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Article

Lao Cypress Forests: Causes of Degradation and the Present State of Conservation in Lao P.D.R.

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This article studies the main causes of degradation of Lao cypress forests and the present state of conservation efforts in Lao P.D.R., aiming to formulate effective conservation measures. This study is based on existing literature, reports, published statistics and supplementary interviews. The results are classified according to an analytical framework consisting of two explanatory models: a relative classification of immediate and underlying causes, and a subdivision of the primary causes into those domestic or foreign in origin. The strong impact of commercial logging and export to Japan and Taiwan has emerged as the main cause of degradation of Lao cypress forests.

Keywords: Lao cypress, Forest destruction, Underlying causes, Timber trade, Conservation strategy.

1. Introduction

Japan today has approximately 25.15 million ha of forestland, which covers around 67% of the country. Roughly 41% of these forests are man-made. Most of the man-made forests consist of coniferous forests less than 45 years old; forests older than 80 years account for only 0.01% of the total forestland. Although forest resources in Japan are rather abundant nowadays, natural coniferous forests have been almost completely depleted because of the strong demand for and dependence on old growth products that is rooted in Japan's cultural background (Totman 1989). As a result, Japan has taken advantage of its economic power and has been continuously importing logs from virgin forests all over the world. Japan's timber trade has spurred international criticism that such importation seriously impacts precious forests in various corners of the world and has accelerated the deforestation or degradation of primary forests (Kuroda 1997). Japan's importation of Lao cypress is a typical target of such criticism, as is its import of Taiwanese cypress and of Tibetan cypress from China.

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In Lao P.D.R., approximately 47% of the land is covered by forest. The share of timber products exported from Lao P.D.R. greatly exceeds that of electricity and coffee, thus making timber Laos' most important commodity in the international market (Tsuburaya 1995). Therefore, to ensure the sustainable development of its economy, Lao P.D.R. must ensure the sustainable use and export of its timber resources. Today, Lao cypress is the leading timber species exported to Japan from Lao P.D.R.. It is observed that the fluctuations in the Japanese timber market have a crucial influence over the resource management of Lao cypress forests (Kuroda 1997). An estimated 98% of primary forests in Lao P.D.R. have already been exploited, and the remaining forests are classified as "on the edge" of extinction and will soon be extinct if measures are not taken (Bryant et al. 1997). A conservation strategy for primary forests is urgently needed.

It is against this backdrop that we will examine the present state of Lao cypress forests and the causes of their degradation. We will focus on the linkages with the resource use in order to discuss possible conservation strategies.

2. Analytical framework

Many scholars have attempted to explain forest destruction[1] (e.g., Hirsch 1987; Brown and Pearce 1994; Bryant et al. 1997; FAO 1997; Kaimowitz and Angelsen 1998; Verolme and Moussa 1999). Some studies have focused on the direct causes of forest destruction from a structural viewpoint, and others have tried to identify the mutual relationships underlying these ultimate causes (e.g., Bryant et al. 1997; Verolme and Moussa 1999). Other studies have given attention to actors who played crucial roles in forest destruction.

Based on past relevant studies, this study employed two explanatory modes in order to understand the structure of proximate causes, underlying causes and leading actors.

The first explanatory mode is the relative classification of causes into categories of proximate/immediate and underlying/ultimate causes. The following approach was adopted to sort the various causes of forest destruction. Immediate, or direct, methods of clearing forests such as burning or cutting, or depleting of specific tree species, were classified as proximate causes (Hirsch 1999). We focused on commercial export logging as a major proximate cause of forest destruction. In addition we examined the contribution of slash-and-burn agriculture[2] by upland inhabitants to forest destruction. A structural approach was adopted to identify underlying/ultimate causes of forest destruction (Hirsch 1999). This approach focuses more on contextual background factors and requires an understanding of the societal, economic, political and ecological contexts in which deforestation occurs (Hirsch 1999).

The second mode seeks to explain forest destruction by classifying causes as domestic or foreign in origin. Various actors have direct links to the destruction of forests, such as the slash and burn cultivator, the landless farmer, the logging company, the government agency and the plantation owner (e.g., Hirsch

1 In the article "forest destruction" and "the destruction of forests" include deforestation as well as degradation of the forests.

2 Inoue (2000) distinguishes "slash-and-burn agriculture" from "swidden agriculture" in shifting cultivation. Swidden agriculture can be regarded as one of the most important local land-use system in the tropics. We defined the slash-and-burn agriculture as a nontraditional and unsustainable shifting cultivation method practiced by newcomers.

1987; Brown and Pearce 1994; Bryant et al. 1997; Verolme and Moussa 1999). In many cases, timber extraction has been directed at promoting foreign exchanges of tropical forest products. Thus, classifying causes by origin can aid in determining the influence of a resource's use in consumer countries on the resource's status in its production country. Thus, we subdivided causes into two categories: those that were influenced by domestic agents/perpetrators (domestic causes) and those that were influenced by foreign agents/perpetrators (foreign causes). As materials for this study we mainly used secondary data such as literature, reports and published statistics, supplemented with relevant personal interviews.

