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Do Relocated Villages Experience More Forest Cover Change? Resettlements, Shifting Cultivation and Forests in the Lao PDR

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Abstract: This study explores the relationships between forest cover change and the village resettlement and land planning policies implemented in Laos, which have led to the relocation of remote and dispersed populations into clustered villages with easier access to state services and market facilities. We used the Global Forest Cover Change (2000–2012) and the most recent Lao Agricultural Census (2011) datasets to assess forest cover change in resettled and non-resettled villages throughout the country. We also reviewed a set of six case studies and performed an original case study in two villages of Luang Prabang province with 55 households, inquiring about relocation, land losses and intensification options. Our results show that resettled villages have greater baseline forest cover and total forest loss than most villages in Laos but not significant forest loss relative to that baseline. Resettled villages are consistently associated with forested areas, minority groups, and intermediate accessibility. The case studies highlight that resettlement coupled with land

use planning does not necessarily lead to the abandonment of shifting cultivation or affect forest loss but lead to a re-spatialization of land use. This includes clustering of forest clearings, which might lead to fallow shortening and land degradation while limited intensification options exist in the resettled villages. This study provides a contribution to studying relationships between migration, forest cover change, livelihood strategies, land governance and agricultural practices in tropical forest environments.

Keywords: resettlements; deforestation; rural development; ethnic minorities; Laos

1. Introduction

There is increasing recognition that land use and land cover change are affected by both economic and institutional drivers [1]. This has led to increasing emphasis on the role of governance and institutional factors in influencing land use and land cover change [1–3]. Public policies in the land sector of developing countries often aim at promoting a more efficient and equitable use of land, but might have unintended effects, including fostering conversion of forest into cropland [4]. This is especially the case with policies which include land redistribution and encourage rural migration, which are shown to be fundamental drivers of forest loss in the tropics [5]. Examining the outcomes and impacts of these policies is of high importance given the fundamental contribution of tropical forests to biological diversity, carbon storage and local livelihoods.

Throughout Southeast Asia, many countries have been enforcing policies—often backed by international cooperation—aimed at halting deforestation and fostering rural development [6]. A pervasive view has been that the practice of shifting cultivation is simultaneously responsible for deforestation and linked to the high poverty rates found among highland and ethnic minority people [7,8]. This view has been and still is held by the government of the Lao People’s Democratic Republic (hereafter: Laos) and some of their development partners, who have placed the reduction of both shifting cultivation and rural poverty high on their agendas. To reach these aims, an important strategy used by the Laotian authorities has been to resettle upland villages and communities to more accessible sites and perform land use planning [7].

The outcomes of the Lao resettlement strategy aimed at the elimination of shifting cultivation and the reduction of deforestation are, however, controversial. Some argue that the strategy has been ineffective at curbing deforestation [8,9] and may have led to cultural trauma and unexpected further migrations [10], or dispossession of farmers of their land [11]. Others, however, emphasize the positive outcomes of resettlement processes, including livelihood improvements [12].

This paper addresses possible relationships between village resettlements and forest cover change in Laos from a multi-scale perspective from the national to the local level. The national assessment builds on the opportunity provided by the release of two important datasets. First, the Lao Census of Agriculture 2010/11 provides a countrywide comprehensive survey on the location of villages that were resettled between 2000 and 2011, as well as information on agricultural populations, living conditions, and agricultural practices in these villages. Second, the Global Forest Change 2000–2012 dataset released by Hansen *et al.* [13] provides a worldwide, high-resolution account of forest loss and

gain between 2000 and 2012. The comparable timeframe of both datasets provides an opportunity to assess the relationship between resettlements and forest cover change at a national scale. A review of existing case studies as well as an original case study were then performed in order to refine the interpretation of the national data.

2. Background: Shifting Cultivation, Resettlements and Land Policy in Laos

Laos is a landlocked country in mainland Southeast Asia. It has the lowest population density in Southeast Asia, one of the lowest GDPs and development levels, and has one of the highest proportions of rural population. A socialist economy until 1986, the country has witnessed substantial changes since opening to a market-based economy and the expansion of trade with its neighbors, particularly China, Vietnam and Thailand.

Laos also has the highest proportion of forested land in mainland Southeast Asia, and the highest forest cover per capita in the region. With all of Southeast Asia labeled as a Biodiversity Hotspot [14], the country's forests make an important contribution to global biological diversity. Accounts of forest cover change in the country vary according to the analysis scale and methods used [7]. According to World Bank data, which classifies stands of trees of at least five meters tall as forest, but excludes urban parks and agroforestry systems, 67.6% of the country's land area was forested in 2012, compared with 75% in 1990 [15]. According to FAO statistics, Laos is currently losing about 0.5% of its forest each year, which lies within the regional average [16].

Finally, Laos is culturally an extremely diverse country, with around 50% of its population belonging to more than 70 (49 officially recognized) ethnic minority groups. The rest of the population is considered "ethnic Lao", traditional paddy rice farmers settled in the Mekong plains that belong to the Tai-Kadai linguistic family and are also dominant in Thailand. Minority groups include some small groups from the same Tai-Kadai family, as well as from three main linguistic families. The Mon-Khmer family, also called Austroasiatic, includes the Khmu, Katang, Makong and Lamet ethnic groups, among others, who occupy significant but less populated areas. The Tibeto-Burman family, which includes the Ahka, Kho, Lahu and other groups, came to Laos from the North (Myanmar and China) between the 16th and 19th century, and currently live in the mountainous areas of the country's far North. The ethnic groups belonging to the Hmong-Mien family, most of whom are from the Hmong group, migrated to Laos between 1810 and 1900 from China, and traditionally occupy highland areas [17].

For centuries, many upland and ethnic minority communities have practiced traditional shifting cultivation for subsistence. A prevailing view among government officials in Laos has been that this practice is the primary cause of deforestation and is simultaneously a cause and a consequence of poverty [7,8,18]. According to this view, shifting cultivators are trapped in a "poverty-resource degradation spiral" in which poverty leads to pressure on resources such as forests, and causes land degradation, declining yields and further poverty [7]. Population growth due to high fertility rates can further exacerbate these problems, making shifting cultivation no longer viable and leading rural societies to ecological and social collapse in the absence of external intervention. This discourse is in line with many narratives found among government agencies, development actors and scholars since the 1970s (e.g., [19–21]).

