

PLANT & FOREST

# The major factors effecting the decrease of forest cover in the Huaphanh Province, Northern Laos

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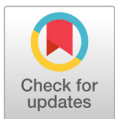
## Abstract

The forest of the Huaphanh Province (HP) has continued to decrease at 0.6% (10,560 ha) per year from 1992 to 2010. In the past few decades, the government of Laos and the Huaphanh Provincial Authority have been trying to address the root causes of deforestation. This study attempts to examine the factors effecting the decrease of the forest cover in the HP by analyzing the influence of the local socio-economic development and implementation of forest management policies on changes in the forest cover. The social data of the province focused on population growth and distribution between urban and rural areas including the number of poor people and the economic growth of three sectors, namely agriculture and forestry, industry, and service, while the implementation of the state forest management policy focused on the state forest management plan, tree plantation, forest land use planning and allocation to households, and shifting cultivation including annual upland rice and maize cultivation. In addition, government reports on socio-economic and rural development including poverty eradication of other provinces, where an increase in the forest cover was observed, were also collected and analyzed using qualitative and comparative analysis. The results from this study indicate that the decrease in forest cover in the Huaphanh Province appears to depend on a very slow economic growth and reduction in rural poverty of the province. The increase in the rural population in the province led to an increase in farm households and are as for shifting cultivation. As a result, forests were cleared leading to a decrease in the forest cover.

**Keywords:** decrease forest cover, economic growth, Huaphanh Province, increase rural population, northern Laos

## Introduction

Huaphanh Province is the poorest province in Lao People's Democratic Republic (Lao PDR) and only province in Northern Laos has a significant rate of the decrease in forest cover during past decades. The province is located in the Northeast Region of Laos lying between 19°40' and 21°00'N and 103°00' and 105°00'E. The total area of the province is 16,500 km<sup>2</sup> at altitudes



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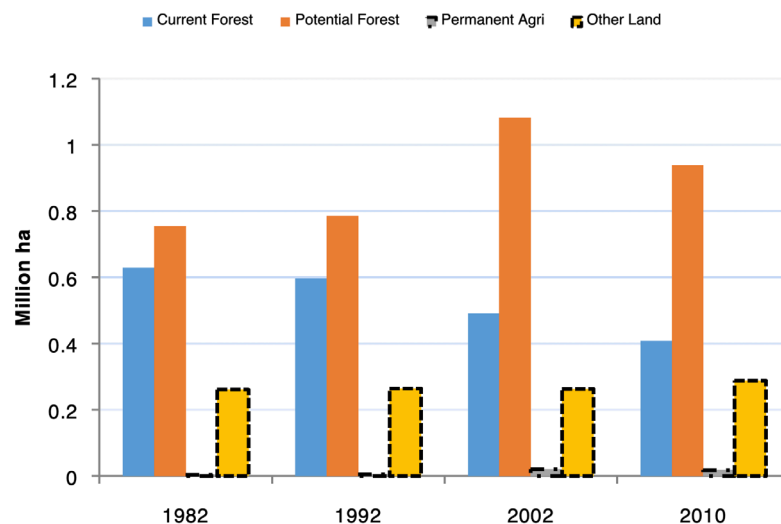


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varying from 350 meters to 2,257 meters above sea level. The province is comprised of ten districts and 718 villages. Total population in 2015 was 289,000 persons (male 50.9% and female 49.1%) with an average household size of 6.2 persons and population growth rate and density of 1.9% and 17.8 person per km<sup>2</sup>, respectively (Lao Statistic Bureau, 2015a). The province receives an average annual rainfall of 1,434 mm with mean maximum temperature and minimum temperature of 32.6°C and 20.4°C, respectively (Lao Statistic Bureau, 2015b). The main occupation of the people is agriculture with 92.4% of households engaged in agricultural production (ACO, 2012).