3. Present state of Lao cypress forests

3.1. May Long Leng or Lao cypress

May Long Leng is a generic term for some conifer species that occur specifically in the high mountains of the northeastern part of Lao P.D.R.. Lao cypress is not an actual plant name but, rather, a brand name given for May Long Leng by a Japanese timber importer (Tsuburaya 1996). Tsuburaya (1996) had believed that the Lao cypress was closely related to the species *Folienia hodginsii or Fokienia kwaii*. But some experts have classified the Lao cypress species under the sub-species of *Chamaecyparis obtusa*.

Table 1. List of the tree species in Lao cypress forest.

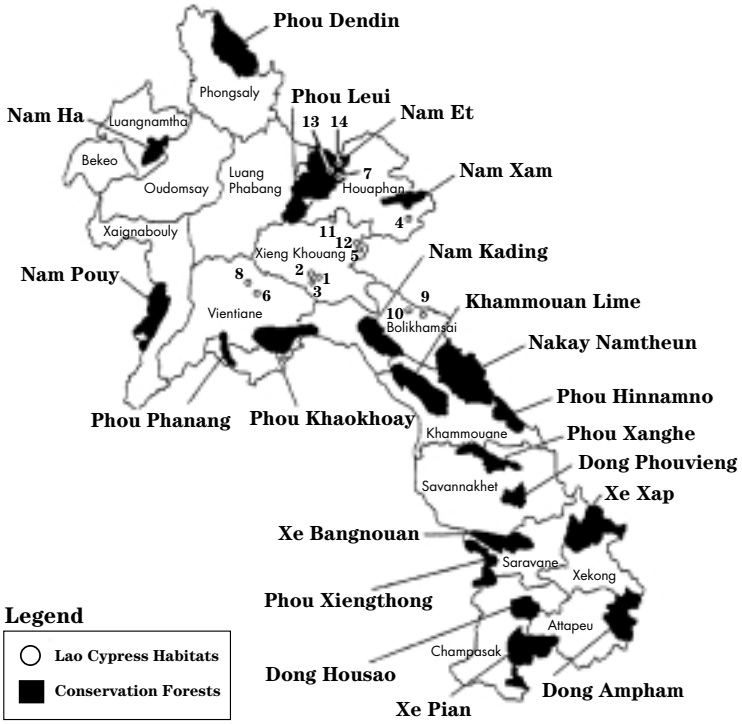
No.	Local name	Scientific name	English name	Remark
1	May Long Leng	*Chameacyparis obtusa*	False cypress	Occurs in clusters
2	May Ko	*Quercus spp., Pasania spp., Castanopsis spp.*	Oak	Distributed throughout the whole area.
3	May Hing Hom	*Cunninghamia lanceolata*	Pine species	Occurs in clusters
4	May Sachouang	*Cinamomum iners*	NA	
5	May Mouath	*Aporosa microcalyx*	NA	
6	May My	*Schima wallichi*	NA	
7	May Lang Dam	*Diospiros spp.*	NA	
8	May Khom Phath	*Biscofia trifolia*	NA	
9	May San Dong	*Dillinia spp.*	NA	
10	May Phao	*Engelhardtia clisolepsis*	NA	
11	May Xai	*Mangletia spp.*	NA	
12	May Leuat Nok	*Knema oblongifolia*	NA	
13	May Hing	*Keteleeria davidiana*	NA	
14	May Pek Khon Kay	*Podocarpus imbricatus*	Pine species	
15	May Tao Khaen	*Podocarpus spp.*	Pine species	
16	Other		Pine species	

Source: NOFIP 1992.

Lao cypress usually grows in clusters of 10 to 50 trees. In general, a Lao cypress forest is not homogeneous. The natural Lao cypress forest is classified as the "upper evergreen mixed forest", which is dispersed with many other species of both broadleaf and coniferous trees (Table 1). Around one hundred of the species, however, have not yet been botanically classified. Although there is no stand-age research available for the Lao cypress forests, it is known that most of the trees are very old, with an average diameter of more than 90 cm and average canopy density of 70%.

3.2. Locations and the profile

There are fourteen habitats for Lao cypress in the *Houa Phanh* Province, the *Xiang Khoiang* Province, the *Xay Som Boun* Special Zone, the *Bolikhamxay* Province and the *Khammouane* Province (Figure 1). The exact number of the forests, however, is not known yet due to insufficient information from the provincial forestry offices. Most of them are located at elevations ranging from 1,000 to 2,000 m above sea level. Each habitat is separate, and the clusters of Lao cypress forests occur within a limited range. The forests are mainly located on dry sites such as upland areas and steep slopes, and grow together with broadleaf trees (Tsuburaya 1996).



Note: The number of Lao cypress habitats is consistent with Table 2.

Figure 1. Identified Lao cypress forest habitats and location of conservation forests in Lao P.D.R..