Based on these considerations, the Government of Laos established the objective of eradicating shifting cultivation from the country by 2010 [22]. Recent studies on the extent and dynamic of shifting cultivation have shown, however, that shifting cultivation is still a widespread practice in Laos [3,23,24]. A spatial analysis of its extent and relation to socioeconomic parameters in Northern Laos has shown that shifting cultivation is prevalent in remote areas, ethnic minority communities, and at middle altitudes (the uplands) [24]. Nevertheless, in this area, a general trend of reductions in the practice has been observed between 2000 and 2009; while core regions of shifting cultivation (Luang Prabang, Oudomxay and Phongsaly provinces) experienced the greatest decreases, some new shifting cultivation areas have also emerged (Luang Namtha, Bokeo and Xaignabouly provinces) [23].

The contribution of shifting cultivation to deforestation is a highly debated issue. According to Ducourtieux [8], the loss of primary or old growth secondary forests to shifting cultivation is significantly smaller than the loss caused by proximate drivers such as logging and frontier agriculture. Furthermore, in many cases, logging precedes deforestation for agricultural expansion [7,22]. Shifting cultivation does not necessarily destroy forests and may even contribute to maintaining multifunctional landscapes when fallow periods are long enough [25,26], but becomes problematic when they are shortened [27,28]. Finally, farmers practicing shifting cultivation usually rely on forests as an important food source. They collect non-timber forest products (NTFPs) that significantly contribute to their diets, and supply medicinal plant products and additional market goods [29].

Other underlying drivers of forest cover change are also at work in Laos, like increasing demands on cash crops, timber and hydropower projects [22]. Recent studies on land cover change in Northern Laos have shown an increasing impact of rubber plantations, driven by Chinese demand, which appear as forest clearings before taking the form of closed cover [30]. As in the rest of Southeast Asia, eradication policies but also the expansion of intensive agriculture and cash crops might contribute to the decline of shifting cultivation in Laos [31].

2.1. Resettlement Policy in the Lao PDR

Though there is no comprehensive account of contemporary population movements in Laos, the Indochina and then, especially, the Vietnamese-American wars had already provoked massive migrations in the country for decades. It is estimated that more than half of the total population of Laos moved during the Vietnamese-American war and the related civil war in Laos [32]. At that time, large parts of the whole population, including lowland and urban populations, were displaced [9]. During the post-war years, the government focused on repopulating deserted regions, and controlling areas with presence of rebels. After 1985, however, the focus shifted to the resettlement of upland communities to regions closer to state services and markets, a process which continues up to now [9].

Though not an official policy until 1998, resettlement has long been seen as a strategy to reach multiple objectives. The first is the eradication of poverty, to be reached by settling people in areas with better access to services and markets. A parallel rationale was cultural assimilation and state control of ethnic minorities, merging them into multiethnic villages where shared Laotian national values were expected to emerge. An important further objective was the conservation and “rational use” of forests, with Laotian authorities viewing land degradation in the uplands as a major threat to natural resources, and traditional shifting cultivation as a primary cause of deforestation [7]. Given

their involvement in shifting cultivation, upland and ethnic minority communities are thus more likely to be resettled.

In this study, we understand resettlements as the physical relocation of a village from one place to another, or the relocation of dispersed settlements into a single village. Contemporary resettlements have been carried out in the framework of the Village Relocation and Consolidation Strategy (VRCS), established by the Laotian government in 1989, which advocated the merging of villages with less than 50 households [33]. In 1998, the resettlement strategy became an official policy, with the introduction of the Focal Site approach, which consists of creating merged villages with the provision of services such as agricultural extension, schools, health centers, electricity and sanitation [33]. Back then, the government planned to relocate 12% of the whole rural population of the country into 1200 villages in four years, and directing most development projects to these sites, with a large amount of public investment stemming from foreign funds [9].

The question of whether resettlements were carried out with the consent of the involved populations has been subject to debate. Many scholars point out that the distinction between “voluntary” and “involuntary” resettlements makes no sense in the Laos context where most people would not openly oppose the one-party government decisions for fear of repression [9,11,22,33]. Some, however, also point out that villagers move in search of better livelihoods, a consideration which has played a role in whether villagers accept resettlement [12]. This is particularly important considering that the higher poverty rate in remote areas of both Laos and Vietnam exceeds that in better connected areas [34,35].

Nearly all analysts agree, however, on the high impacts of resettlements on rural livelihoods, most being negative short term economic, social and cultural consequences, especially in the first five years after resettlement [9]. These include land shortages due to the concentration of populations and the fact that the best cropland where they are resettled is usually already occupied by existing land users [9,12,22], impoverishment through food insecurity [11,12], greater exposure to diseases like malaria [9], loss of traditional ecological knowledge [33], and a lack of delivery of the services promised by authorities [12].

Villagers have also developed passive strategies for resistance to resettlement. For example, villager groups may use the networks created by their presence in several resettled areas to avoid land use regulations [33]. Others try to return to their upland sites, sometimes clandestinely, or officially move to new sites but keep their land and temporary dwellings in the old one [9]. The impacts of resettlement and passive resistance strategies on forest cover are relatively unknown. Evrard and Goudineau [9] mention an increase in shifting cultivation in Luang Namtha and Oudomxay provinces, which they attribute to resettlements. Based on studies in Phongsaly province, Ducourtieux [8] also found that resettlements did not completely curb the practice of shifting cultivation but contributed to an increase in commercial agriculture and combined shifting and fixed agricultural practices in villages. However, no study has specifically addressed the impact of resettlements on land use and land cover at a national scale in Laos.

2.2. Land Policy: Allocation, Titling and Planning

The impact of resettlements cannot be understood without considering land planning policies that were often carried out after resettlements in the framework of the VRCS. From the mid-1990s onwards, the Lao authorities, backed by international donors—especially the World Bank—have been implementing a land planning and titling programme called Land and Forest Allocation (LFA), modelled after the Thai experience [22], and later also called Land Use Planning and Land Allocation (LUPLA). The initial rationale of the programme was that enhancing tenure security by delineating village boundaries and giving villagers collective titles would contribute to a more sustainable use of resources [22].