In Lao PDR, a national forest cover assessment is conducted every ten-year starting in 1992 to assess forest cover changes. For this assessment, the Department of Forestry (DOF) developed a national land classification and forest definition. The national land use is classified into five classes, namely: The potential forest, current forest, other wooded areas, permanent agriculture land, and other non-forest area such as water, residential, etc. Forest is defined as land with a tree canopy cover of more than 20% and area of more than 0.5 ha and the trees should reach a minimum height of 5 meter. If the tree canopy covers of less than 20%, it is classified as potential forest which included bamboo, degraded forest, and slash- and- burn shifting cultivation. According to the definition, the forest of Huaphanh province has continued to decline at the rate of 0.6% (10,560 ha) per year from 1992 to 2010. In 1982, the forest was estimated at 38.1 % (0.63 million ha) of the total area of the province. This decreased to 29.7% (0.59 million ha) by the early 2000s and then to 24% (0.46 million ha) in 2010. While, the potential forest cover increased by nearly 18% (0.3 million ha) from 1992 to 2001, but decreased by 9% from 2002 to 2010 (Fig. 1).

The causes for the decrease of forest in Laos are multiple, but the main causes are: Unsustainable wood extraction, pioneering slash- and- burn shifting cultivation, agricultural expansion, industrial tree plantations, mining, hydropower, infrastructure development, urban expansion, and forest fire. Among these causes, pioneering slash- and- burn shifting cultivation is predominant land use system and widely and dynamically utilized in the Northern Laos (DOF, 2010b; Kaspar et al., 2012). Most of slash- and- burn shifting cultivation in Laos involve the poorest people, who are dependent on forest resources and have a very limit alternative livelihood option. With a serious concern over the destruction of forests by the rural poor in the 1980s accounting for 300,000 ha annually, the government of Laos (GoL) has taken some



**Fig. 1.** Land-use changes in Huaphanh Province from 1982 to 2010.

measures to eradicate poverty in rural areas by promoting a program to stabilize shifting cultivation, land-use planning and land allocation (LUPLA) to families in rural areas, etc., In the 2000s, the GoL endorsed the forest strategy 2020 (FS 2020) and amended forest law. The strategy sets major sector targets, which must be achieved by 2020 to contribute to poverty eradication. State forests have been classified into three categories (referred to as the three forest categories), namely: protection forest (PFs), conservation forest (CFs) and national production forest (NPFs). Each forest category has a specific function and different management objectives, which forestry sectors need to develop a long-term management plan and implement the plan with local villagers based on sustainable forest management principles and guideline. Based on the results of recent cover assessment 2010, there was a net gain of forest in the Northern region at an average of 0.7% annually from 2002 to 2010. However, the effectiveness of these programs and their influence on change in forest cover in Northern region have yet to be analytically assessed and evaluated. A recent study on forest policy measures influencing the increase of forest cover in Northern Laos conducted by Kim and Alounsavath (2015) illustrated that the major causes of the gain in forest cover could be attributed to poverty reduction, land-use planning and land allocation, and decrease in slash- and- burn shifting cultivation. A subsequent study on factors influencing the increase of forest cover in Luang Prabang Province, Northern Laos conducted by Kim and Alounsavath (2016) indicated that the increase in forest cover is closely linked to socio-economic development in the province. The objective of this study was to examine the major factors affecting the decrease in forest cover in Huaphanh Province (HP) during past decades by analyzing the influence of local socio-economic development and implementation of forest management policy in the province.

## Materials and Methods

### Data collection

This study collected secondary socio-economic and agriculture and forestry data of HP from various sources (Table 1). The social data focused on population growth and distribution between urban and rural areas including the number of poor people, were collected from the National Population Census and Lao Expenditure and Consumption Survey (LECS). LECS is the most comprehensive household survey in Lao PDR and forms the basis for official poverty estimate. The economic data focused on the growth of three sectors, namely: Agriculture and forestry, industry, and service, were collected from Provincial Statistics Center of Huaphanh. The state forest management policy implementation focused on state forest management plan, tree plantation, forest land use planning and allocation to households, and shifting cultivation including annual upland rice and maize cultivation.