The Lao cypress is not abundant. The size of the habitats varies from 2,300 ha to 37,900 ha, and the total area is merely 1.3% of the forestland in Lao P.D.R.. The volume of stock per habitat varies from 1,200 m^3 to 163,000 m^3 (Table 2). The unit volume per habitat also varies from 0.1 m^3/ha to 16.7 m^3/ha, suggesting that the growth of Lao cypress is scattered within these ranges. The most abundant habitat with the largest area and the highest stock volume is located near the *Pou Bias* (Mt. Bias), the highest mountain in Lao P.D.R. (2,819 m above sea level). *Nam Thong* and *Phou Sam Soum* in the Xiang Khoiang Province are next most abundant. Habitats with high units stocks of more than 10 m^3 are Phou Sam Soum

Table 2. Location of Lao cypress forests in Lao P.D.R..

No.	Location	Area (ha)	Volume (m^3)	Volume / Area	Survey years	Remarks
1	Phou Sam Soum (X.K.)	6,700	92,700	13.8	1991-1992	Exploited
2	Phou Long Math (X.K.)	2,800	12,900	4.6	1992-1993	Not yet exploited
3	Phou Len Le (X.L.)	2,300	38,500	16.7	1992-1993	Not yet exploited
4	Phou Xang Kom (H.P.)	5,000	8,700	1.7	1993-1994	Exploited
5	Nam Thong (X.K.)	30,100	80,000	2.7	1992-1993	Exploited
6	Phou Bia (X.S.B.)	37,900	163,000	4.3	1991-1992	Under exploitation
7	Phou Leuy (H.P.)		4,255		1990-1991	Exploited
8	Phou Pha Deang (X.S.B.)		1,200		1992-1993	Not yet exploited
9	Nam Xoth (B.L.K.X.-K.M.)		8,000		1992-1993	Somewhat exploited
10	Phou Ong Hon (B.L.K.X.)	2,500	3,145	1.3	1991-1992	Exploited
11	Gnoth Gneuang (H.P. & X.K.)	10,000	20,000	2.0	1998-1999	Surveyed
12	Bouam Vay (X.K.)	4,000	10,000	2.5	1998-1999	Surveyed
13	Phou Liou (H.P.)	6,000	13,000	2.2	1998-1999	Surveyed
14	Phou Louang (H.P.)	10,000	1,000	0.1	1998-1999	Surveyed

Note: H.P.=Houa Phanh Province; X.K.=Xieng Khoiang Province; X.S.B.=Xay Som Boun Special zone; B.L.K.X.=Bolikhamxay Province and K.M.= Khammouane Province.

and Hou Len Le. Many of these habitats, however, have been or are now being logged, and the stock volumes have dwindled to less than 5 m^3.

4. Degradation of Lao cypress forests

4.1. Commercial logging

Local people have been utilizing this species as material for coffins, roofs and walls of traditional houses, and for water containers. It was not harvested as export logs until the 1980s. In the 1970s, the name of *May Long Leng*, or Lao cypress, was not on the list of tree species for export, while the list contained various other species such as *May Puay (Lagestroemia spp.)*, *May Dou (Pterocarpus macrocarpus)*, *May Bak (Anisoptera cochinchinensis)* and *May Hao (Tarrietia cochinchinensis)* (USAID 1970). The average unit price for round logs of these species was between 20 to 70 U.S.$, which is significantly lower than that of Lao cypress in general.

In 1991, a timber trader began to log commercially and export Lao cypress to Japan after the logging of Taiwanese cypress was banned due to its depletion. Until then, the Taiwanese cypress had been meeting the strong demand in Japan for a substitute of the “old” and “precious” natural Japanese cypress. Although precise statistics are not available for the annual production of Lao cypress, approximately 7,500 to 8,000 m^3 were exploited in 1992; 7,500 m^3 in 1993 and 3,700 m^3 in 1994 (Tsuburaya 1996; Chanthirath 1999).

An official notice in 1994 determined that the *Bolisat Phanthana Khet Phoudoi* (BPKP), the mountainous regional development public corporation, was to handle the logging concessions of Lao cypress forests. BPKP is one of the three public regional development corporations that exclusively possessed logging concessions in Lao P.D.R. and the privilege to control logging in the middle part of the country. By the time the official notice was enforced, however, four Taiwanese companies and one Chinese com-

Table 3. List of Lao cypress logging companies in Lao P.D.R. (based on the hearing survey at the Department of Forestry, Ministry of Agriculture and Forestry).

No.	Joint venture company name	Year established	Location	Remark
1	BIG-LAO (Lao-Taiwan)	1992	Phou Sam Soum	Xieng Khouang Province
2	Chang Linh Lumber (Taiwan)	1993	Nam Thong	Xieng Khouang Province
3	Ching Chang Lumber (Taiwan)	1993	Phou Bia	Special Zone
4	Yu Nan (China)	1993	Phou Xang Kom	Houa Phanh Province
5	B.P.K.P. (State company)	-	Phou Ong Hon, Nam Xoth	Bolikhamxay Province
6	Kouang Keomany (Lao-Taiwan)	1992	Phou Leuy	Houa Phanh Province

pany had already obtained concessions and exploited the Lao cypress forests in various places (Table 3). Today, the Koang Keomany Company has discontinued its operations due to financial and marketing problems. Five other companies are still continuing their activities.