However, the LFA also entails the demarcation of agricultural land. In this framework, areas considered not suitable for agriculture have been labelled as “forest land”, which under the land planning and titling program falls under the jurisdiction of state agencies, namely the Ministry of Forest and Agriculture (MAF) [22]. The Prime Minister’s decree No. 169 in 1993, requested that all villages implement a land zoning system; the 1996 Forestry Law gives further guidelines as to zoning by standardizing the classification of forest into five categories emphasizing protection and conservation functions, allowing agriculture only in degraded forests and banning shifting cultivation [7].

Concretely, the LFA (later LUPLA) took the form of agreements between village authorities, who were allocated agricultural land, and local District Agriculture and Forest Offices (DAFOs), charged with managing forests, with around 90% of village areas becoming classified as forests between 1995 and 2004 [7]. The actual land allocation process then concerned only the remaining agricultural land, which was assigned to the village authorities with additional instructions that each household was limited to three plots and would lose land fallowed for more than three years, thus making shifting cultivation impossible [7]. Given these considerations, effectively implementing land use planning should increase areas labelled as forest and put them under strict protection.

Land planning also places considerable pressure on villagers. Some authors argue that, even if the LFA and LUPLA appear highly participatory and centered on collective rights, they have in some places exacerbated the negative effects of resettlements, producing land shortages, degrading working conditions and farm productivity, and leading to higher food insecurity and poverty [9,36,37]. The pressures generated could have counterproductive outcomes including poor implementation of regulations and increases in illegal and uncontrolled land clearings.

Successful resettlement and land planning policies also depend on the development prospects at new sites and on the allocation of land and resources. The Government of Laos and several international organizations often mention agricultural intensification as a way to curb the problems linked with resettlements and to increase agricultural productivity in general. Aside from the provision of agricultural extension services in resettled villages [33], a key identified challenge has been the expansion of irrigation, which could contribute to improving yields substantially [38,39]. Understanding to what extent resettlement and the LUPLA come along with effective processes of agricultural intensification could give further insights into the impact of these land policies on forests.

2.3. Objectives and Research Questions

Three research questions arise from the considerations described above regarding the relationships between resettlements, ethnic minorities, shifting cultivation and forest cover.

A first research question relates to the impact of resettlements on forest cover, which can take two possible contradictory pathways. On the one hand (first hypothesis), resettled and consolidated villages might experience less forest loss due to land planning implementation, and compensate for land losses with the intensification of agriculture. On the other hand (alternative hypothesis), population concentration, land shortages and livelihood stresses, coupled with a relative tolerance of banned practices by local authorities, might lead to increased forest conversion in resettled villages. Whether the resettled population has access to existing or developing irrigated land might be an important factor enabling intensification.

The second research question addresses the socio-economic potential of resettled villages. The hypothesis is that resettlements usually concern upland and ethnic minority villages that face cultural and economic constraints to intensification. To what extent are resettled villages dominated by ethnic minorities? Are there ethnic groups that are especially affected by recent resettlements? If yes, is a higher forest cover loss observable in villages dominated by these groups?

The third research question addresses the new physical location of resettled villages and their potential for agriculture intensification. The hypothesis is that recently resettled villages are located at intermediate sites, considered relatively accessible and at the same time with available land and resources, including a higher forest cover than in more densely populated areas. On the one hand, resettled villages are expected to be located in areas with higher forest cover than average villages in Laos, thus making resettlements particularly relevant to forest management. On the other hand, they might occupy areas with steep slopes and poor soils less suitable for agricultural intensification.

In summary, this paper aims to examine the visible impacts of resettlements and accompanied land policies on forest cover by comparing resettled and non-resettled villages at the national scale and using case studies at finer scales, with a focus on the research questions mentioned above.

3. Study Area and Methods

We took a multi-scale approach to address the question of the relationship between resettlements and forest cover change in Laos. Firstly, our research draws on two main datasets at the national scale related to the location of resettled villages and land cover change. Secondly, we reviewed six published case studies of resettlement, land planning and impacts on livelihoods and land use in Laos, covering a total of 44 villages. Third, we performed a case study on resettlement history, land access, and land cover change in two villages in Luang Prabang province, an area with high ethnic diversity and little available land, and with many resettled villages.

National data on the location of resettled villages was obtained from the Lao Census of Agriculture 2010/11 (hereafter: LCA2011), the second agricultural census carried out in the country since the first in 1998/99. Implemented by the Ministry of Agriculture and Forestry (MAF) with support from the Lao Bureau of Statistics (LSB), the census included household questionnaires, which focused on basic information on crop and livestock production at the household level, and village questionnaires, which

inquired about village organization, infrastructure and land use. The village questionnaires were completed by village organizations including village leaders (Nai Ban) and councils. In this study, we used the following questions from the village questionnaire: “Has this village been resettled since 2000” (question 40); “What is your assessment of the living conditions of people in the village compared with two years ago? Improved/Stayed the same/Declined” (question 15), “Did any farmers in the village use shifting cultivation in the last 12 months?” (question 30).

The LCA2011 data were spatialized using the GPS location (points) of each village, provided by MAF, which was done subsequent to the census. To integrate forest cover into the analysis, a further step was necessary to transform the points into polygons. This was performed using the “small area estimation” method [3,24]. The calculation of village polygons was based on the assumption that people reported to live around a point are more likely to interact with the resources located the shortest travel time from that point. We used an accessibility model, developed by Messerli *et al.* [3], which models travel time per each 90 m cell as a function of land cover, slope, and the roads and navigation networks. The model was used to allocate to each village point an area within which travel time to that point is the shortest. We obtained a total of 8643 village polygons for the whole country and integrated them with the LCA2011 data.

The second national dataset used was a subset of the high-resolution global map of 21st century forest cover change, produced by Hansen *et al.* [13], published in November 2013 and available online under Creative Commons Attribution License since February 2014. The map provides global data on tree cover extent (from 0 to 100%) at a spatial resolution of 30 m in year 2000, as well as forest loss (with year of loss) and forest gain from 2000 to 2012. Trees were defined as any vegetation taller than 5 m, forest loss as a “stand-replacement disturbance” and disaggregated with reference to percent tree cover and year of loss, and forest gain as non-forest to forest change with more than 50% tree cover. The global map was based on the analysis of more than 650,000 Landsat 7 Thematic Mapper Plus (ETM+) scenes and a binary High/Low biomass classification of Landsat imagery, which has been proven to be very robust [23]. The images were pre-processed through a series of automated algorithms and then classified using time-series spectral metrics derived from training areas. The scene classification at a global level was performed using Google Earth Engine (© Google) [13].

