from 100 to 2820 m above the Mekong River plains. The remaining 20% comprises lowland plains of the Mekong and its main tributaries as well as the adjacent flat and undulating plains. These alluvial plains range in elevation up to approximately 200 m above sea level.

The National Forest Inventory and Planning Division (NOFIP) conducted a Nationwide Reconnaissance Survey in 1992 (NOFIP 1992) and divided the land use and forest types into six main land-use groups as follows:

- Current Forest Areas (evergreen, dry dipterocarp, mixed deciduous, gallery, coniferous, mixed coniferous and broadleaved forest)
- Potential Forest Areas (bamboo, unstocked and ray (forest land after shifting cultivation) areas)
- Other Wooded Areas (savannah/open woodland, heath/scrub)
- Permanent Agriculture (rice paddy, agriculture plantation, other agricultural land)
- Other Land Use Areas (barren land/rock, grassland, urban areas, swamp)
- Water (river, reservoir)

A summary of land use in Lao PDR is provided in Tables 1 and 2.

Table 1. Land use and forest cover in Lao PDR in 1989

Land use	Northern region	Central region	Southern region	Country total
Current Forest	36%	52%	59%	47%
Potential Forest	56%	28%	21%	38%
Other Wooded Land	4%	8%	9%	6%
Other Non-forest Land	3%	8%	4%	5%
Permanent Agriculture	1%	4%	7%	4%
Total	100%	100%	100%	100%

Table 2. Land use and vegetation types in Lao PDR in 1992 (Khamphay & Mats 1992)

Land-use group/ land-use and vegetation type	Area	
	(%)	(1000 ha)
1. Current Forest (CF)	47.2%	11182.0
Dry Dipterocarp (DD)	5.1%	1206.5
Dry Evergreen (DE)	4.8%	1146.5
Mixed Deciduous (MD)	35.1%	8334.9
Gallery Forest (GE)	0.4%	87.5
Coniferous (S)	0.6%	132.3
Mixed Coniferous/ Broadleaves (MS)	1.2%	280.5
2. Potential Forest (PF)	37.8%	8949.0
Bamboo (B)	6.5%	1531.9
Unstocked (T)	26.7%	6791.4
Ray (RA)	2.6%	625.6
3. Other Wooded Areas (OW)	6.1%	1444.4
Savannah / Open Woodlands (SH)	3.9%	912.5
Heath, Scrub Forest (SR)	2.2%	531.7
4. Permanent Agriculture Land (PA)	3.6%	849.5
Rice Paddy (RP)	3.3%	789.4
Agriculture Plantation (AP)	0.1%	17.8
Other Agriculture Land (OA)	0.2%	42.3
5. Other Non-Forest Land (NF)	5.4%	1269.5
Barren Lands / Rock (R)	0.5%	116.1
Grassland (G)	3.5%	822.8
Urban Areas (U)	0.4%	84.2
Swamps (SW)	0.1%	35.4
Water (W)	0.9%	210.9
TOTAL	100%	23680.0

Forest resources

Lao PDR is still quite rich in forest resources compared to many other Asian countries. However, the relatively abundant forest resources of the Lao PDR are disappearing fast. According to the national forest reconnaissance survey, in 1940 the country had about 17 million hectares of forest, accounting for 70% of the total land area. However, forest areas have diminished rapidly, accounting for only 47% of the total land area in 1992. The causes for the forest loss include encroachment into forest for permanent cultivation, slash and burn cultivation, forest fires, legal and illegal logging as well as infrastructure development.

Current economic importance of the forestry sector

The forest and forestry sector plays an important role in the national socioeconomic development process. On the other hand, forests have a role in protecting the environment, prevention of soil erosion, drought and flood hazards, maintenance of watersheds and watercourses, which are habitats for many kinds of fish and aquatic species and important for agricultural production as well as industrial development, particularly hydropower generation. However, the forests play a very significant role in economic development, income generation as well as in the livelihoods of the rural people. The forestry sub-sector contributes 8% of the national GDP (MAF 2001).

Silvicultural approaches

The National Forest Inventory and Planning Office (National Forest Inventory and Planning Division) under the Forestry Department plays an important role in the management of natural forest resources by carrying out forest management plans, pre-logging surveys and tree marking. In selective cutting, cutting limits for each species are based on the actual state and balance of forest types and species composition. The selection of suitable species and design for planting programmes is based on socioeconomic factors and environment in each planting zone.

Conservation of forest genetic resources

Lao PDR, a landlocked country, is rich in biodiversity of flora and fauna compared to the neighbouring countries and other countries in the region. Lao PDR is one of the hotspots of biodiversity in the region, yet the country is lacking in basic floristic information. According to Xu Zai Fu (1994), there are at least 8000 to 11 000 species of plants in Lao PDR. As for fauna, 100 species of bats, over 100 species of large mammals, 700 species of birds and 166 species of reptiles and amphibians have been documented in the country (Duckworth *et al.* 1999).

The Ministry for Agriculture and Forestry (MAF) provided a national list of tree species in the conservation category and only limited commercial cutting is permitted for species in this category (MAF 1997). Later, the Forestry Research Centre (FRC) identified 114 priority tree species (FRC 1999). Greijmans and Phongoudome (2003), Greijmans and Inthavong (2003), Greijmans *et al.* (2002a) and Greijmans *et al.* (2002b) prepared the national status report on the conservation of forest genetic resources (FGR) in Lao PDR. This study included information on distribution, occurrence and conservation status of selected species as well as a seed zoning system. The results of these studies were based on a database involving more than 113 indigenous tree species. The NOFIP and the National Agriculture and the Forestry Research Institute (NAFRI), with the help of national as well as international experts assessed the status of selected species in the country (for results, see Appendices 1 and 2 and Figure 1.)

Between 1998 and 2002, establishment of some National Biodiversity Conservation Areas (NBCAs), namely Nam Et-Phou Loie, PhouKhaoKuay and Phouphanang was supported by the Netherlands Committee for IUCN (NC-IUCN), Danish International Development Agency (Danida), Swedish International Development Cooperation Agency (SIDA) and other agencies. A few botanical surveys were conducted.

Bamboo and rattan diversity

In 1994 the International Development Research Centre (IDRC) supported the FRC to conduct a survey of bamboos in Lao PDR. In total, 8 genera and 93 species were documented, of which 50 were identified and 43 are still unidentified (Sengkhamyong 1994). Vichit (2000) also provided a list of priority species based on seed demand and supply. In 2001, the Darwin Initiative supported the FRC to conduct a study on the ecology of rattan in Lao PDR. A total of 6 genera and 51 species were documented, of which 3 genera and 32 species are still unidentified (Evans *et al.* 2001).

Threats to genetic diversity of forest species

Xiong and Gilmour (2000) assessed the causes of threats to forests and species genetic diversity in Lao PDR. The five main threats identified were encroachment into forest for permanent agriculture, shifting cultivation (with short rotational cycle), forest fires, legal and illegal logging and infrastructure development.

Current FGR conservation activities

Both *in situ* and *ex situ* conservation efforts are rare in Lao PDR and there is hardly any data on the distribution of FGR. More information should be extracted from, for example, existing provenance trials and demonstration plots to develop plans for the conservation