The government of Lao P.D.R. is trying to ensure the proper trade between a concessionaire and a buyer of Lao cypress by means of checks and investigation by the Overseas Investment Governmental Committee. The Ministry of Agriculture and Forestry also oversees the provincial administration to ensure that logging is practiced in a legal manner (Tsuburaya 1996). Lao cypress extraction is solely for export purposes, and most of the Lao cypress sales are rendered directly to the national revenue. However, because the Lao cypress forests occur in remote, mountainous areas, logging is considerably difficult to monitor constantly and to control adequately. Thus the Lao cypress is subject to unregulated cutting or destructive actions by local people or illegal loggers. Every year, Lao cypress is extracted as materials for housing and construction (such as for roofing and panels), for coffins, etc. The depletion of Lao cypress growing on the southern slope is considered to originate from such activities conducted by local inhabitants for over the past 200 years. However, the impact of these local practices seems rather small compared to more recent illegal extraction for commercial export. Illegally extracted Lao cypress is exported either directly or through the hands of middlemen. Unfortunately, detailed and reliable data on the volume and the routes of such trade is not available.

Regulations allow the cutting down of trees with DBH (diameter at breast height) of more than 95 cm, and selective logging is applied in the felling of Lao cypress. As mentioned earlier, Lao cypress forests are mixed stands with a low percentage of Lao cypress. In theory, commercial logging should not cause deforestation. However, unsustainable methods of extraction are also used to log Lao cypress. According to an interview with a Japanese importer, small Lao cypress with a DBH of less than 60 cm are usually not harvested, in consideration of forest regeneration. However, it was said that Taiwanese companies for the most part tend to extract all cypress in a logging site regardless of size. Skyline yarding is the main method of extraction, but helicopter yarding is employed on occasion. Further, however, semi-ground yarding is also common, because of the heavy weight of the logs and the cost performance of the logging operation. Practice of this illegal method causes serious damage to the forest floor's vegetation.

After logging, the rehabilitation of the logged areas or the transportation path is not adequately enforced. Regeneration efforts such as tree planting are not carried out intensively. There seem to be three main reasons: high costs of afforestation, limited budgets and lack of forestry technicians able to train

others about the cultivation of seedlings. As mentioned earlier, the Lao cypress usually grows mixed with natural broadleaf tree species. For such a species, natural regeneration is difficult because the seedlings often do not receive sufficient sunlight to grow. The only effective way to reestablish the cypress forest is through the artificial cultivation and planting of seedlings. However, only a few attempts have been made so far to develop techniques for the silviculture and nursery of Lao cypress. Even if the seedlings or the young plants were available, the cypress forest usually grows at a high altitude, on a rocky mountain or a steep slope. Under such geographical conditions, artificial tree planting is quite difficult and costly.

4.2. Export of the logs

In Japan, timber from Lao cypress and Taiwanese cypress is highly appreciated as a substitute for native Japanese cypress timber because it is dense and of good quality. Lao cypress and Taiwanese cypress wood is used as building materials for traditional architectural structures such as Shinto shrines, Buddhist temples and others. The average unit price of a round log is approximately 2,500 to 5,000 U.S.$/m^3, and that of processed wood is roughly 5,000 to 10,000 U.S.$/m^3. The demand for Lao cypress has increased especially since the logging of Taiwanese cypress was banned in 1990. In Lao P.D.R., the price of logs varies greatly depending on the quality and the size/diameter of the logs. The unit price of Lao cypress, however, is extremely high when compared with other tree species. Lao cypress was once

Table 4. Trade statistics of round logs from Lao P.D.R. to Japan. The volume (left) in m^3 and value (right) in U.S.$.

Year	Coniferous						Not coniferous					
	Pine		Cypress		Other		Teak		Padock		Other	
	vol. (m^3)	value (U.S.$)	vol. (m^3)	value (U.S.$)	vol. (m^3)	value (U.S.$)	vol. (m^3)	value (U.S.$)	vol. (m^3)	value (U.S.$)	vol. (m^3)	value (U.S.$)
1989	12961	543205			224	6387					1524	454467
1990	7516	396060									2517	162260
1991	4973	221126	37	9065							485	4217
1992	4294	194033	608	182758	2830	660136					223	7539
1993	9571	365458	558	108096							359	12941
1994	32967	863037	2886	629476	10681	336135					1343	23164
1995	25611	700949	1923	432264	7952	201513					805	17778
1996	14164	392122	3349	589357			9	1130	46	5283	291	9825
1997	4055	123627	1091	163129	720	20200	16	5413	211	20619	379	12736
1998	346	22567	2396	734119	5976	176360			283	37434	325	0

Source: JMOF Trade Statistics 1989-1998.

traded at more than 2,000 U.S.$/m^3, although recent unit prices are usually between 900 and 1,500 U.S.$/m^3 with an average of 1,000 U.S.$/m^3 (Tsuburaya 1996). Royalties are imposed across the board on exported Lao cypress. The required royalty is 960 U.S.$/m^3 for round logs and 350 U.S.$/m^3 for processed wood (Tsuburaya 1996).