The Hansen *et al.* [13] dataset represents the only multi-temporal dataset on forest cover change after 2000 available at this resolution and at no charge. A particularity of this dataset is that it is exclusively based on land cover, thus avoiding mixing up land use and land cover concepts in the raw data production. This constitutes an advantage, since no interpretation of actual land use is provided, allowing different possible interpretations according to forest cover change patterns in time and space, but also a limitation in the sense that natural forest cover change cannot be distinguished from human-induced change.

For our analysis, we defined forest loss as a loss of tree cover below the threshold of 50%. Therefore, we calculated forest cover in 2000 per village area using the tree cover extent of 50 to 100% provided by Hansen *et al.* [13], areas with reported forest losses which had 50% or more of tree cover in 2000, and areas of forest gain, which were combined with the loss areas to calculate areas with both forest loss and gain between 2000 and 2012. The raster datasets produced were used to calculate forest cover in 2000; areas of forest loss, of forest gain, and of forest loss and gain for each village polygon. Forest loss in relation with forest cover in 2000 was then also calculated, as well as forest gain and

loss/gain relative to the whole village area. Using ArcGIS software (© ESRI), we also calculated the mean altitude of villages on the basis of the Shuttle Radar Topography Mission (SRTM) digital elevation model of the U.S. National Aeronautics and Space Administration (NASA), as well as the mean travel time to district capital using the accessibility model [3]. These variables were tested for statistically significant differences ($p < 0.05$) between resettled and non-resettled villages, performing the non-parametric Mann-Whitney tests. Forest cover in 2000 and forest cover change from 2000 to 2012 was also tested for statistical significance in the difference between villages dominated by different aggregated ethnolinguistic families. The merging of information on ethnic groups into aggregated ethnolinguistic families was performed according to the list provided by Engwall [40].

Additional to data at the national scale, case studies were examined. We first reviewed six published case studies on land use and land cover change in Laos, in which references to resettlement and/or land use planning are mentioned. Then, a new case study was performed to understand the resettlement patterns at the village level, and their relationship with the availability, access, quality and distribution of land and (marginally) of water resources among households [41]. Fieldwork was performed during February and March 2013 in two villages of Phonexay district (Luang Prabang province) by a research team including Lao and Swiss researchers as well as the Phonexay DAFO staff. Fifty-five households (about one third of all households in the villages) were surveyed on their history of settling into the village, whether they had access to highly productive, irrigated land, and whether they had lost land after the LUPLA process. The households were randomly sampled within three income groups. Information was then complemented with semi-structured interviews with the Nai Bans (village heads) and a group of farmers.

Since fieldwork was carefully monitored by the local DAFO representatives, who were also in charge of controlling LUPLA enforcement, it was not possible to ask households about forest clearings and the practice of shifting cultivation as they are considered illegal. However, we could observe forest clearings in the villages using data on forest loss year from the Hansen *et al.* [13] dataset, and the boundaries of the villages defined by the LUPLA process, obtained from The Agrobiodiversity Initiative Project (TABI).

The choice of Luang Prabang province as the case study site was based on the characteristics of the province, which represents a “mature” stage of rural development and implementation of resettlement and LUPLA policies. Luang Prabang has for decades been a hotspot of development and research interventions backed by international organizations, as well as one of the pilot areas for the implementation of LFA and LUPLA [37]. Luang Prabang is described by anonymous experts to have better infrastructure and more educated district staff than is typical throughout Laos [41]. On the other hand, it is also a very mountainous area with limited arable land, and is ethnically diverse with many areas dominated by minority groups.

The two surveyed villages are located in the Phonexay district, situated within a travel distance of approximately 63 km of the city of Luang Prabang (Figure 1; Table 1). The district is 80% mountainous with few paddy field areas and a prevalence of rain-fed cultivation on sloping land, and has a poverty incidence of 55% [41]. The first village studied, Sopchia, located approximately 11 km from the district capital, is an ethnically mixed village. It was originally founded in 1914 by ethnic Lao from Xiengkhouang province [42], to which Khmu households immigrated due—among other reasons—to resettlements in nearby villages. It has access to both permanent and upland agriculture

areas. The second village, Houay Si Nhoua, is located a little further from the district capital, about 4 km from Sopchia. With more difficult access to markets than Sopchia and a lack of flat areas suitable for paddy, the village is dominated by Khmu ethnic minority households. Originally founded in 1975, the village was resettled in 2003 to a new site (closer to Sopchia) grouping its original population with households coming from two neighboring villages.

Table 1. Main characteristics of the villages studied.

	Sopchia	Houay Si Nhoua
Location ¹	Approximately 11 km from district capital	Approximately 15 km from district capital
Altitude (village center) ¹	470 m	515 m
Population ¹	413 people, 86 households	672 people, 93 households
Ethnic groups ¹	Lao, Khmu	Khmu
Resettled ²	No	Yes
Living conditions ²	Improved	Declined
Shifting cultivation practices ²	No	No

Data sources: ¹ C.Stich [41]; ² Derived from LCA2011.