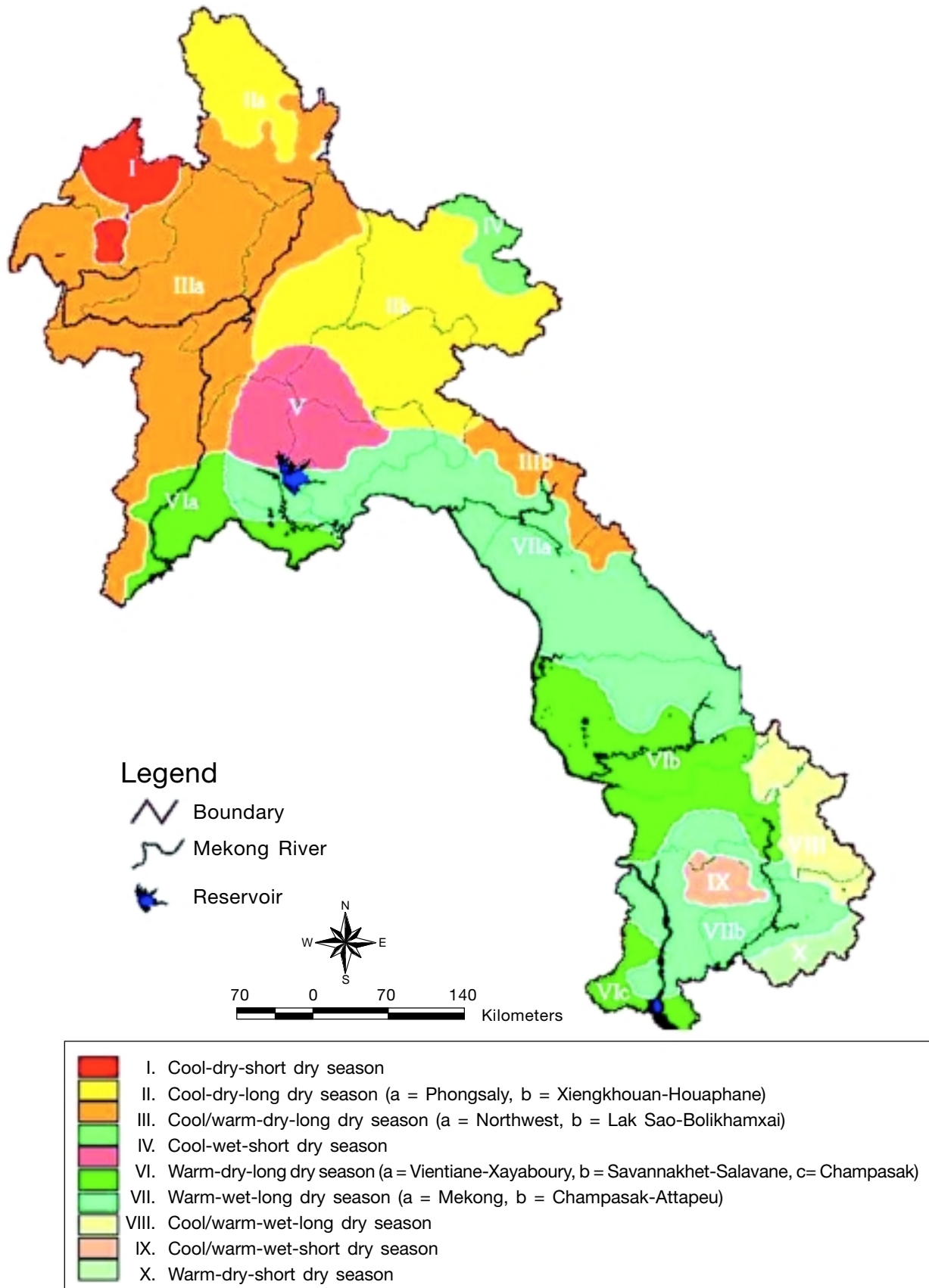


Figure 1. Gene-ecological zoning system for Lao PDR

of FGR. Such plans should be shared with the neighbouring countries, i.e. China, Vietnam, Cambodia, Thailand and Myanmar to learn from their experiences and to enhance regional conservation efforts (Thepphavong *et al.* 2001).

Policies and initiatives relevant to the management of natural resources (including FGR) include the 1st National Forestry Conference in 1989, National Tropical Forestry Action Plan 1990, Nation-wide Reconnaissance Survey (NRS) (NOFIP 1992) and the National Forest Inventory (NOFIP 2000), National Biodiversity Conservation Areas (NBCAs) in 1993 (see Figure 2.), Forestry Law 1996, Land Law 1997 and National Biodiversity Country Report (NBCP) 2003.

Past and present research activities in the field of conservation, utilization and management of FGR

Most research and development activities in Lao PDR emphasize adaptive research, applied research and sometimes basic research on agricultural genetics. Floristic works in Laos have been based on documentation provided by the *Flora of Indochina* (1905–1952) and *Flora of Cambodia, Laos and Vietnam* since the 1960s until today. These volumes were written mainly by French botanists. Some books were also developed specifically for Lao PDR, for example by the French botanist J. Vidal who described the taxonomy of the local tree family of Dipterocarpaceae, later revised by B. Svengsuksa and J. Vidal (Vidal 1959; Vidal 1963; Svengsuksa and Vidal 1997). Some other relevant botanical volumes include: Flora of Thailand (Smitinand 1980; Smitinand *et al.* 1970–2000), Vietnam Forest Trees (Vu Van Dung 1996; Pham Hoang Ho 1999–2001), PROSEA-volumes, etc. There is a lack of young botanists, national herbaria and laboratories for R&D in this area.

Agroforestry, plantations and afforestation programmes

Most agroforestry systems applied in Lao PDR may be classified into two categories:

- Traditional systems (shifting cultivation, economically improved fallows, living fences, plantations of orchards and taungya)
- Modern systems (biologically improved fallows, alley cropping and contour hedgerows)

The purpose of research on suitable agroforestry techniques is to explore plant species for improving local living conditions and the environment. Appendix 3 provides information on the benefits and constraints of different agroforestry systems.

Plantation and afforestation efforts in Lao PDR started during the early French colonial era for some species such as *Tectona grandis* (NOFIP 1991). There has also been testing of exotic species, e.g. *Swietenia macrophylla* and *Eucalyptus* spp. in the central and southern parts of the country since 1970. Some exotic species have been introduced into plantation and afforestation programmes since 1976. Table 3 provides a summary of domestication and plantation activities on some indigenous species. A summary of annual planting areas is presented in Table 4.

Table 3. Summary of some indigenous species used for domestication and plantation (compiled by C. Phongoudome, July 2003)

Species	Area (ha)	Province	Year	Remarks/ source of data*
<i>Azelia xylocarpa</i>	135	Bolikhamsai, Vientiane	1992	
<i>Alstonia scholaris</i>	426	Bolikhamsai	1992, 1991	Report 1995; NOFIP 1991
<i>Anisoptera costata</i>	5	Bolikhamsai, Vientiane, FRC		
<i>Anthocephalus chinensis</i>	5		1994	FRC
<i>Aquilaria crassna</i>	20	Vientiane, Saravan, Champasack		
<i>Azadirachta indica</i>	12	FRC, Vientiane, Champasack	1998	
<i>Cassia siamea</i>	2	Vientiane		
<i>Castanopsis hystrix</i>	5	Xiengkhuang		
<i>C. tribuloides</i>	1	Xiengkhuang		
<i>Chukrasia tabularis</i>	10	Luangprabang		
<i>Dalbergia cochinchinensis</i>	200	Bolikhamsai, FRC	1992	
<i>Dipterocarpus alatus</i>	10	Champasack		
<i>Fagraea fragrans</i>	2	Bolikhamsai		
<i>Gmelina arborea</i>	3	Luangprabang, Vientiane		
<i>Hopea odorata</i>	5	Champasack, Savahnakhet		
<i>Keteleeria davidiana</i>	3	Xiengkhuang		
<i>Lagerstroemia calyculata</i>	1			
<i>Azadirachta indica</i>	285	Champasack, Sekong, Savahnakhet	1994	DAFI 1995
<i>Peltophorum dasyrhachis</i>	1	Vientiane		
<i>Paramichelia bailonii</i>	<10	Sekong, Champasack, Saravane	1995	
<i>Pentace burmanica</i>	5	Champasack		
<i>Persia glambeii</i>	2	Champasack, Saravane, Xaiyabouli		
<i>Pinus kesiya</i>	5	Xiengkhuang		
<i>P. merkusii</i>	5	Xiengkhuang, Bolikhamsai, Huaphanh		
<i>Pterocarpus macrocarpus</i>	1382	Bolikhamsai, Saravane, Savahnakhet, Khammoun, Champasack	1992	NOFIP
<i>Quercus griffithii</i>	1	Xiengkhuang		
<i>Q. serrata</i>	1	Xiengkhuang		
<i>Sandoricum koetjape</i>	6	Champasack,		
<i>Scaphium macropodum</i>	4	Champasack, Attapeu, Saravan, Sekong		
<i>Schima wallichii</i>	1	Xiengkhuang		
<i>Sindora cochinchinensis</i>	1	Vientiane, Bolikhamsai		
<i>Styrax tonkinensis</i>	10	Luang prabang, Oudomxai		
<i>Tectona grandis</i>	8000	ALL	1932–2001	JICA Report 2001
<i>Tetrameles nudiflora</i>	2	Champasack,	1995	
<i>Toona ciliata</i>	1	Vientiane, Luangprabang		
<i>Vatica cinerea</i>	1	Bolikhamsai		
<i>Wrightia arborea</i>	2	Vientiane		
<i>Xylia xylocarpa</i>	3	Vientiane, Khammoun		
Other species	84 436	ALL	2002	Both indigenous and exotic

* Source of data: DAFI 1995 = Development Agriculture and Forestry Industry Database

Demand and supply of tree seed

During the past 20 years, seeds of indigenous species from unidentified seed sources and seeds of local and exotic species from mature plantations as well as imported seeds from original locations for exotic species have been used. The majority of the seeds produced have been used for forest rehabilitation and plantation establishment. A summary of seed collection and seedling production activities is provided in Table 4.