Prior to 1992, almost all of the logged Lao cypress was consumed locally and was not exported to foreign countries. However, since 1992, almost all of the logged Lao cypress has been exported to either Japan or Taiwan. An estimated 90 to 95% of the exported Lao cypress is eventually consumed in Japan (Tsuburaya 1996). High quality round logs are sent directly to Japan (Tsuburaya 1996). The rest are first

exported to Taiwan for processing and then re-exported to Japan. There are two routes for international shipping. The logs from the Houa Phanh, Xieng Khouang and Bolikhamxay provinces are transported to and shipped from either Port Vinh or Port Haiphong in Vietnam. The logs from Phou Bia (Mt. Bia) near Thailand are transported by land to Bangkok through Vientiane, and shipped from there. According to the 1988 to 1989 statistics on the round log trade between Lao P.D.R. and Japan (JMOF 1989), the export of cypress logs from Lao P.D.R. to Japan started in 1991 immediately after the logging ban on Taiwanese cypress was enacted (Table 4). Japan's import of Taiwanese cypress has been decreasing since 1989, with the total import of Taiwanese cypress in 1998 only one-seventh of what it was in 1989. Although the Japan's import of Lao cypress logs was merely 37 m^3 in 1991, it has drastically increased since 1994, when Japan's import of Lao cypress first exceeded that of Taiwanese cypress. The fluctuation in the total amount of imported Lao cypress logs from 1994 to 1998 was between 1,091 and 3,349 m^3, its average being 2,431 m^3 (Table 4). From 1994 to 1998, the average annual export of Lao cypress logs to Japan was approximately 40% of the average total volume production of cypress in Laotian forests between

Table 5. Trade statistics of round logs exported from Lao P.D.R. to Taiwan. The volume (left) in m^3 and value (right) in N.T.1000 $.

	Chamaecyparis spp.		Pinus spp.		Other coniferous species		Other non-coniferous species	
Year	vol. (m^3)	value (N.T. 1000 $)	vol. (m^3)	value (N.T. 1000 $)	vol. (m^3)	Value (N.T. 1000 $)	vol. (m^3)	value (N.T. 1000 $)
1994					3795	27839		
1995	3113	131081	27	260	2053	59865	6607	12963
1996	1772	103836	850	2766			4157	75370
1997	3042	140763			404	12956	4819	88627
1998	1374	38325			2790	69141	1269	39541

Source: Taiwan Trade Statistics 1994-1998.

1992 and 1994. Imports of Lao cypress logs from 1994 to 1998 were estimated at approximately 14% of the total round log imports from Lao P.D.R. to Japan during the same period. In terms of sales, the same imports were equivalent to 684 million JPY, and the share in value from total imports was more than 70%. This means that the unit price of a Lao cypress round log is considerably higher than logs coming from other types of trees (227,000 JPY/m^3 = approximately 1,900 U.S.$/$m^3$ on average).

Based on trade statistics from Taiwan for 1994 to 1998, the annual import of round logs of Chamaecyparis spp. from Lao P.D.R. to Taiwan was between 1,374 m^3 (in 1998) and 3,113 m^3 (in 1995), with the average being 2,325 m^3 (Table 5). The share is less than 30% of the annual total round log imports from Lao P.D.R. The average value for annual round log imports from Lao P.D.R. was equivalent to 410 million JPY, varying from 150 million JPY in 1998 to 560 million JPY in 1995. The average monetary share for Lao cypress was 51%, ranging from 26% to 64%. As for the Lao cypress round log exports to Japan, the unit price of a log is between 112,000 JPY/m^3 (in 1998) and 230,000 JPY/m^3 (in 1996), with the average being 174,000 JPY/m^3.

4.3. Slash-and-burn agriculture

It is often stated that the two main causes of deforestation in Lao P.D.R. are slash-and-burn agriculture and forest fires. Experts have estimated that these two factors are responsible for more than 80% of the

total deforestation (Suzuki 1993). A remote sensing survey in 1988 has shown a low percentage of forest coverage in the northern part of the country, and this fact is considered proof that slash-and-burn agriculture is a key factor in the deforestation of Lao P.D.R. (Inoue 1994). This inference may be applicable to this analysis of destruction of the Lao cypress forests.

Although exact details have not been confirmed, more than 91,000 households (around 503,000 people) practice shifting cultivation within the Lao cypress habitats (NOFIP 1992). Generally speaking, the upper altitude limit for slash-and-burn agriculture is between 800 and 1000 m due to the limitation of natural conditions. As mentioned earlier, the habitats of Lao cypress forests are located at rather high altitudes, ranging from 1000 to 2000 m in elevation. Consequently, the activities of slash-and-burn agriculture are limited mostly to the lower part of the habitats.