### Data analysis

Socio-economic information and data collected were analyzed using qualitative and comparative analysis. The qualitative analysis was used to gain an in-depth understanding of underlying factors effecting forest cover changes for HP, Luang Prabang (LPB), and Luang Namtha (LN) Province based on forest transition theory. The comparative analysis was used to study the different between the provinces where decrease or increases in forest cover were observed from 2002 to 2010. Recent studies on factors influencing the increase in forest cover in Northern Province of Laos,

particularly LPB and LN and others studies on forest transition in other countries, particularly Republic of Korea and Vietnam are compared and discussed. The study then conclude by summarizing which factors are most likely effecting the decrease of forest cover in Huaphanh Province.

**Table 1.** Forestry, agriculture, socio-economic data and sources.

Date categories	Unit	Date sources	Year
Forestry sector		Department of Forestry	
Areas of current forest	ha	Department of Forestry	2002 - 2015
Lands allocation	family	Shifting Cultivation Stabilization Office	1994 - 2005
Areas of tree plantation	ha	Department of Forestry	1994 - 2015
Agricultural sector		Department of Planning	
Area of annual crops irrigated	ha	Agriculture Statistic Yearbook	2000 - 2015
Area of lowland rice cultivation	ha	Agriculture Statistic Yearbook	2000 - 2015
Area of upland rice cultivation	ha	Agriculture Statistic Yearbook	2000 - 2015
Area of maize cultivation	ha	Agriculture Statistic Yearbook	2000 - 2015
Rice production	tone	Agriculture Statistic Yearbook	2000 - 2015
Major crop production	tone	Agriculture Statistic Yearbook	2000 - 2015
Farm households	family	Agriculture Census	1998/99 - 2010/11
Socio-economic sector		National and Provincial Statistic Centers	
Rural population growth	head	Statistical Yearbook	1997 - 2013
GDP per capital	USD	Provincial Statistic Center	2000 - 2010
Agricultural Sector growth	%	Provincial Statistic Center	2000 - 2015
Industrial sector growth	%	Provincial Statistic Center	2000 - 2015
Service sector growth	%	Provincial Statistic Center	2000 - 2015
Rate of poverty reduction	head	Rural Development Committee	1992 - 2013

## Results and discussions

### Change in rural population

Many case studies demonstrate that negative change in rural population has a positive impact on forest. Reduction of rural population was one of other main factors influencing the increase of forest cover in LPB Province during the 2000s (Kim and Alounsavath, 2016). The massive rural-urban migration had a positive effect on the increased growing stock level in South Korea during 1970s as a result of decrease of firewood consumption (Bae et al., 2012). Reduction of the pressure on forest resources and availability of non-natural resource-based income permit some degree of environmental recovery in Southern Bolivia (Preston et al., 1997).

From 1997 to 2010, the percentage of rural population decreased, but the total rural population rose from 231,814 in 1997 to 250,325 in 2010. The percentage of rural population slowly increased from 6.4% in 1997 to 13.5% in 2010 (Table 2). The percentage of farm households increased by 9% from 83% of the total household in 1998/99 to 92% in 2010/11 (ACO, 2012), resulting in the increase of slash-and-burn shifting cultivation, particularly upland rice cultivation and production of other upland crops.

## Change in rural poverty

Increasing rural population and poverty causes an increased rate of slash-and-burn shifting cultivation, particularly in the Northern region of Laos, because most slash-and-burn shifting cultivation in Laos consist of the poorest people, who live in rural areas without a basic infrastructure and have very limited alternative livelihoods (Ministry of Agriculture and Forestry, 2005). Kim and Alounsavath (2015) illustrated that a large potential of un-stocked forests were naturally regenerated and that caused significant increase in forest cover in the Northern region from 27.9% in 2002 to 33.8% (3.28 million ha) in 2010. The increase could be the results of poverty reduction, land use planning and land allocation, and decrease in slash-and-burn shifting cultivation. The rate of rural poverty in Huaphanh Province has remained the highest in Northern Laos. From 1997 to 2010, the poverty rate slowly decreased by 21% from 71% in 1997 to 50% in 2010, of which 93% were in rural areas. The poverty rate decreased to 48% in 2013 comprising about 7% of the national poverty (Ministry of Planning and Investment, 2010, 2014).