Table 4. Summary of seed collection, seedling production, plantation and rehabilitation activities in Lao PDR between 1978-2002 (compiled by C. Phongoudome, July 2003)

Year	Seed collection (kg)	Nursery (ha)	Seedling production (nos.)	Planting area (ha)		Rehabilitation (ha)	Remarks
				Target	Actual		
1978	2381	n.a.	1 134 366	n.a.	452	n.a.	
1979	5320	n.a.	2 047 649	n.a.	184	n.a.	
1980	2500	n.a.	3 000 000	n.a.	405	n.a.	
1981	7573	n.a.	n.a.	n.a.	176	n.a.	
1982	12 751	n.a.	n.a.	n.a.	202	n.a.	
1983	13 315	n.a.	n.a.	n.a.	350	n.a.	
1984	14 452	n.a.	n.a.	n.a.	310	n.a.	
1985	14 200	n.a.	574 868	n.a.	346	n.a.	
1986	18 579	n.a.	426 200	n.a.	192	n.a.	
1987	4680	n.a.	492 700	n.a.	236	n.a.	
1988	9259	n.a.	513 900	n.a.	316	n.a.	
1989	12 901	n.a.	772 000	n.a.	513	n.a.	
1990	4216	n.a.	927 180	n.a.	716	n.a.	
1991	17 585	n.a.	1 823 820	n.a.	1359	n.a.	
1992	10 400	n.a.	975 250	n.a.	901	n.a.	
1993	6651	n.a.	850 370	n.a.	2219	n.a.	
1994	46 393	n.a.	4 640 470	n.a.	3798	34 170	
1995	47 676	1787	26 382 656	10 000	8828	n.a.	Nursery all sector
1996	13 354	1796	26 707 230	20 000	11 850	6878	Nursery all sector
1997	44 849	1828	17 436 192	n.a.	12 290	4590	Nursery all sector
1998	35 167	1828	12 368 808	n.a.	9030	5780	Nursery all sector
1999	2878	2407	10 172 764	20 000	6350	5800	Nursery all sector
2000	42 843	1983	23 546 267	20 000	15 160	21 304	Nursery all sector
2001	18 783	n.a.	9 430 133	23 000	20 500	n.a.	
2002	2871	n.a.	22 600 000	25 000	15 000	4000	2871 Kg by FRC provinces
Total	411 577	—	201 822 823	118 000	111 683	82 522	

n.a. = figures not available

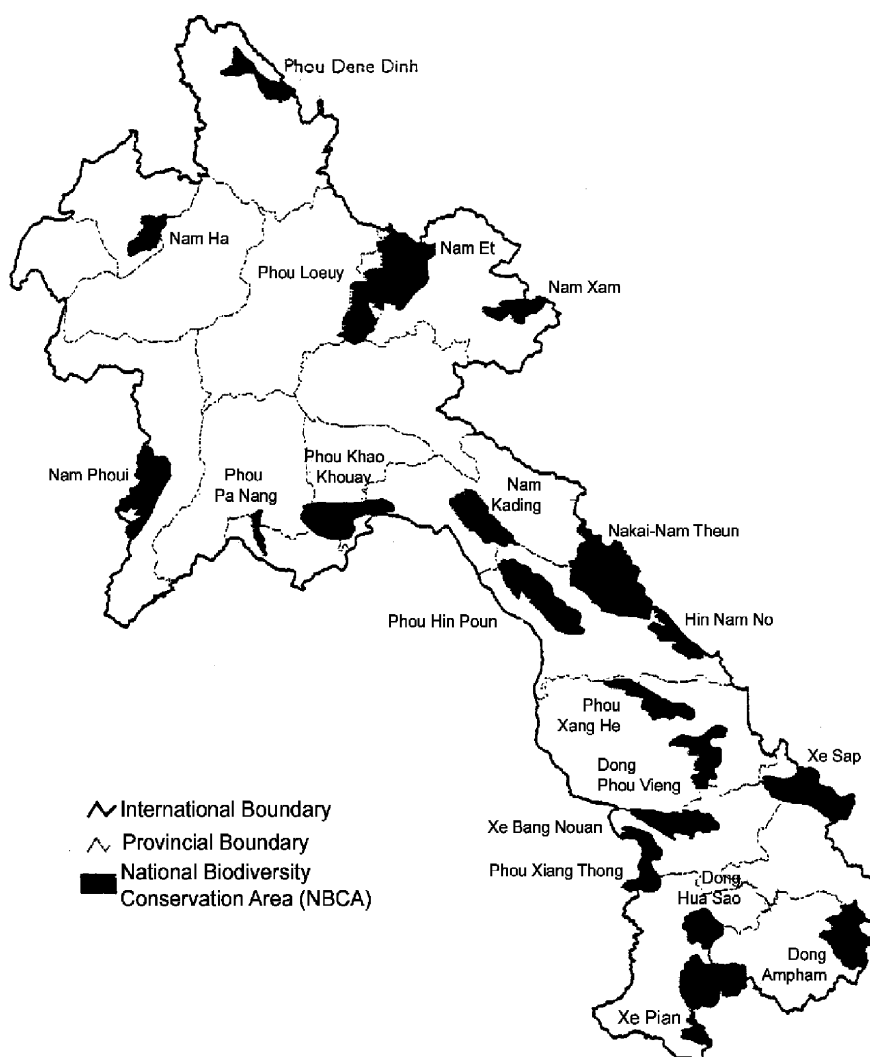
Data compiled from databases of the Forestry Department, Forestry Extension Division, NAFRI Forestry Research Centre, MAF Basic Statistics, Department of Finance and Planning and the LTSP.

***In situ* conservation**

Presently the emphasis of most *in situ* conservation activities is on protected areas and NBCAs (Figure 2). Table 5 provides a summary of different types of conservation areas in Lao PDR.

Table 5. Conservation areas in Lao PDR in 1993

Category	Units	Area (ha)	%	Remarks
National Biodiversity Conservation Areas (NBCA)	20	3 315 200	14.0	See Figure 2.
District Conservation Forests	144	503 000	2.1	Excluded from Fig. 2.
Provincial Conservation Forests	57	932 000	3.9	Excluded from Fig. 2.
District Protection Forests	52	55 713	0.2	Excluded from Fig. 2.
Provincial Protection Forests	23	461 410	2.0	Excluded from Fig. 2.
Total	296	5 267 323	22.24	

**Figure 2.** National Biodiversity Conservation Areas (NBCA) in Lao PDR

Ex situ conservation

Demonstration plots for some indigenous species have been established by the FRC/Lao Tree Seed Project (LTSP). The purpose of these demonstration plots is to conserve the high economic value indigenous tree species. A summary of tree domestication activities is provided in Appendix 4.

Tree improvement activities

The identification of 50 seed sources in natural forests was initiated by LTSP in 2002/2003. Some provenance trials of indigenous species have been established for species such as *Chukrasia tabularis* and *Azadirachta indica*. Seedling seed orchards for certain exotic species, such as *Eucalyptus camaldulensis* have been established in 2000. Appendix 5 provides a summary of registered seed sources in Lao PDR.

Use of biotechnology for characterisation, improvement and conservation

The National Agriculture Research Centre under the MAF, located in the southern part of Lao PDR, and the Science, Technology and Environment Agency (STEA) at the Institute of Biotechnology have established three tissue culture laboratories. These laboratories provide services to some research activities and for students in practical training.

Socioeconomic conditions and issues related to conservation, utilization and management of FGR**Status of forest resources and utilization of trees**

In 1940, the total forest area of Lao PDR was estimated to be 17 million ha, or 70% of the total territory of the country (NOFIP 1992). By 2000, this area had declined to 12.5 million ha, or 54% of the total territory (FAO 2001). Utilization of trees has been based on regulations by the MAF that created a forest management plan for each concession area based on species composition, selective cutting and cutting limits that were applied for each zone.

Based on the 1st National Forestry Conference held in 1989 and Tropical Forestry Action Plan (TFAP) in 1990, the forest areas allocated for management and development within the categories described are shown in the Table 6.

Table 6. Forest area in Lao PDR divided into management categories (TFAP 1990)

Forest type	Area
Protection forest	9.5 million ha
Conservation forest	2.5 million ha
Production forest	5.0 million ha
Total	17 million ha

Identification of national priorities**List of priority species for FGR conservation and management**

The list of national priority species is provided in Table 7. The criteria used for selecting the priority species include: a) the species is indigenous to Lao PDR, b) economically important now or in the near future and c) threatened as a result of over-use or destruction of natural habitats. The list is based on the preliminary list provided by APFORGEN.