Nearly half of the area is believed to be degraded due to the slash-and-burn agricultural practices of the upland people, particularly the *Hmong* ethnic group (*Lao sung*), who live in or around the Lao cypress forests (NOFIP 1992). The Hmong dwell on land of rather high altitude, where the soil is generally less fertile and the slopes are very steep. There is no arable land available for permanent agriculture. As a result, they rely on shifting cultivation to make a living. The most common crops are maize and poppy. Upland rice is cultivated at lower altitudes where temperatures are higher. Maize and poppy are cultivated together as inter-crops, requiring significant amounts of minerals from the soil. Pulses are planted to improve the soil fertility. However, the Hmong emphasize high-yield, short-term agricultural production and do not pay much attention to the sustainability of vegetation and the stability of land. The steep slopes are often cleared so much that there are almost no trees left. Fires are not carefully tended and frequently get out of control. Usually, slash-and-burn cultivation is practiced with no intention for reuse after the fallow period; that is, cultivation continues until the land is totally depleted of nutrients. Then the area is abandoned. Because the Lao cypress forests are located at rather high altitudes with steep slopes, and because the forestland is vulnerable to erosion, the abandoned land is subject to soil erosion in the rainy season, and turns into barren land or savanna with some species of grass dominating the area. Once the land is deteriorated, natural rehabilitation and soil regeneration is difficult, or impossible.

The details of the relationship between commercial logging and slash-and-burn agriculture by local inhabitants are uncertain because of the lack of available studies. According to an interview with a Japanese timber exporter, slash-and-burn agriculture is not generally conducted just after commercial logging of Lao cypress because broadleaf trees still remain at the logging site and the site is not suitable for agriculture. However, commercial logging might be used to provide people access to new land and, in turn, trigger new slash-and-burn activities, as is the mechanism of deforestation in many tropical forests, especially in lowlands or accessible locations.

The Lao government places a high priority on the reduction/stabilization of shifting cultivation in the country in order to protect its natural resources and environment. Shifting cultivation with swidden agriculture has long been practiced as a sustainable system of agriculture in upland areas of the country. However, the government regards this method as no longer sustainable as the increasing population exerts greater pressure on the land and its resources, continuously expanding areas required for slash-and-burn agriculture, and shortening the fallow period. Therefore, the government has started a national

program that includes the "reduction of shifting cultivation". They have introduced several countermeasures such as (i) allocation of land to local peoples, (ii) classification of agricultural and forest land, (iii) local peoples' participatory forest management and (iv) improvement of the productivity of upland agricultural land. As a result of such new policies, by 1996 to 1997 19,300 households have given up shifting cultivation. This outcome, however, is not yet sufficient, and the government has to realize that it must provide more extensive services and financial support to the land users in order to implement fully these programs.

5. Current state of Lao cypress conservation

To date, the government of Lao P.D.R. has established and declared 20 National Biodiversity Conservation Areas (NBCA), covering nearly 30,000 km^2 or 12.5% of the total land area of the country (Table 6). In addition, large areas are designated as Protection or Conservation Forest at provincial and district levels. In total, these classes of forest cover 8 million ha or 76% of the perceived forest estate. It is a large commitment by any standard.

Table 6. Locations of National Biodiversity Conservation Areas.

No.	Name of NBCA	Area (ha)	Province/location	Remarks
1	Phou Deandeen	222,000	Phongsaly	
2	Phou Leui	150,000	Houaphanh	Including Lao cypress locations
3	Nam Et	170,000	Houaphanh	Including Lao cypress locations
4	Nam Sam	70,000	Houaphanh	Including Lao cypress locations
5	Nam Ha	69,000	Luangnamtha	
6	Nam Pui	191,200	Xayabury	
7	Phou Khao Khuay	200,000	Vientiane-Borikhamxay	
8	Phou Phanang	70	Vientiane municipality	
9	Nam Kading	169,000	Borikhamxay	
10	Nakai-Nam Theun	353,200	Khammouane	Including Lao cypress locations
11	Phou Hinponn	150,000	Khammouane	
12	Hin Namno	82,000	Khammouane	
13	Phou Sanghe	109,900	Savannakhet	
14	Se Bang Nouane	150	Savannakhet-Saravane	
15	Phou Xieng Thong	120,000	Saravane	
16	Dong Houa Sao	1120,000	Champasack	
17	Sepiane	240,000	Champasack-Attopeu	
18	Dong Ampham	200,000	Attopeu	
19	Se Sap	133,500	Saravane	
20	Dong Phouvieng	53,000	Savannakhet	
	Total	3,012,800		

In 1996 the National Assembly passed the Forestry Law, which provides a comprehensive policy framework for all aspects of forestry. It includes a basis for zoning NBCAs into "Strictly Protected" areas and "Controlled Use" zones. Regulations are currently being drafted to provide necessary directives for the management of wildlife, habitats and protected areas.