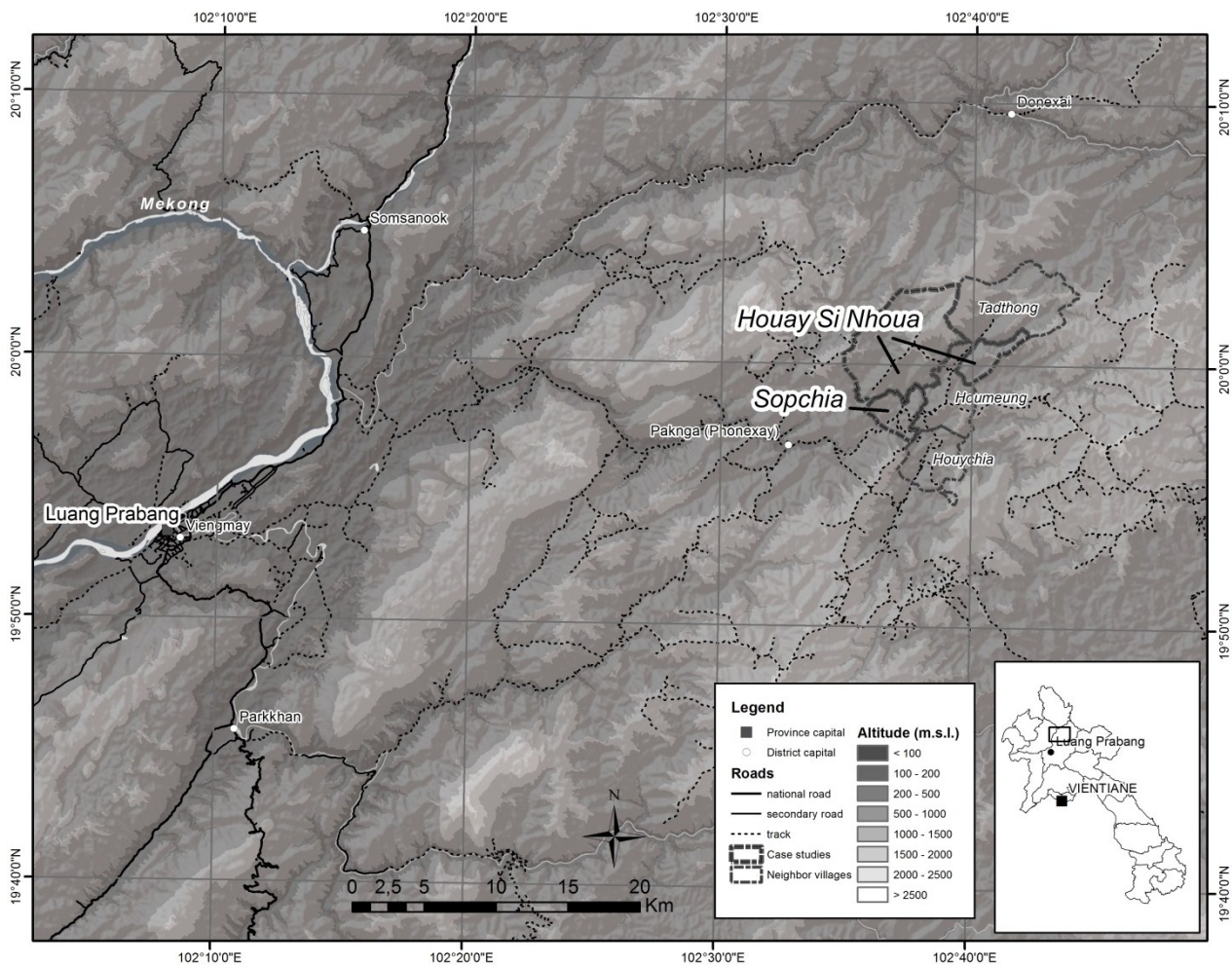


Figure 1. Locations of the case study areas.

4. Results and Discussion

4.1. Geographical Characteristics of Resettled Villages in Laos

Among a total of 8643 villages in Laos, the LCA2011 reported 872 villages to have been resettled between 2000 and 2011. This represents 11.2% of all villages in Laos. On average, new sites of resettled villages are still located at higher altitudes and further away from district centers than non-resettled villages (Table 2). One can also observe that resettled villages have a greater forest cover than the national village average. Finally, the location of resettled villages (Figure 2) shows a general concentration of resettled villages in mountainous and forested areas. Since high forest cover and higher altitudes are also characteristics of shifting cultivation villages, these observations suggest a clear link between resettlements, upland settlements, and shifting cultivation. Table 2 also shows that the total forest loss per village (in ha) between 2000 and 2012 is higher in resettled than in non-resettled villages, though this must be related to resettled villages having larger areas and higher baseline forest cover. When considered relative to baseline forest cover, forest loss is lower in resettled than in non-resettled villages.

Table 2. Characteristics of resettled vs. non-resettled villages in Laos.

Villages	Non-Resettled	Resettled (2000–2011)	No Information
Number of villages	7752	872	19
Altitude (mean)	524	785	402
Travel time to district capital (hours, mean)	3.9	6.6	4.1
Area (ha, mean)	2560	3547	2534
Forested area in 2000 (ha, mean)	1980	3222	1816
Forest cover in % (2000)	56.9	82.7	55.5
Forest loss 2000–2012 (ha, mean)	122	207	133
Forest loss in % of 2000 cover (mean)	11.1	9.9	9.3

There are differences in the proportion of resettled villages by province. Please note that the list and map of Lao provinces corresponds to the situation in December 2012, and thus does not include the province of Xaisombum, created December 2013. Most provinces along the lower Mekong (Vientiane, Savannakhet, and Champasak provinces) have experienced fewer resettlements. On the other hand, resettlements appear to be especially relevant in the whole Northern region of the country, as well as in the far South-East. In two provinces of each of these two regions, more than 20% of all villages were resettled between 2000 and 2011.

Table 3 examines the relationships between resettled villages and reported change in living conditions as assessed by the LCA2011. Though most villages report better living conditions, the proportion of villages reporting no change or a decline in living conditions is slightly higher (10% for each category) in resettled villages than in non-resettled villages (7%). On the other hand, the proportion of villages reporting the existence of shifting cultivation is also higher (27%) in resettled villages than in non-resettled villages (15%).