Table 7. Priority species for Lao PDR (compiled by C. Phongoudome)

No.	Priority species	References and reports
1	<i>Azelia xylocarpa</i>	MAF 1997; FRC 1999; Greijmans <i>et al.</i> 2002b
2	<i>Albizia lebbeck</i>	FRC 1999
3	<i>A. procera</i>	FRC 1999
4	<i>Alstonia scholaris</i>	MAF 1997; FRC 1999; Greijmans <i>et al.</i> 2002b
5	<i>Anisoptera costata</i>	MAF 1997; FRC 1999; Greijmans <i>et al.</i> 2002b
6	<i>Aquilaria crassna</i>	MAF 1997; FRC 1997; Greijmans <i>et al.</i> 2002b
7	<i>Azadirachta indica</i>	MAF 1997; FRC 1999; Greijmans <i>et al.</i> 2002b
8	<i>Cassia siamea</i>	FRC 1999
9	<i>Chukrasia tabularis</i>	Greijmans <i>et al.</i> 2002b
10	<i>Dalbergia cochinchinensis</i>	MAF 1997; FRC 1999; Greijmans <i>et al.</i> 2002b
11	<i>Dipterocarpus alatus</i>	MAF 1997; FRC 1999; Greijmans <i>et al.</i> 2002b
12	<i>D. grandifolius</i>	MAF 1997
13	<i>D. tuberculatus</i>	MAF 1997; FRC 1999; Greijmans <i>et al.</i> 2002b
14	<i>Fagraea fragrans</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
15	<i>Hopea odorata</i>	MAF 1997; FRC 1999; Greijmans <i>et al.</i> 2002b
16	<i>Parashorea stellata</i>	Greijmans <i>et al.</i> 2002b
17	<i>Parkia speciosa</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
18	<i>Pinus kesiya</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
19	<i>P. merkusii</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
20	<i>Pterocarpus indicus</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
21	<i>P. macrocarpus</i>	MAF 1997; FRC 1999; Greijmans <i>et al.</i> 2002b
22	<i>Schima wallichii</i>	Greijmans <i>et al.</i> 2002b
23	<i>Shorea cochinchinensis</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
24	<i>S. roxburghii</i>	Greijmans <i>et al.</i> 2002b
25	<i>Sindora cochinchinensis</i>	MAF 1997
26	<i>Sterculia lychnophora</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
27	<i>Tarrietia javanica</i>	MAF 1997
28	<i>Tectona grandis</i>	MAF 1997; FRC 1999; Greijmans <i>et al.</i> 2002b
29	<i>Toona sureni</i>	Greijmans <i>et al.</i> 2002b
30	<i>Vatica odorata</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
31	<i>Xylia xylocarpa</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
Bamboo & rattan species (Rao <i>et al.</i> 1998)		
Bamboo		
1	<i>Bambusa</i> spp.	Sengkhamyong 1994
2	<i>B. tulda</i>	Sengkhamyong 1994
3	<i>B. vulgaris</i>	Sengkhamyong 1994
4	<i>B. blumeana</i>	Sengkhamyong 1994
5	<i>Cephalostachyum</i> spp.	Sengkhamyong 1994
6	<i>Dendrocalamus asper</i>	Sengkhamyong 1994
7	<i>D. latifolius</i>	Sengkhamyong 1994
Rattan		
1	<i>Calamus palustris</i>	Evans <i>et al.</i> 2001
ADDITIONAL PRIORITY SPECIES		
1	<i>Acacia mangium</i>	Greijmans and Phongoudome 2003
2	<i>Ailanthus excelsa</i>	MAF 1997; Greijmans and Phongoudome 2003
3	<i>Betula alnoides</i>	Greijmans and Phongoudome 2003
4	<i>Calamus erectus</i> (rattan)	Evans <i>et al.</i> 2001
5	<i>C. longisetus</i> (rattan)	Evans <i>et al.</i> 2001
6	<i>Cunninghamia lanceolata</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
7	<i>Dalbergia cultrata</i>	MAF 1997, FRC 1999; Greijmans <i>et al.</i> 2002b
8	<i>Diospyros mun</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
9	<i>Dipterocarpus turbinatus</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
10	<i>Dysoxylum loureirii</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
11	<i>Erythrophleum fordii</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
12	<i>Eucalyptus camaldulensis</i>	Greijmans and Phongoudome 2003
13	<i>Fokienia hodginsii</i>	MAF 1997; Greijmans <i>et al.</i> 2002b
14	<i>Gmelina arborea</i>	MAF 1997, FRC 1999; Greijmans <i>et al.</i> 2002b
15	<i>Toona ciliata</i>	MAF 1997; Greijmans <i>et al.</i> 2002b

Institutional framework and capacity-building activities

Institutions and organizations involved in FGR conservation & management: their roles, responsibilities and capabilities

The following national and international organizations are involved in FGR conservation and management activities in Lao PDR:

- Ministry of Agriculture and Forestry (MAF):
 - Department of Forestry (DOF)
 - Centre of Watershed and Conservation
 - National Agriculture and Forestry Research Institute (NAFRI)
 - Forestry Research Centre (FRC)
 - Tree Seed and Tree Improvement Research Unit
 - National Agriculture and Forestry Service (NAFES)
 - Division of Forest Extension and Rehabilitation
- Science, Technology and Environment Agency (STEa):
 - Department of Environment (Strategy and Action Plan on Biodiversity)
 - National University of Laos (NUOL), Faculty of Science, Department of Biology and Faculty of Forestry, Department of Forest Management (important role in education)
- IUCN, Lao PDR office: (Advises the Government)
- Danida: (Supports Lao Tree Seed Project (LTSP) as one component of the Indochina Tree Seed Programme (ITSP))
- SIDA: (Supports research activities on upland agriculture and forestry)
- JICA: (Supports activities such as training on field forestry and afforestation programme)
- Korea International Cooperation Agency (KOICA): (Provides volunteers to work in fields of forestry and entomology at the Provincial Agriculture and Forestry Office (PAFO) level)
- APAFRI: (Lao PDR is a member of APAFRI)

National legislation, policies and strategies on FGR

The National Strategy of the Forestry Sector Vision 2020 aims to increase the forest cover up to 60–70% through the establishment of 0.5 million ha of forest plantations, using both indigenous and exotic species as well as the rehabilitation of 2 million ha of natural forest. At present, the following laws and decrees concerning FGR are in force:

- Decree No. 164/PM on Established National Biodiversity Conservation Areas (1993)
- Forestry Law (1996)
- Land Law 1997
- Decree No. 196/MAF on Promotion of Forest Plantation (2000)
- Decree No. 0524/MAF on Conservation and Administration of NBCAs and Wildlife

Biosecurity regulations

In early 2003, several concerned ministries, such as MAF and STEa played an important role in the newly established technical working group that prepared a draft of the National Biodiversity Strategy and Action Plan as well as other related regulations.

Links with other international initiatives

Lao PDR has ratified the Convention on Biological Diversity (CBD) in 1996 and the United Nations Framework Convention on Climate Change (UNFCCC) in 2003. Lao PDR is a new party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). There have been discussions at the national level on future activities in international cooperation.

Training and capacity building activities

There is a need for capacity building on FGR conservation and management in Lao PDR, for example in plant genetic resources conservation technologies. There is no specific training on forest genetics and flora supported by international organisations but only on natural resources management and the environment in general.

Public awareness efforts

Some authors have provided articles on FGR and conservation to The Lao National Television, Vientiane News (in Lao and English), Lao newspapers as well as the National Radio Station. Some extension materials, such as posters, video programmes and songs have been produced by the MAF, DOF and LTSP.

Proposal for regional and international collaboration

The areas proposed for regional co-operation and networking to improve FGR conservation and management and information flow in the region could include determining the status of forest resources and FGR, creating lists and databases for priority species, ecological zoning, species distribution and genetic variation as well as regional strategies and action plans on FGR. Human resources development and capacity building are the main prerequisites for these activities and funding is needed.

Conclusions

FGR activities in Lao PDR are still new compared to other countries in the Asia-Pacific region. This is because of a lack of human resources and funding to carry out this kind of work. Research and national capability building need more support in the fields of genetics, taxonomy, ecology, botany and forest tree improvement. International collaboration and networking are recommended.

Acknowledgements

The authors' special thanks go to the Lao Tree Seed Project/Danida for support of funding to attend this workshop. We also thank the FRC, NAFRI and MAF, Lao PDR for the permission to prepare this report.