At the international level, the government has ratified the Convention on Biological Diversity and signed the World Heritage Convention, although it is not yet a party to the Convention on International Trade in Endangered Species. At a national level, in order to expedite the implementation of the "Environmental Action Plan" through cross-sectoral co-ordination (STENO 1994), a new authority—the Science, Technology and Environment Organization (STENO)—was established in 1993 under the Prime

Minister's Office (STENO 1993). Moreover, several donor-funded projects are trying to promote an integrated conservation and development of the protected areas as well as the watershed areas (Kingsada 1998).

The establishment of the protection area, along with the above-mentioned ministerial ordinance on commercial logging in 1994, is the sole framework for the conservation of Lao cypress forests so far. Officially, NBCA oversees more than 25% of the total area of Lao cypress forests (Figure 1). In theory, all cypress forests within the jurisdiction of the NBCA will be protected. In reality, due to an insufficient budget and the lack of a solid management planning, NBCA cannot effectively carry out its mission of protection. A plan for the sustainable management of Lao cypress in non-protected areas has not been drafted yet. In 1996, the Lao government made a request to the Japanese government through the embassy of Japan in Lao P.D.R. to establish a development study focused on Lao cypress forests that would enlist experts from Japan. The proposed aim of the project was to clarify some basic facts required for the scientific management of the Lao cypress, such as the preferred location, the abundance/conditions of the Lao cypress resources and the process of regeneration (Tsuburaya 1996). As of 1999, however, the project has not yet materialized.

As mentioned earlier, the Lao cypress forests are located in the mountainous area of northern Lao P.D.R., and the total area of its identified habitats accounts for only 1.3% of the total forestland in the country. Most of the Lao cypress forests are not designated as Protection or Conservation Forests. Further, protection is not very effective even in the protected areas. The exploitation of the Lao cypress has undoubtedly been aggravated in recent years, and several Lao cypress habitats are on the verge of complete depletion. If Lao cypress logging is conducted at the same pace as it was from 1992 to 1994, approximately 1,340 ha or 1.14% of the known Lao cypress forests will be degraded or deforested per year. If no efforts are made to check this forest destruction, the Lao cypress is likely to be extinct in less than 100 years. Urgent efforts to develop feasible and effective strategies are required to ensure a sustainable use of the Lao cypress.

6. Discussion of causes

The proximate causes studied in this article can be categorized into either the "domestic proximate causes" or the "foreign proximate causes".

Commercial logging. Proximate causes such as "commercial logging" and "export of the logs" are categorized as "foreign proximate causes". This is because at the root of these activities lies an underlying cause of foreign origin: the high evaluation and strong demand for the Lao cypress in Japan and Taiwan. On average, 75% of the total Lao cypress extracted from 1992 to 1994 was exported to Japan and Taiwan. Some experts believe that almost all of the exported timber from Lao P.D.R. is being consumed in Japan (Tsuburaya 1996). These facts imply that Japan and Taiwan are responsible for the destruction of Lao cypress forests in Lao P.D.R.. The monetary shares of round log Lao cypress exports to Japan and Taiwan account for more than 50% of total exports from Lao P.D.R., despite their small share of timber export volume. This indicates the strong demand for and high appreciation of Lao cypress in the importing countries. In turn, the high profit and steady demand in the importing countries

enhance the economic incentives in Lao P.D.R. to extract and export the Lao cypress, increasing the pressures of development and raising the domestic market prices. As a result, Lao cypress will be extracted even in the upper reaches of Lao P.D.R. because the high domestic market prices will compensate for the high harvesting costs. This vicious cycle could continue until the Lao cypress resources are totally exhausted. With respect to other natural resources, this cycle, with its many international links, has been compared to a chain around the environment. In some cases the concerned material is imported across the board by many different countries. In other cases the demand itself is the product of a particular culture, such as Japan's demand for Lao cypress, which arises from its unique cultural roots and its deep-seated demand for special wooden buildings. When consumers in an importer country view a material as indispensable and no domestic substitute is available, countermeasures such as trade regulations and tariff barriers may not function effectively, for these consumers will purchase the material however high the cost. An export ban in an exporter country may only shift the site of exploitation to another country, just as the logging ban on Taiwanese cypress generated the Japanese demand for Lao cypress. When no substitutes are available anywhere, a ban on exports will only trigger the sudden increase of illegal exploitation and trade. Introduction of certification systems and eco-labeling to ensure a sustainable use of resources would be more feasible than these measures. In any case, efforts by the importer country to reduce consumption through efficient and/or repetitive use are essential. As a basis for such actions, consumers in importer countries must be informed about the conservation status of Lao cypress forests. Thus, elements of environmental education aimed at public awareness should be included in this effort. The importing countries would also have their own benefits to reap from conservation efforts, because the extinction of the Lao cypress would be an inconvenient result for its consumers.

Unregulated logging. The underlying cause of "unregulated logging" appears to be "foreign" because exportation to countries where demand is strong and profits are high is the most likely motivation for illegal logging. However, it is necessary to conduct further investigation in this area.