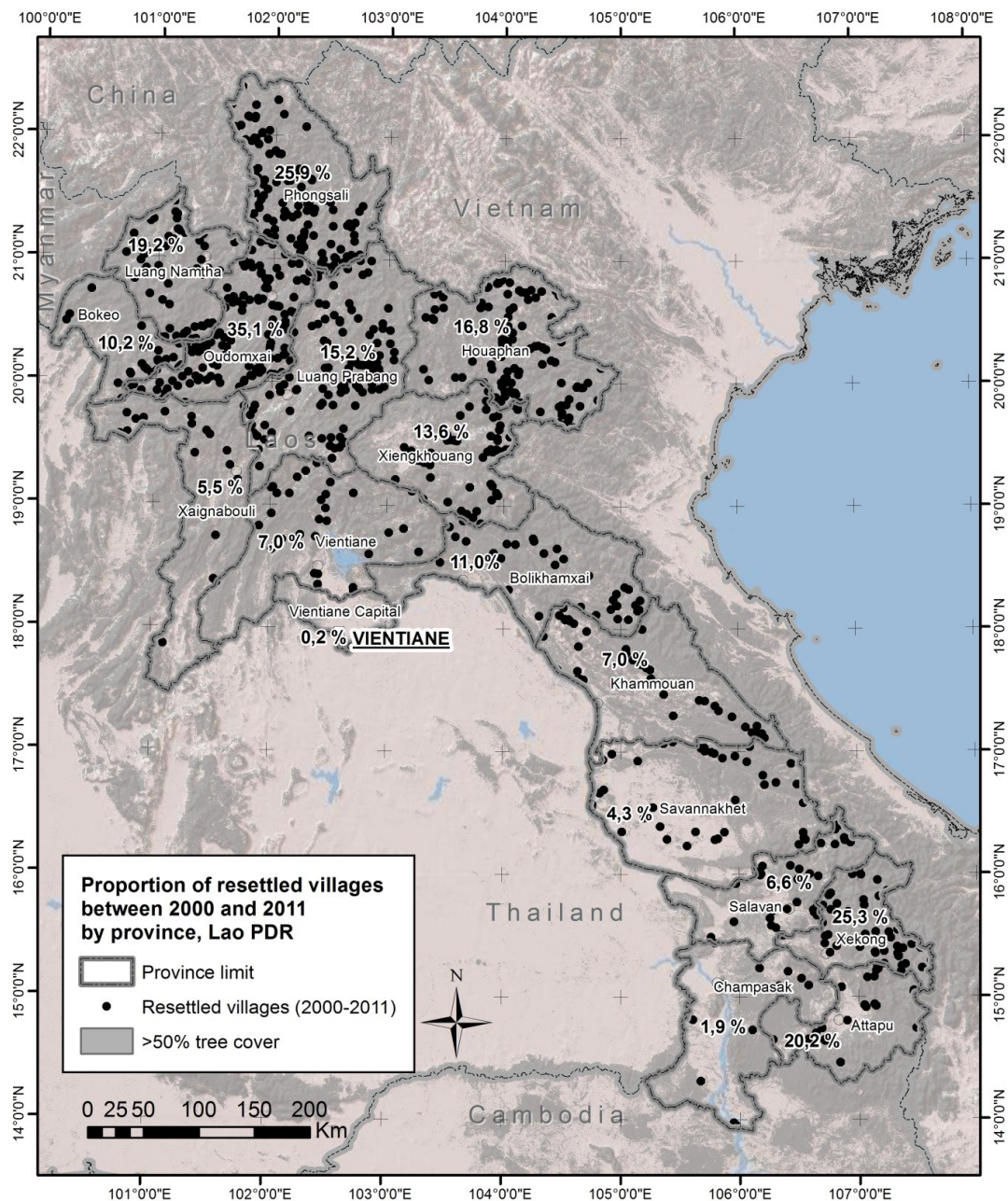


Figure 2. New site location of resettled villages between 2000 and 2011 in Laos.

Table 3. Living conditions and presence of shifting cultivation practices in resettled and non-resettled villages.

	Living Conditions			Shifting Cultivation Practiced			
	Improved	Stayed Same	Declined	No answer	No	Yes	No Answer
Resettled villages	80%	10%	10%	0%	73%	27%	0%
Not resettled villages	85%	7%	7%	0.2%	84%	15%	1%

Figure 3 shows the distribution of resettled villages as well as villages reported to practice shifting cultivation and to have experienced a decline in living conditions, in relation to the aggregated four ethnolinguistic families. Resettled villages exist among the four main ethnolinguistic families. However, minorities (non-Tai-Kadai) are indeed clearly overrepresented in resettled villages.

About 50% of resettled villages but only 30% of all villages have populations dominated by Mon-Khmer ethnic groups. Inversely, only 20% of resettled villages but more than 50% of all villages are dominated by Tai-Kadai groups.

Villages where shifting cultivation still exists are also mostly predominantly populated with ethnic minorities in about 75% of the cases. There, Mon-Khmer and Hmong-Mien have a larger contribution to the total number of villages with shifting cultivation than in most villages, but this is not the case for Tibeto-Burman groups.

Decline in living conditions is not a characteristic of villages dominated by ethnic minorities only, with 40% of villages reporting declining living conditions dominated by Tai-Kadai groups. However, Mon-Khmer groups are also relatively overrepresented in villages with declining living conditions. Hmong-Mien and Tibeto-Burman show the inverse trend, with a lower proportion of villages experiencing declining living conditions as compared to all villages overall.