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Appendix 1

Selected tree species assessed for their conservation status in Lao PDR

1. *Azelia xylocarpa* (Tekha)
2. *Aglaia gigantea* (Nok kok)
3. *A. grandis* (Mak kong)
4. *Allospondias lakonensis* (Som ho)
5. *Alstonia rostrata* (Teen Pet, T. Khai)
6. *A. scholaris* (Teen pet)
7. *A. spathulata* (Teen pet)
8. *Anisoptera costata* (Bak, B. deng, B. khao)
9. *A. scaphula* (Bak luang)
10. *Aquilaria crassna* (Ked sana, Dam, Po huang)
11. *Azadirachta indica* (Ka dao, Khom ka dao)
12. *Bischofia javanica* (Khom fad, Fung fad)
13. *Broussonetia papyrifera* (Poh sa)
14. *Caesalpinia sappan* (Fang deng)
15. *Castanopsis acuminatissima* (Ko duay)
16. *C. hystrix* (Ko deng, Ko fan)
17. *Cephalotaxus mannii* (Kham pom deng, Pek khon nok)
18. *Chukrasia tabularis* (Nhom, N. hen, N. hao)
19. *Cinnamomum iners* (Sa chouang, Si khai ton, Chouang hom)
20. *C. obtusifolium* (Khae)
21. *Cunninghamia lanceolata* (Hing hoame)
22. *Dacrycarpus imbricatus* (Pek deng, Hing)
23. *Dalbergia cochinchinensis* (Kha nhoung)
24. *D. cultrata* (Ka bo, Kamphee, Nang noune, Kha nhoung)
25. *D. hupeana* (Kha nhoung)
26. *D. lanceolaria* (Khampee, Nang noune, Pa dong deng)
27. *D. oliveri* (Kampee)
28. *Dialium cochinchinense* (Kheng)
29. *D. indium* (Kham phaep, Kam thep)
30. *Diospyros ferrea* (Makhua)
31. *D. malabarica* (Makhua, Lang dam, Kua nam)
32. *D. mollis* (Makhua)
33. *D. mun* (Makhua, Moun)
34. *Dipterocarpus alatus* (Nhang khao, N. na, N. khiauw, N. mwak)
35. *D. costatus* (Nhang deng)
36. *D. hasseltii* (Nhang kiang)
37. *D. intricatus* (Ta baeng, Sa baeng)
38. *D. kerrii* (Nhang khayeng)
39. *D. obtusifolius* (Sad)
40. *D. retusus* (Nhang dong)
41. *D. tuberculatus* (Koung)
42. *D. turbinatus* (Nhang deng)
43. *Dysoxylum binectariferum* (Khouang deng, Chan luang, Kon ta sewa)
44. *D. loureirii* (Khon ta sang)
45. *Elaeocarpus stipularis* (Moune)
46. *Eriobotrya serrata* (Khon dok)
47. *Erythrophleum fordii* (Kha cha, Than, Lem)
48. *Fagraea fragrans* (Man pa)
49. *Fokienia hodginsii* (Long leng, Len le, Lang Len)
50. *Garcinia fagraeoides* (See)
51. *Gmelina arborea* (So)
52. *Haldina cordifolia* (Khae)
53. *Hopea chinensis* (Khaen see)
54. *H. ferrea* (Khen hen)
55. *H. odorata* (Khen hua)
56. *H. pierrei* (Khaen hen, K. hak yong, La en)
57. *H. recopei* (See dok deng, Khen fai)
58. *H. thorelii* (Khaen see)
59. *Irvingia malayana* (Bok)
60. *Keteleeria evelyniana* (Hing)
61. *Lagerstroemia calyculata* (Puay khao, P. dok khao)
62. *L. floribunda* (Puay phuak bang, P. dok deng)
63. *Litsea glutinosa* (Bong mee)
64. *Mangifera pentandra* (Mouang pa)
65. *Manglietia garrettii* (Mak thek)
66. *Mansonia gagei* (Chan hom)
67. *Melia azedarach* (Hien, Khadao sang)
68. *Melientha suavis* (Pak wan pa)
69. *Mesua ferrea* (Lek)
70. *Michelia champaca* (Cham pa pa)
71. *M. masticata* (Ham)
72. *M. mediocris* (Cham pa pa)
73. *Millettia leucantha* (Sa thon)
74. *Mitragyna diversifolia* (Thom dong)
75. *Paramichelia baillonii* (Cham pipa, Som suai, Sai)
76. *Parashorea stellata* (Hao)
77. *Parkia speciosa* (Houa lone)
78. *Peltophorum dasyrhachis* (Sa phang, Sa kham)
79. *Pentace burmanica* (Si siat)
80. *Persea gamblei* (Bong deng)
81. *Pinus dalatensis* (Pek 5 bai)
82. *P. kesiya* (Pek 3 bai)
83. *P. merkusii* (Pek 2 bai, Pek yang, Khoua)
84. *Pometia pinnata* (Koh ka, Deng nam)
85. *Pterocarpus indicus* (Dou khang, D. khon)
86. *P. macrocarpus* (Dou, D. luad, Padou pa)
87. *Sandoricum koetjape* (Mak thong)
88. *Scaphium macropodum* (Chong ban)
89. *Schima wallichii* (Mee)
90. *Shorea henryana* (See)

- | | |
|---|---|
| 91. <i>S. obtusa</i> (Chik) | 102. <i>S. tinctorium</i> (Ha, Wa dong) |
| 92. <i>S. roxburghii</i> (Khen kha nhom) | 103. <i>Toxicodendron succedanea</i> (Klet ling, Ket lin) |
| 93. <i>S. siamensis</i> (Hang, Phao) | 104. <i>Tectona grandis</i> (Sak) |
| 94. <i>S. thorelii</i> (Khen ning) | 105. <i>Terminalia alata</i> (Seuak) |
| 95. <i>Sindora siamensis</i> (Te nam) | 106. <i>Tetrameles nudiflora</i> (Phoung, Sa phoung) |
| 96. <i>Stereospermum fimbriatum</i> (Khe Foy) | 107. <i>Toona ciliata</i> (Nhom hom) |
| 97. <i>Strychnos nux-vomica</i> (Toum) | 108. <i>T. sureni</i> (Yom hom, Nhom hom) |
| 98. <i>Styrax benzoides</i> (Chan pa, C. dong, Nyan deng, N. hom) | 109. <i>Vatica harmandii</i> (See dong, Chik dong) |
| 99. <i>S. tonkinensis</i> (Nyan, N. khao) | 110. <i>V. odorata</i> (Khen se See khen) |
| 100. <i>Syzygium chloranthus</i> (Wa deng) | 111. <i>Wrightia arborea</i> (Mouk) |
| 101. <i>S. grata</i> (Sameth, Samek) | 112. <i>Xylia xylocarpa</i> (Deng) |
| | 113. <i>Zanthoxylum rhetsa</i> (Khaen, Khouang) |

Backup list of tree species not assessed for conservation status

This list have been obtained from WCMC (UNEP World Conservation Monitoring Centre, Tree Conservation Database, 2001), IUCN (The World Conservation Union, 2001) and LTSP (Lao Tree Seed Project, 2000). The expert group rejected these 24 tree species for the selected list, for various reasons as these did not fulfil the criteria used. Some incorrect names may be listed here and the list needs to be further verified.

1. *Aglaia lawii* (WCMC)
2. *A. odorata* (WCMC, IUCN)
3. *A. simplicifolia* (WCMC, IUCN)
4. *A. spectabilis* (WCMC)
5. *A. tomentosa* (WCMC)
6. *Albizia lebbbeck* (LTSP)
7. *A. procera* (LTSP)
8. *Amesiodendron chinense* (WCMC)
9. *Cyclobalanopsis rex* (WCMC, IUCN)
10. *Knema globularia* (WCMC)
11. *K. tenuinervia* ssp. *setosa* (WCMC)
12. *K. tonkinensis* (WCMC, IUCN)
13. *Lophopetalum wightianum* (WCMC)
14. *Magnolia henryi* (WCMC, IUCN)
15. *Markhamia stipulata* (WCMC)
16. *Millingtonia hortensis* (WCMC)
17. *Paradina hirsuta* (WCMC)
18. *Pauldopia ghorta* (WCMC)
19. *Platanus kerrii* (WCMC, IUCN)
20. *Rhamnoneuron balansae* (WCMC)
21. *Schoutenia hypoleuca* (WCMC)
22. *Tabernaemontana corymbosa* (WCMC)
23. *Taraktogenos annamensis* (WCMC, IUCN)
24. *Wrightia laevis* (WCMC)