Unsustainable methods of tree cutting. Methods of cutting Lao cypress are categorized as "domestic", because the relevant actors are governmental or private companies in Lao P.D.R.. In theory, the Forestry Law has several clauses to check overcutting, such as Article 8 regarding "Obligations in the Protection and Conservation of Forest and Forest Land", Article 25 on the "Harvesting of Timber and Other Forest Products" and Article 35 on "Promoting the Rehabilitation of Reed Forests". However, these clauses are not effectively implemented for a number of reasons. Neither reliable guidance for its implementation nor rules for sustainable harvesting have been developed so far, although these need to be provided urgently. For example, Tsuburaya (1996) highlights the necessity of scientific research for identifying the annual maximum amount of trees that can be logged without damaging forest sustainability and for developing sustainable harvesting systems and regeneration techniques, including reforestation. However, Lao P.D.R. does not have the domestic financial and human resources to conduct such research and develop such technologies; external assistance from donor countries may be necessary. Pursuit of international cooperation in the conservation of Lao cypress may be critical to overcoming these funding constraints. At the same time, the insufficient institutional infrastructure can also be regarded as an underlying cause of ineffective implementation of legal instruments. In this regard as well, support and assistance for the administrative organizations appear to be essential.

Slash-and-burn agriculture. The practice of "slash-and-burn agriculture" is categorized as a "domestic proximate cause", for the actors concerned are mainly the local inhabitants. This cause certainly plays a role in the deforestation of the forests, particularly in the accessible or lower part of the Lao cypress forests. Since the 1950s, shifting cultivation in the mountainous areas has transformed from sustainable to unsustainable, brought about by various changes in social[3], political[4] and economic[5] aspects originating from the government (Suzuki 1993; Inoue 1994; Namura and Inoue 1998). Thus countermeasures to check the expansion of unsustainable slash-and-burn agriculture should be discussed within these contexts. Of all the possible causes for the spread of this agricultural method, the land-use classification policy aimed at the reduction of shifting cultivation appears to be the most significant. Due to its unrealistic limitations on forest use by local inhabitants, it has created a great disparity between the land-use rights determined by the law and the reality of the destructive land-use practices by the local inhabitants (Namura and Inoue 1998). As a result, quite contrary to its original intention, this policy has exacerbated deforestation both in the commercial and the protection/conservation forests. The following two strategic approaches proposed by Namura and Inoue (1998) seem to be worth consideration as feasible solutions. One is the introduction of rational agro-forestry systems, including swidden agriculture, along with re-classification of the land during a transition period. Another is the introduction of a law or rule allowing land allocation to be carried out in such a way that the present practices and use of forest resources by the local people would be left intact. Some difficulties are expected for the first approach, because it requires a reexamination of the land-use classification policy itself. The second approach appears more pragmatic, and its introduction can be legally founded on Article 30 of the Forestry Law, which provides that the "Customary Use of Forest and Forest Land" should be respected.

This analysis has demonstrated that the degradation of Lao cypress forests has various proximate and underlying causes of both domestic and foreign origin. However, causes of foreign origin seem to be more significant than causes of domestic origin. The strong demand and consumption of Lao cypress in Japan appear to act as the major ultimate causes of the degradation of Lao cypress forests. Thus, it can be said that the fate of the Lao cypress forests lies in the hands of Japanese consumers.

In conclusion, domestic actors should use three strategic approaches to address the domestic causes of forest degradation:

(1) Development of a law or rule that allows the land-use allocation policy to be implemented without hindering the local inhabitants from their customary use of the forest resources.

(2) Preparation of a guide for the implementation of related laws and/or introduction of a rule to ensure the sustainable management of the forest resources through scientific research and development of feasible management techniques.

(3) Promotion of international cooperation to establish a project that enlists experts from the international community in the conservation of the Lao cypress.

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3 An example of such social changes is the strong demand for new cultivation areas by newcomers who migrated to the mountainous areas in 1960s and 1970s.

4 Examples of political changes include the new government policies after the revolution in 1975 to 1985, such as the implementation of land reform and the establishment of a new labor organization (Inoue 1994).

5 An example of economic changes is the new economic mechanism started in 1986.

Foreign actors (with Japan as the main consumer) should take three strategic approaches to avert the extinction of the Lao cypress:

(1) Reduction of the total amount of consumption by limiting consumption through more effective use, and even re-use, of the materials, and environmental education of consumers and stakeholders aimed at creating a public awareness for the necessity of these efforts.

(2) Introduction of non-tariff barriers such as “certification” and “eco-labeling”, which ensure that the logging is conducted only in sustainably managed forests.

(3) Contribution to international efforts to protect the Lao cypress, such as the establishment of a project to study the Lao cypress. Such efforts will benefit the exporter countries in the long run.

As our studies showed, the degradation of Lao cypress forests has been driven by strong consumer demand in two consumer countries—Japan and Taiwan. At the same time, the forests have suffered from the lack of sufficient legal and administrative bases for forest management. Therefore, the well-balanced implementation of these strategic approaches through a bilateral project may be crucial for the effective conservation of Lao cypress forests.

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