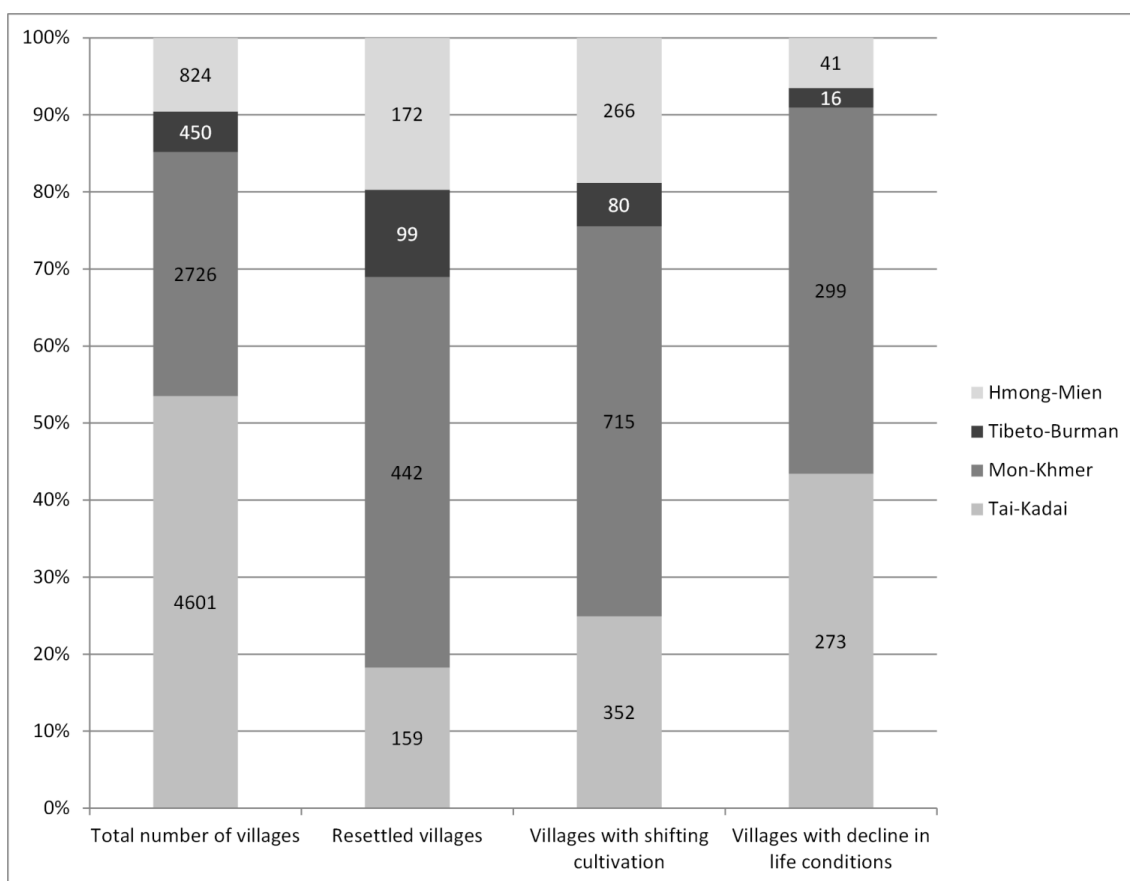


Figure 3. Distribution of resettled villages and their characteristics in relation with aggregated ethnolinguistic families.

4.2. Forest Cover Change in Laos

According to our analysis of the Hansen *et al.* [13] dataset, 79.15% of the whole territory of Laos exhibited tree cover of 50% or more by 2000. Between 2000 and 2012, 1.13 Million hectares of these areas lost their forest cover, which represents an annual forest cover loss rate of 0.52%. Meanwhile,

there were 0.3 Million hectares of observed gained forest, and 0.15 Million hectares with both gain and loss of forests from 2000 to 2012.

Figure 4 shows forest cover, loss and gain by province, derived from the Hansen *et al.* [13] dataset. Many Northern provinces still have significant forest cover. The largest amount of lost forest can be found in the provinces of Houaphan, Bolikhamxai, Vientiane, Luang Prabang and Luang Namtha. On the other hand, Houaphan and Luang Prabang show the largest amount of forest regrowth. In general, Northern provinces show both high forest loss and forest gain.

When related to the dominant aggregated ethnolinguistic families by village (Table 4), forest cover in 2000 appears to be clearly higher in villages dominated by ethnic minorities, with statistically significant ($p < 0.05$) differences between Tai-Kadai as well as Tibeto-Burman villages and all other groups. Mon-Khmer and Hmong-Mien dominated villages show similar forest covers, while the highest forest cover occurs in Tibeto-Burman dominated villages. Forest cover loss occurs in all categories of villages by ethnolinguistic families. However, the overall difference in total forest loss with relation to ethnolinguistic families was not significant at $p < 0.05$ level, suggesting that the variability in forest cover change is higher within ethnolinguistic families than among them. Though variable at the village level, the average forest loss rate appears to be higher in villages dominated by Tai-Kadai groups, with 13% forest loss between 2000 and 2012, taking into account that these villages also had lower forest cover in 2000. In general, Tai-Kadai dominated villages have higher population densities. Unfortunately, since only one category—the “main” ethnicity by village—was listed in the LCA2011 database, we have no information on ethnic representation within the villages.