Appendix 2

Conservation status scores and ranking of tree species in Lao PDR

No.	Species	Vernacular (Lao) name	Geographical range & rarity	Habitat specificity	Habitat status	Human impact on habitat	Human impact on species	Total	Category (consultancy)
1	<i>Aquilaria crassna</i>	Ked sana, Dam, Po huang	4	3	5	5	5	22	A
2	<i>Cunninghamia lanceolata</i>	Hing hoame, Mai long len	5	3	5	4	5	22	A
3	<i>Michelia champaca</i>	Cham pa pa	5	3	5	4	5	22	A
4	<i>Anisoptera scaphula</i>	May Bak Luang	5	3	5	4	4	21	A
5	<i>Caesalpinia sappan</i>	Fang deng	4	3	5	4	5	21	A
6	<i>Cinnamomum obtusifolium</i>	Khae	4	3	5	4	5	21	A
7	<i>Erythrophleum fordii</i>	Lem, Kacha	4	3	5	4	5	21	A
8	<i>Fokienia hodginsii</i>	Long leng, Len le, Lang Len	4	3	5	4	5	21	A
9	<i>Pentace burmanica</i>	Si siat	4	3	5	4	5	21	A
10	<i>Persea gamblei</i>	Bong deng	4	3	5	4	5	21	A
11	<i>Dalbergia cochinchinensis</i>	Kha nioung	4	3	4	4	5	20	B
12	<i>Dalium indicum</i>	Kham phep, Kam thep	4	3	5	4	4	20	B
13	<i>Melientha suavis</i>	Pak van	4	3	5	4	4	20	B
14	<i>Paramichelia baillonii</i>	Cham pa pa, Some suay	4	3	5	4	4	20	B
15	<i>Dalbergia cultrata</i>	Ka bo, Kamphee, Nang noune	4	3	5	4	3	19	B
16	<i>Dipterocarpus costatus</i>	Nhang deng	4	3	4	4	4	19	B
17	<i>Fagraea fragrans</i>	Man pa	4	3	4	4	4	19	B
18	<i>Hopea chinensis</i>	Khaen see	5	3	5	3	3	19	B
19	<i>Pinus dalatensis</i>	Pek 5 bai	5	5	5	2	2	19	B
20	<i>Shorea henryana</i>	Si	5	3	5	3	3	19	B
21	<i>Sindora siamensis</i>	Te nam	4	3	4	4	4	19	B
22	<i>Tectona grandis</i>	Sak	5	3	5	3	3	19	B
23	<i>Zanthoxylum rhetsa</i>	Khaen	2	3	5	4	5	19	B
24	<i>Dipterocarpus alatus</i>	Nhang khao, N. na, N. khiauw, N. mwak	2	3	4	4	5	18	B
25	<i>D. kerrii</i>	Nhang kha nheng	4	3	5	3	3	18	B
26	<i>Hopea pierrei</i>	Khaen hin, La en, Khaen hak yong	4	3	5	3	3	18	B
27	<i>H. recopei</i>	See dok deng, Khen fai	4	3	5	3	3	18	B
28	<i>H. thorelii</i>	Khaen see	4	3	5	3	3	18	B
29	<i>Keteleeria evelyniana</i>	May Hing	4	3	4	3	4	18	B
30	<i>Mangifera pentandra</i>	Muang pa	4	3	5	3	3	18	B
31	<i>Manglietia garrettii</i>	Luang khom (Mak Tek)	4	3	5	3	3	18	B
32	<i>Mesua ferrea</i>	Lek	5	3	4	3	3	18	B
33	<i>Parashorea stellata</i>	Hao, Phao	4	3	5	3	3	18	B

No.	Species	Vernacular (Lao) name	Geographical			Habitat status	Human impact on habitat	Human impact on species	Total	Category (consultancy)
			range & rarity	Habitat specificity	Habitat status					
34	<i>Pinus kesiya</i>	Pek 3 bai	4	3	5	3	3	18	B	
35	<i>Pinus merkusii</i>	Pek 2 bai, Khoua	2	3	5	4	4	18	B	
36	<i>Pterocarpus indicus</i>	Dou khang, Dou khon	4	3	5	3	3	18	B	
37	<i>Scaphium macropodium</i>	Chong ban	4	5	5	2	2	18	B	
38	<i>Shorea thorelii</i>	Khing ning	4	3	5	3	3	18	B	
39	<i>Styrax benzoides</i>	Nhan deng	4	3	5	3	3	18	B	
40	<i>S. tonkinensis</i>	Nyan khao, Nhan, Sanjaan deng	4	3	5	3	3	18	B	
41	<i>Syzygium chloranthum</i>	Va deng	4	3	5	3	3	18	B	
42	<i>Azelia xylocarpa</i>	May tekha	4	1	4	3	5	17	B	
43	<i>Castanopsis acuminatissima</i>	Ko deua	4	3	4	3	3	17	B	
44	<i>Dacrycarpus imbricatus</i>	Mai Hing Khieo	4	3	4	3	3	17	B	
45	<i>Dalbergia lanceolaria</i>	Khamphee, Nang noune, Pa dong deng	4	3	4	3	3	17	B	
46	<i>D. oliveri</i>	Kampee	4	3	4	3	3	17	B	
47	<i>Dipterocarpus hasseltii</i>	Nhang kiang	4	3	4	3	3	17	B	
48	<i>Dysoxylum binectariferum</i>	Quang deng, Chan luang, Khon ta seu	4	3	4	3	3	17	B	
49	<i>Garcinia fagraeoides</i>	Lee	4	3	4	3	3	17	B	
50	<i>Millettia leucantha</i>	Sa thon	4	3	4	3	3	17	B	
51	<i>Mitragyna diversifolia</i>	Thom dong	4	3	4	3	3	17	B	
52	<i>Pometia pinnata</i>	Deng nam	4	3	4	3	3	17	B	
53	<i>Strychnos nux-vomica</i>	Seng bua, Toum	5	3	5	2	2	17	B	
54	<i>Aglala gigantea</i>	Nok kok	4	3	5	2	2	16	B	
55	<i>Bischofia javanica</i>	Khom fad, Fung fad	2	3	4	4	3	16	B	
56	<i>Dipterocarpus intricatus</i>	Ta baeng, Sa baeng	2	3	3	3	5	16	B	
57	<i>D. obtusifolius</i>	Sad	2	3	3	3	5	16	B	
58	<i>D. tuberculatus</i>	Kung	2	3	3	3	5	16	B	
59	<i>Hopea ferrea</i>	Khen hin	2	3	3	4	4	16	B	
60	<i>Pterocarpus macrocarpus</i>	Dou	2	1	4	4	5	16	B	
61	<i>Toxicodendron succedaneum</i>	Ket lin	4	3	5	2	2	16	B	
62	<i>Allospondias lakonensis</i>	Som ho	4	3	5	2	2	16	B	
63	<i>Castanopsis hystrix</i>	Ko fan	2	1	4	4	4	15	C	
64	<i>Gmelina arborea</i>	So	2	3	4	3	3	15	C	
65	<i>Hopea odorata</i>	Khen hua	2	3	3	3	4	15	C	
66	<i>Lagerstroemia calyculata</i>	Puay (Dok khao)	2	3	3	3	4	15	C	
67	<i>L. floribunda</i>	Puay (Dok Si Boua)	2	3	3	3	4	15	C	
68	<i>Litsea glutinosa</i>	Bong Mi	4	3	4	2	2	15	C	
69	<i>Alstonia rostrata</i>	Teen pet	4	3	5	1	1	14	C	
70	<i>Anisoptera costata</i>	May bak	2	1	3	3	5	14	C	

No.	Species	Vernacular (Lao) name	Geographical range & rarity	Habitat specificity	Habitat status	Human impact on habitat	Human impact on species	Total	Category (consultancy)
108	<i>Mansonia gagei</i>	Chan home	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	E
109	<i>Michellia masticata</i>	Ham, Hum	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	E
110	<i>M. mediocris</i>	Cham pa pa	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	E
111	<i>Toona ciliata</i>	Nhom home	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	E
112	<i>T. febrifuga</i>	Yom Hom	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	E
113	<i>Vatica cinerea</i>	Xi dong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	E
TOTAL			9	2	39	1	18		

n.a. = data not available

NOTES:

Criteria/Score	5	4	3	2	1
Geographical range and rarity	Very rare, found in 1 zone	Rare, found in more than 1 zone	Common, found in 1 zone	Common, found in more than 1 zone	Very common
Habitat specificity	Highly specific		Restricted		Broad
Habitat status (% under protection)	<5 11-15	6-10 16-20	>20		
Human impact on the habitat	Conversion	Heavy	Regular	Periodical	Little or no impact
Human impact on the species	Always	Almost always	Regular	Periodical	Little or no impact

Category	Description	Score	No. of species	Recommendations
A	Endangered	21-25	10	Ex-situ conservation, survey, update the DOF list = no cutting, participatory conservation
B	Vulnerable	16-20	52	Update the DOF list, survey, ex situ and participatory conservation
C	Lower risk, conservation dependent/nearly threatened	11-15	28	Monitor, survey
D	Lower risk, least concern	5-10	7	Monitor
E	Lacking information	16	7	

Appendix 3

Benefits and constraints of agroforestry systems in shifting cultivation areas of Lao PDR (Humchitsavath and Hansen 1996)