## Slash-and-burn shifting cultivation

Upland rice and maize cultivation, among other crops, have been extensively cultivated since the last decade (ACO, 2012) and have a significant impact on land-use and forest cover change in most of the provinces in Northern Laos (DOF, 2010a; Kaspar et al., 2012). In HP, many crop varieties were cultivated during the last decade from 2000 to 2015, but upland rice was the most dominant crop, followed by maize and lowland rice, with an average of annual cultivation in HP decreased by 16.5% (330,000 ha) of the total area between 2000 and 2009 (Kaspar et al., 2012), but the production of cash crops like maize increase rapidly from 6,040 ha in 2000 to 31,445 ha in 2014, with an average of annual cultivation of 17,024 ha (Lao Statistics Bureau, 2015b). The increase is related to increased market integration, infrastructure investments and reduced taxes for exports to Vietnam.

## Forestland Allocation

Land and forest allocation and village relocation and consolidation have been used as the main mechanisms for stabilizing shifting cultivation. Forest allocation regulated the use of forest and forestland is envisaged led to both the recovery of forest vegetation and increased quantities of forest resources available to villagers. The Land and Forest Allocation Program had been vigorously implemented between 1995 and 2005, covering about 7,130 villages (90% of total villages in the country) where land and forestall location were completed. However, the land-use planning and

**Table 2.** Change in rural population in Huaphanh Province from 1997 to 2010.

Year	Total population (person)	Rural population (person)	Rural population (% of total population)
1997	257,000	231,814	93.6
2002	272,310	238,319	84.0
2005	280,938	247,916	88.2
2007	287,467	260,967	89.0
2010	289,728	250,325	86.4

Adapted from Huaphanh Provincial Office, 2010.

land allocation program was very slow in implementation in HP. From 1995 to 2005, only about 20% of the villages completed land allocation and only about 32% of the families received land-use certificates (SCSC, 2005). In LPB, nearly 80% of total villages in LPB completed land allocation and 65% of all families received land-use certificates. Meyfroidt and Lambin (2008), the natural forest re-growth in Vietnam was significantly not only associated with the area of forest land use allocation to households in 1994, but also the significant negative correlation with forestland allocation and rate of increase in mountain maize.

## Economic growth

According to Mather and Needle (1998), the forest transition theory was developed to understand the shift from deforestation to reforestation, and then the growth of a stable and extended forest cover, that occurred in several countries. Rudel et al. (2005), suggest that, because of economic expansion, labor force is driven from agriculture to other economic sectors and from rural to urban areas (Han et al., 2017). At the same time, due to market development, agricultural intensification is concentrated in the most suitable regions. Large areas of land marginally suitable for agriculture are therefore abandoned and left to forest regeneration. Many studies have indicated that there is a historical relationship between economic development, deforestation, and forest transition. Based on the underlining ideas on forest transition in the context of a developing country, deforestation occurs due to the requirement for economic growth, and that an expansion of income results from the demand for forestland conversion for agriculture and forest products (Richard and Culas, 2012). Antle and Heidebrink (1995), analyzed the relationship between deforestation and GDP and indicated U-shaped EKC (Environmental Kuznets Curve) for deforestation with turning points ranging from USD 1200 to 2000 GDP per capita. The U-shaped EKC also applies to Asia (Richard and Culas, 2012). The positive change in forest cover in LPB is related to economic development in the Province in the 2000s (Kim and Alounsavath, 2016). LPB's economic development was the highest compared with other provinces in Northern Laos. GDP grew at annual rate of 7% per year from 2001 to 2005 and 9.4% per year from 2006 to 2010 with the estimated GDP per capita rising from USD 310 in 2000 to USD 931 in 2010 (Luang Prabang Provincial Office, 2005, 2010). Amongst the growth of three sectors (agriculture and forestry, industry and services), the share of service sector in GDP was the highest growth amongst all of the provinces in Northern Laos. The service sector continues showing growth since UNESCO declared the town of LPB as a World Heritage Site in 1995 as a result of its unique architectural, religious and cultural heritage. Since then, LPB has been transformed into an important natural, historic and cultural tourism site of Laos. The number of hotels and guesthouses including resorts increased from 9 and 7 in 1995 to 58 and 254 in 2014, respectively. The number of travel agents increased from 1 in 2002 to 49 in 2014 (Lao Statistics Bureau, 2015a). The number of foreign visitors continued to increase from 31,050 in 2000 to 135,000 in 2005 and 240,712 in 2009 (Luang Prabang Provincial Office, 2005, 2010).