Agroforestry system	Description	Benefits	Constraints	Example from Lao PDR
Traditional systems				
Shifting cultivation	Alternating periods of tree growth and agricultural crops.	Restoration of soil fertility. Suppression of weeds and crop pests.	Requires long fallow periods. Low productivity with short fallows. Government condemnation.	Most widespread cropping system in Lao PDR
Economically improved fallows	The economic benefit of the fallow is improved through manipulation of the fallow vegetation.	Increased income or output from the fallow.	Increased labour needs. May require long fallow periods.	Production of paper mulberry bark, cardamom, and benzoin.
Living fences	Hedges of woody species planted around agriculture fields.	Mainly to fence off agriculture fields, but also for leaf fodder, mulch, firewood and wind reduction.	Efficient only after several years. May complete with crops.	Widely used around permanent fields and gardens.
Plantations of orchards	Various other combinations of tree and crops, such as multi-storey gardens, home gardens, and estate plantations.	High productivity per area unit. Good use of the available resources.	Herbaceous component suppressed in older plantations. Rational management may be difficult.	Homegardens and multi-storey gardens common in older villages all over Lao PDR
Taungya	Cultivation of agricultural crops during the early stages of tree establishment.	Economic return from the plantation during the early years. Ensures weeding during the cropping periods. Cheap establishment.	Agriculture land is lost. Land-use rights may be transferred to investors. Farmers may become labourers.	Common along river banks in the North. In recent years also in upland areas. Traditional planting method of forest authorities.
Modern systems				
Biologically improved fallows	The biophysical effects of natural fallows are improved through enrichment planting or other manipulation.	Increased restoration of soil fertility. Increased suppression of weeds and pests.	The improved fallow may become a serious weed during the cultivation periods.	Experimental stage at the moment. No extension recommendations.
Alley cropping	Belts of woody species alternate with belts of agriculture crops.	Nutrient recycling and nitrogen fixing. May also produce leaf fodder, firewood and mulching material.	Occupies agriculture land. Woody component may compete with agriculture crops. Requires additional labour.	Introduced by various projects, but little or no adoption by farmers.
Contour hedgerows	Woody species planted in hedges along the contours alternating with belts of crops.	Mainly for erosion control; may have benefits similar to alley cropping.	Occupies agriculture land. Woody component may compete with agriculture crops.	Requires additional labour. Introduced by various projects, but little or no adoption by farmers.

Appendix 4

Summary of domestication activities of forest tree species in Lao PDR (compiled by C. Phongoudome, July 2003)

No.	Species	Vernacular name	Family	Purpose of domestication
1	<i>Adenantha microsperma</i>	Mak lam noy	Papionoideae	Reh, Dem
2	<i>Azelia xylocarpa</i>	Te kha	Caesalpinioideae	Exc, Dem, Pt
3	<i>Ailanthus malabarica</i>	Nhom pha	Simarubaceae	Dem
4	<i>Albizia lebbeck</i>	Thon	Mimosoideae	Dem, Exc
5	<i>A. procera</i>	Sa thon	Mimosoideae	Dem, Exc
6	<i>Alstonia rostrata</i>	Teen pet noy	Apocynaceae	Exc, Dem
7	<i>A. scholaris</i>	Teen pet	Apocynaceae	Reh, Lans, Dem, Pt
8	<i>Anacardium occidentale</i>	Mouang him ma phan	Anacardiaceae	Ex, Hg, Ftf
9	<i>Anisoptera costata</i>	Bak	Dipterocarpaceae	Dem, Exc
10	<i>Anthocephalus chinensis</i>	Kan luang	Rubiaceae	Dem, Agr
11	<i>Aquilaria crassna</i>	Ket sa na	Thymelaeaceae	Exc, Agr, NTFP
12	<i>Artocarpus</i> spp.	Mi ban	Moraceae	Hg, Agr
13	<i>Asoka longifolia</i>	A sok	Anonaceae	Lans, Ex
14	<i>Averrhoa carambola</i>	Fuang	Rosaceae	Hg, Lans
15	<i>Azadirachta indica</i>	Khom ka dao	Meliaceae	Exc, Dem, Prot
16	<i>Bauhinia variegata</i>	Dok ban	Caesalpinioideae	Reh, Dem
17	<i>Bischofia javanica</i>	Fung fad	Euphorbiaceae	Exc, Reh, Dem
18	<i>Bombax ceiba</i>	Ngiou	Malvaceae	Hg, Pt
19	<i>Bouea burmanica</i>	Fang	Anacardiaceae	Hg, Ftf
20	<i>Broussonetia papyrifera</i>	Po sa	Moraceae	Agr, Hg
21	<i>Caesalpinia sappan</i>	Fang deng	Caesalpinioideae	Exc, Hg
22	<i>Carpinus poilanei</i>	Kiou	Betulaceae	Reh
23	<i>Cassia fistula</i>	Khoun	Caesalpinioideae	Lans
24	<i>C. javanica</i>	Ka la pheuk	Leguminoseae	Lans, Agr
25	<i>C. siamea</i>	Khi lek	Caesalpinioideae	Hg, Pt, Agr, Reh
26	<i>Castanopsis hystrix</i>	Ko deng	Fagaceae	Reh
27	<i>C. spp.</i>	Ko	Fagaceae	Reh
28	<i>C. tribuloides</i>	Ko keut	Fagaceae	Reh
29	<i>Casuarina equisetifolia</i>	Son tha le	Casuarinaceae	Lans, Ex
30	<i>Chrysophyllum cainito</i>	Nam nom	Spotaceae	Hg, Lans
31	<i>Chukrasia tabularis</i>	Nhom hin	Meliaceae	Prot
32	<i>Cinnamomum cassia</i>	Khe hom	Lauraceae	Exc, Hg
33	<i>Citrus aurantium</i>	Kiang	Rutaceae	Hg, Ftf
34	<i>C. bergamia</i>	Ve	Rutaceae	Hg, Ftf
35	<i>C. digitata</i>	Mu	Rutaceae	Hg, Agr
36	<i>C. grandis</i>	Som o	Rutaceae	Hg, Ftf, Agr
37	<i>C. hystrix</i>	Khi hoot	Rutaceae	Hg, Ftf, Agr
38	<i>C. medica</i>	Nao	Rutaceae	Hg, Agr
39	<i>C. nobilis</i>	Liou	Rutaceae	Hg, Agr
40	<i>Coffea</i> spp.	Ka fe	Rubiaceae	Hg, Agr, Ftf
41	<i>Dalbergia cochinchinensis</i>	Kha nhoung	Papilinoideae	Exc, Dem
42	<i>Dipterocarpus alatus</i>	Nhang khao	Dipterocarpaceae	Ex, Dem
43	<i>Dorenix regia/ Poinciana regia</i>	Hang nhoung	Caesalpinioideae	Lans
44	<i>Eucalyptus</i> spp.	Vic	Myrtaceae	Ex
45	<i>Eugenia</i> spp.	Chieng	Myrtaceae	Hg
46	<i>Euphoria longana</i>	Lam yai	Sapindaceae	Hg, Ftf
47	<i>Fagraea fragrans</i>	Man pa	Loganiaceae	Exc, Dem
48	<i>Gliricidia sepium</i>	Khe frang	Leguminoseae	Lans, Agr
49	<i>Gmelina arborea</i>	So	Verbenaceae	Exc, Dem
50	<i>Hopea odorata</i>	Khen heua	Dipterocarpaceae	Exc, Dem, Reh, Pt
51	<i>Keteleeria davidiana</i>	Hing	Pinaceae	Reh
52	<i>Lagerstroemia calyculata</i>	Peuay khao	Myrtaceae	Dem

No.	Species	Vernacular name	Family	Purpose of domestication
53	<i>Leucaena leucocephala</i>	Ka thin phan	Mimosoideae	Agr, Hg, Reh, Ex ?
54	<i>Litchi</i> spp.	Lin chi	Sapindaceae	Hg
55	<i>Mangifera indica</i>	Mouang	Anacardiaceae	Hg, Ftf
56	<i>Melia azedarach</i>	Ka dao sang	Meliaceae	Agr, Hg, Pt
57	<i>Moringa pterygosperma</i>	Phak I houm	Moringaceae	Hg
58	<i>Nyssa javanica</i>	Mak theun	Cornaceae	Heh, Dem
59	<i>Ormosia semicatrata</i>	Mak lam nhai	Papionoideae	Reh
60	<i>Oroxylum indicum</i>	Lin mai	Bignoniaceae	Hg
61	<i>Paramichelia bailonii</i>	Som souay, Cham pa pa, Ham, Xay	Magnoniaceae	Heh, Dem, Ex
62	<i>Peltophorum dasyrhachis</i>	Sa fang, Sa kham	Caesalpinioideae	Reh, Dem, Pt
63	<i>Pentace burmanica</i>	Si siet	Tiliaceae	Ex, Hg, Pt
64	<i>Persea gamblei</i>	Bong	Lauraceae	NTFP, Hg, Pt, Dem
65	<i>Pinus kesiya</i>	Pek sam bai	Pinaceae	Exc, Dem, Reh
66	<i>P. merkusii</i>	Pek song bai	Pinaceae	Exc, Dem, Reh
67	<i>Pyrus laosensis</i>	Leung	Rosaceae	Hg, Lans, Ftf
68	<i>P. pashia</i>	Chong	Rosaceae	Hg, Ftf
69	<i>Prunus armeniaca</i>	Foung khai	Rosaceae	Hg, Ftf
70	<i>P. puddum</i>	Man theun	Rosaceae	Hg
71	<i>P. persica</i>	Khai	Rosaceae	Hg, Ftf
72	<i>P. salicina</i>	Man	Rosaceae	Hg, Ftf
73	<i>Psidium guajava</i>	Si da	Myrtaceae	Hg, Agr
74	<i>Pterocarpus indicus</i>	Cham pa pa, Dou King on	Papilinoideae	Dem, Pt
75	<i>P. macrocarpus</i>	Dou	Papilinoideae	Exc, Dem, Pt, Reh
76	<i>Punica granatum</i>	Phi la	Punicaceae	Hg, Agr
77	<i>Quercus griffithii</i>	Ko sa	Fagaceae	Reh
78	<i>Q. serrata</i>	Ko sa	Fagaceae	Reh
79	<i>Q. serrata</i>	Ko khe	Fagaceae	Reh
80	<i>Samanea saman</i>	Sam sa	Caesalpinioideae	Lans
81	<i>Sandoricum koetjape</i>	Tong	Meliaceae	Hg, Ftf
82	<i>Scaphium macropodum</i>	Mak chong ban	Sterculiaceae	Dem, Hg
83	<i>Schima wallichii</i>	Mi	Theaceae	Reh, Dem
84	<i>Sesbania grandiflora</i>	Khe khao	Fabaceae	Hg
85	<i>Sindora cochinchinensis</i>	Te ho	Caesalpinioideae	Exc, Dem
86	<i>Spondias axillaris</i>	Mak meu	Anacardiaceae	Dem
87	<i>Strychnos nux-vomica</i>	Toum ka	Loganiaceae	Hg
88	<i>Styrax tonkinensis</i>	Nhan	Styracaceae	Exc, Dem, Pt, Reh
89	<i>Swietenia macrophylla</i>	Ham ngoua yai	Meliaceae	Ex, Lans
90	<i>Syzygium grata</i>	Chieng	Myrtaceae	Hg
91	<i>Ziziphus jujuba</i>	Ka than	Ramnaceae	Hg, Lans
92	<i>Tamarindus indica</i>	Kham	Caesalpinioideae	Hg, Ftf
93	<i>Tarrietia javanica</i>	Hao	Sterculiaceae	Dem
94	<i>Tectona grandis</i>	Sak	Verbenaceae	Exc, Dem, Pt, Hg Agr, Tip
95	<i>Terminalia catappa</i>	Hou kuang	Combretaceae	Lans, Ex ?
96	<i>Tetrameles nudiflora</i>	Phoung	Datisaceae	Exc, Dem, Pt
97	<i>Toona ciliata</i>	Nhom hom	Meliaceae	Exc, Dem, Prot
98	<i>Toxicodendron succedaneum</i>	Ket lin	Anacardiaceae	Exc, Dem
99	<i>Vatica cinerea</i>	Si	Dipterocarpaceae	Dem, Pt
100	<i>Wrightia arborea</i>	Mouk	Apocynaceae	Dem, Pt
101	<i>Xylia xylocarpa</i>	Deng	Mimosaceae	Exc, Dem
102	<i>Zanthoxylum rhetsa</i>	Khen	Rutaceae	Hg, Reh, Inc
103	<i>Z. alatum</i>	Mat	Rutaceae	Hg

Agr = Agroforestry, Dem = Demonstration, Ex = Exotic, Exc = *Ex situ* conservation, Ftf = Fruit tree farm, Hg = Home garden, Inc = *In situ* conservation, Lans = Landscape, NTFP = Non-timber forest product, Prot = Provenance trial, Pt = Plantation, Reh = Rehabilitation, Tip = Tree improvement

Appendix 5

Summary of registered seed sources in Lao PDR as in July 2003

No	Province	District	Village	Species	Area (ha)	Number of trees	Estimate of seed	Period of seed collection	Remark
1	Xayabouly	Paklai	Nasak	<i>Tectona grandis</i>	2750	90	900	Dec-March	Natural forest (conservation)
2	Xayabouly	Paklai	Nakha yang	<i>Azela xylocarpa</i>	222	37	2.22	Dec-March	Natural forest (conservation)
3	Xayabouly	Paklai	Nakhayang	<i>Vatica cinerea</i>		21	210	April-May	Natural forest (conservation)
4	Xayabouly	Phieng	Phonsak	<i>Dipterocarpus alatus</i>	25	17	234	April-May	Natural forest (conservation)
5	Vientiane Pro.	Thulakhom	Vangheua	<i>Pinus merkusii</i>	135	134		Nov-Dec	PKK National Park
6	Vientiane Pro.	Keoudome	Mai Nangeng	<i>Dipterocarpus alatus</i>	500	22			PKK National Park
7	Vientiane Pro.	Keoudome	Mai Nangeng	<i>Hopea ferrea</i>		39			PKK National Park
8	Vientiane Pro.	Keoudome	Mai Nangeng	<i>Pterocarpus macrocarpus</i>	50	15			Village Protected Forest
9	Vientiane Mun.	Naxay thong	Syvilai	<i>Pterocarpus macrocarpus</i>		35	399	Dec-March	Livestock Research Centre & Farm Land
10	Vientiane Mun.	Xaithany	Nonsaat	<i>Azela xylocarpa</i>		28			Huay yang Conservation Area
11	Vientiane Mun.	Xaithany	Dongsanghin	<i>Dipterocarpus alatus</i>	300	39			Conservation & Rice field
12	Bolikhamesai	Khamkeut	Poung	<i>Aquilaria crassna</i> (Big)		107		April-August	Natural forest (conservation)
13	Bolikhamesai	Khamkeut	Poung	<i>Aquilaria crassna</i> (Small)		11			
14	Bolikhamesai	Khamkeut	Thongchaleun	<i>Dalbergia cochinchinensis</i>		46		Sep-Nov	Natural forest (conservation)
15	Bolikhamesai	Khamkeut	Namphao	<i>Dalbergia cochinchinensis</i>		52		Sep-Nov	Natural forest (conservation)
16	Khammuan	Yommalat	Huatat	<i>Hopea odorata</i>		30	105	March-April	Natural forest (conservation)
17	Khammuan	Mahasay	Phonsavan	<i>Dipterocarpus alatus</i>	322	41	564	April-May	Natural forest (conservation)
18	Savanna khet	Khantha bouly	That, Phon sim	<i>Anisoptera costata</i>	50	34	510	March-April	Natural forest (conservation)
19	Savanna khet	Khantha bouly	That, Phon sim	<i>Hopea odorata</i>		19	429	March-April	Natural forest (conservation)
20	Savanna khet	Khantha bouly	That, Phon sim	<i>Dalbergia cochinchinensis</i>		10	60	Sep-Nov	Natural forest (conservation)
21	Savanna khet	Khantha bouly	That, Phon sim	<i>Dipterocarpus alatus</i>		31	426	April-May	Natural forest (conservation)
22	Savanna khet	Phin	Alao dong	<i>Dipterocarpus alatus</i>	1111	50	688	April-May	Natural forest (conservation)
23	Savanna khet	Phin	Alao dong	<i>Xylocarpa</i>		28	42	Feb-April	Natural forest (conservation)
24	Savanna khet	Khantha bouly	Nachilith	<i>Eucalyptus camaldulensis</i>	5	501		May-Aug	Plantation 1996
25	Champasak	Sanasomboun	Nadan	<i>Azadirachta indica</i>	50	52	910	March-May	Farmer land
26	Champasak	Khong	Hua moun	<i>Dalbergia cultata</i>	60	24	336	Sep-Nov	Natural forest (conservation)
27	Champasak	Khong	Don khong	<i>Pterocarpus macrocarpus</i>	60	27	308	Dec-March	Natural forest (conservation)
28	Champasak	Khong	Veun kham	<i>Pterocarpus macrocarpus</i>	250	50	570	Dec-March	Natural forest (conservation)
29	Champasak	Pathum phon	Kiet Ngong	<i>Dipterocarpus alatus</i>	60	38	523	April-May	Natural forest (conservation)
30	Champasak	Pathum phon	Kiet Ngong	<i>Hopea odorata</i>		15			
TOTAL					5950	1643	7216		