In contrast, HP's economic development has been considerably slow compared with other provinces in Northern Laos with the estimated GDP per capital rising from USD 180 in 2000 to only USD 388 in 2010, the lowest growth amongst the provinces in Northern Laos (Huaphanh Province Office, 2005, 2010). The share of the services sector in GDP gradually increased from 14.3% in 2002 to 20.4% in 2010. The number of hotels and guesthouses including resorts increased from 2 and 3 in 1995 to 8 and 53 in 2014, respectively. The number of travel agents did not increase, two

agents from 2010 to 2014 (Lao Statistics Bureau, 2015b). From 2006 to 2010, the province has 57,076 visitors including 15,525 foreigners. The average tourism income was 12.9 billion kip including 229.23 million kip from Viengxay District (Huaphanh Province Office, 2010).

## Tree plantation

The increase in forest cover in many countries was attributed to the huge state afforestation program. For instance, the forest cover in South Korea increased from 35% of its land area in the mid-1950s to nearly 60% (5.9 million ha) in the mid-1970s. The increase was due to large-scale forest rehabilitation program. In the case of Vietnam, the planted forest contributed to the increase of forest cover about 80% from 9.3 million ha in 2010 (FAO, 2010). In the case of China, forest cover increased from 21.2% in 1990 to 28.7% in 2005 (FAO, 2005). In Luang Namtha and Luang Prabang, tree plantation development (mainly rubber and teak) were also important factors contributing to increase in forest cover. Luang Namtha begun planting rubber in 1994 and extensively planting since 2003 in response to China's demand for rubber. In 2010, total rubber plantation reached 35,085 ha. In Luang Prabang, the total area of teak and rubber plantations are 25,440 ha and 13,999 ha, respectively. In contrast, rubber and teak were not a popular species in Huaphanh Province because of unfavorable soil and climatic condition. To-date, the total plantation is just above 4000 ha.

## Management of State Forest

Forest management plan is a very important tool for sustainable management of forest resources. The forests in the province are classified into three categories (or referred to a three forest categories), namely: Protection Forest (PF's), Conservation Forest (CF's) and National Production Forest (NPF's). The forest areas constitute nearly 67% (or 1.2 Million ha) of the total land area of the province. Most of forest areas in the province are not physically demarcated and have not been covered by management plans. Management of state forests have faced many challenges. Incomplete national land-use zoning based on land-use policy (forestland, agricultural land, industrial land, etc.) and detailed provincial, district, and village land-use planning lead to confusion over land use (Alounsavath, 2015).

## Comparisons with other provinces

Luang Namtha and Luang Prabang Province (increased forest cover) were compared with Huaphanh Province. The data being compared includes GDP per capita, percent of upland rice cultivation, percent of rural poverty, percent of rural population, percent of households and villages were under land allocation, tree plantation (ha), and maize cultivation (ha). The result shows that Huaphanh Province led in terms of rural population, rural poverty, and maize cultivation, but was lowest in terms of tree plantation and land allocation, which together seem to indicate the low economic situation of the rural population. LPB led in terms of upland rice, land allocation, and GDP, and the lowest in terms of rural population. LN was lowest in terms of upland rice, poverty, and maize, and highest in terms of tree plantation. The comparison shows that LPB and LN are economically better off, e.g. higher GDP and lower rural poverty and rural population, as well as more engaged in tree plantation development. The results of one-way ANOVA of seven data categories between HP and LPB, only maize was not significantly different (Table 3); between HP and LN, only GDP was not significantly different (Table 4). The results suggest that rural population, rural poverty, and tree plantation development have a

significant influence on the increases in forest cover in LPB and LN. The decrease of forest cover in Huaphanh Province appears to depend on a very slow economic growth and reduction in rural poverty of the province. The rural population was very high above 85% and about 20% of the total villages were completely conducted LUPLA. As a result, the area of slash - and - burn shifting cultivation and upland rice production continued to increase and increase in forest clearances leading to deforestation and decline in forest cover.

**Table 3.** Results of one way ANOVA of mean value ( $\pm$  standard deviation) of seven data categories between Huaphanh and Luang Prabang Province.

Data categories	Huaphanh	Luang Prabang	df	F	p
GDP (USD)	244.91 $\pm$ 78.28	550.45 $\pm$ 219.61	1	18.891	< 0.001
Rural population (%)	87.67 $\pm$ 1.59	78.44 $\pm$ 6.83	1	19.065	< 0.001
Rural poverty (%)	46.90 $\pm$ 3.05	28.01 $\pm$ 5.40	1	101.97	< 0.001
Tree plantation (ha)	2848.64 $\pm$ 1129.18	7762.27 $\pm$ 7169.86	1	5.041	= 0.036
Upland rice (%)	51.79 $\pm$ 3.89	60.70 $\pm$ 7.86	1	11.335	= 0.003
Land allocation (family)	22.41 $\pm$ 7.37	55.38 $\pm$ 6.90	1	117.425	< 0.001
Maize (ha)	11700.18 $\pm$ 10322.23	10933.73 $\pm$ 9015.59	1	0.034	= 0.855

Adapted from Alounsavath, 2015.

**Table 4.** Results of one-way ANOVA of mean value ( $\pm$  standard deviation) of seven independent variables between Huaphanh and Luang Namtha Province.

Independent variables	Huaphanh	Luang Namtha	df	f	p
GDP (USD)	244.91 $\pm$ 78.28	298.00 $\pm$ 120.39	1	1.503	= 0.234
Rural population (%)	87.67 $\pm$ 1.59	80.01 $\pm$ 1.97	1	100.176	< 0.001
Rural poverty (%)	46.90 $\pm$ 3.05	23.48 $\pm$ 3.951	1	241.943	< 0.001
Tree plantation (ha)	2848.64 $\pm$ 1129.18	14395.09 $\pm$ 12610.45	1	9.149	= 0.007
Upland rice (%)	51.79 $\pm$ 3.89	47.75 $\pm$ 5.16	1	4.283	= 0.052
Land allocation (family)	22.41 $\pm$ 7.37	50.72 $\pm$ 27.44	1	8.89	= 0.008
Maize (ha)	11700.18 $\pm$ 10322.23	2216.73 $\pm$ 1730.58	1	9.918	= 0.005

Adapted from Alounsavath, 2015.

## Conclusion

Local socio-economic development was the main factor effecting the decrease in forest cover in Huaphanh Province during the 2000s. By analyzing the social and economic data of HP from various sources and comparing socio-economic development of Luang Namtha and Luang Prabang Province which increase forest cover, the study has illustrated that the major factors effecting the change in forest cover in HP are closely linked to the level of local socio-economic development. The increase in rural population and the high numbers of poor people in rural areas, including the high ratio of subsistence farm households resulted in increase of shifting cultivation or upland rice cultivation, in turn leading to decrease in forest cover.

Since the slash-and-burn shifting cultivation and upland rice production is the main driver of deforestation in Northern Laos and the Government's forest strategy sets a target to increase forest cover to 70% of the total land area, this study provides substantial information in improving a current state forest management that provides a clear policy incentive for local communities to actively engage in implementation of forest resources management and contributes to reduction of rural poverty. In addition, in order to minimize conversion of forest to other cash crop, forest land use and allocation and sustainable farming practices should be promoted in the forest management policy.



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