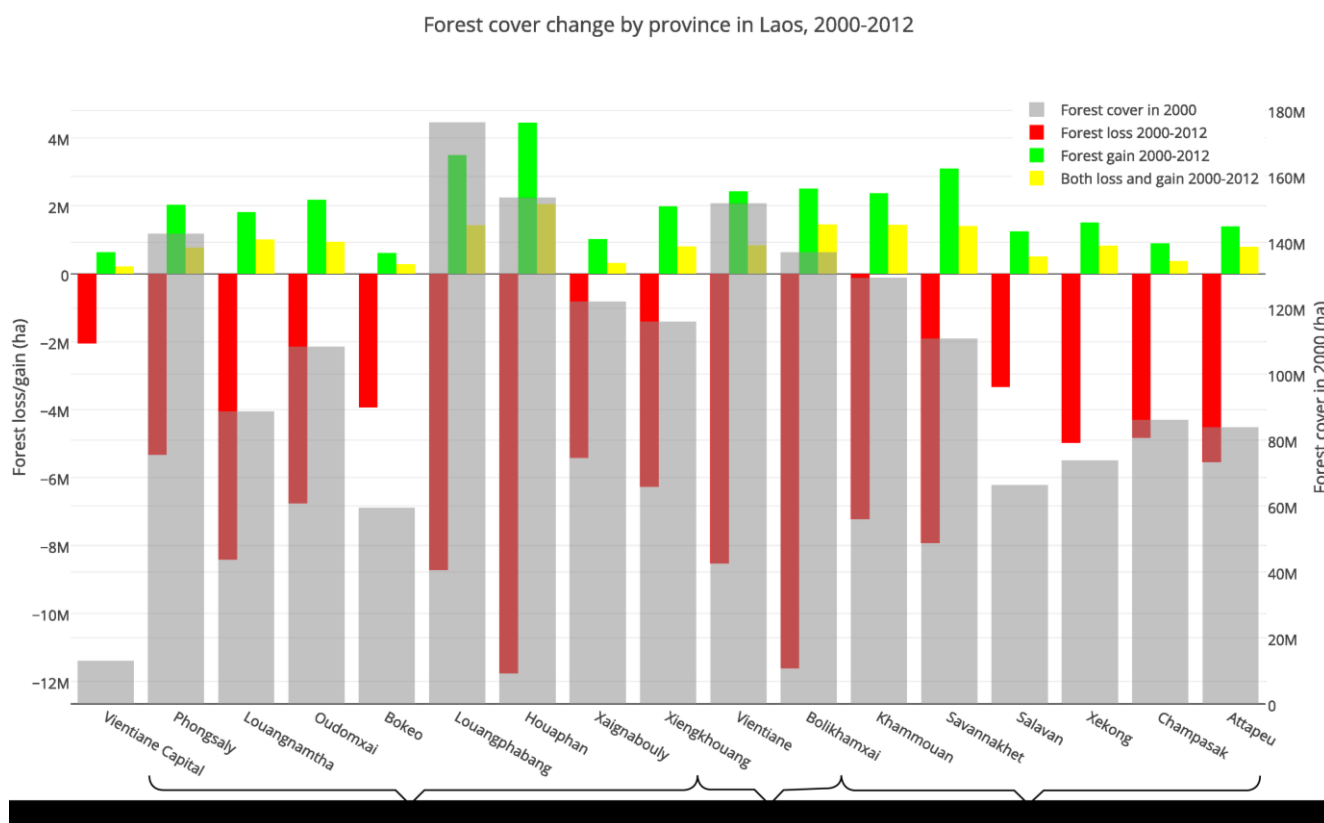


Figure 4. Forest cover change by province in Laos.

Table 4. Aggregated ethnolinguistic families and forest cover change.

<i>4a. Average Forest Area and Loss of Villages by Main Ethnolinguistic Family</i>				
	Proportion of Forested area in 2000 (% , Mean)	Forest Loss (% 2000–2012, Mean)	Number of Villages	
Tai-Kadai	43	13	4601	
Mon-Khmer	77	9	2726	
Tibeto-Burman	87	10	450	
Hmong-Mien	78	10	824	
<i>4b. Significance Matrix of Differences in Proportion of Forested Area according to Ethnolinguistic Families</i>				
	Tai-Kadai	Mon-Khmer	Tibeto-Burman	Hmong-Mien
Tai-Kadai		0.00	0.00	0.00
Mon-Khmer	0.00		0.00	0.554
Tibeto-Burman	0.00	0.00		0.00
Hmong-Mien	0.00	0.554	0.00	
<i>4c. Significance Matrix of Differences in Relative Forest Loss according to Ethnolinguistic Families</i>				
	Tai-Kadai	Mon-Khmer	Tibeto-Burman	Hmong-Mien
Tai-Kadai		0.231	0.684	0.421
Mon-Khmer	0.231		0.259	0.915
Tibeto-Burman	0.684	0.259		0.309
Hmong-Mien	0.421	0.915	0.309	

4.3. Resettlement and Forest Cover Change

Table 5 and Figure 5 show the average forest cover change metrics (loss, gain, and both loss and gain) by province for resettled and non-resettled villages. In all provinces, forest cover is significantly higher in resettled villages ($p < 0.05$, Table 5). This explains the fact that in nine of the 17 provinces, forest loss relative to the whole village area is also higher in resettled villages (Table 5). When forest loss is considered relative to the baseline forest cover measured in 2000, however, only four provinces show higher forest loss in resettled villages (Figure 5): Phongsaly, Luang Prabang, Houaphan and Salavan.

Two provinces (Bolikhambxai and Xekong), as well as the country measured in whole, exhibit the inverse trend of presenting less relative forest loss in resettled villages. All provinces with significant differences in forest loss between resettled and non-resettled villages have experienced resettlements in more than 10% of villages, with the exception of Salavan.

Table 5. Forest cover change statistics for resettled and non-resettled villages by province.

Province Name	Resettled Since 2000	Number of Villages	Forest Cover 2000	% Forest Loss (to Forest) (Mean)	% Forest Loss (to Area; Mean)	% Forest Gain (to Area; Mean)	% Loss and Gain (to Area; Mean)
01 Vientiane capital	no	485	41.1	11.3	3.6	0.7	0.3
	yes	1	34.2	8.9	4.6	0.4	0.1
02 Phongsaly	no	425	87.4 *	5.5 *	4.9 *	1.8	0.7 *
	yes	110	91.2 *	6.3 *	5.8 *	2.1	0.8 *

Table 5. Cont.

Province Name	Resettled Since 2000	Number of Villages	Forest Cover 2000	% Forest Loss (to Forest) (Mean)	% Forest Loss (to Area; Mean)	% Forest Gain (to Area; Mean)	% Loss and Gain (to Area; Mean)
03 Luang Namtha	no	297	74.7 *	17.6	11.6	2.4	1.2
	yes	57	89.9 *	15.0	11.4	2.7	1.4
04 Oudomxai	no	348	78.7 *	7.9	6.1	2.0	0.8 *
	yes	122	88.0 *	7.5	6.5	2.1	0.9 *
05 Bokeo	no	256	68.9 *	16.4	8.1 *	1.3 *	0.6 *
	yes	26	79.7 *	19.8	11.3 *	1.9 *	0.9 *
06 Luang Prabang	no	676	74.1 *	5.7 *	4.4 *	1.8 *	0.7 *
	yes	103	87.1 *	7.0 *	6.2 *	2.3 *	1.1 *
07 Houaphan	no	615	80.0 *	10.9 *	8.4 *	3.1 *	1.4 *
	yes	103	86.1 *	13.5 *	11.5 *	4.4 *	2.2 *
08 Xaignabouly	no	421	61.0 *	6.9	4.5 *	0.8 *	0.2 *
	yes	23	78.4 *	8.8	7.1 *	1.3 *	0.5 *
09 Xiengkhouang	no	450	63.5 *	9.6	5.4 *	1.5 *	0.6 *
	yes	61	79.1 *	7.3	6.2 *	1.9 *	0.7 *
10 Vientiane	no	472	57.7 *	11.8	5.3	1.7	0.6
	yes	33	79.3 *	8.0	5.5	1.5	0.6
11 Bolikhamxai	no	291	66.5 *	20.7 *	12.2	2.3	1.4
	yes	32	84.6 *	15.0 *	10.8	2.1	1.3
12 Khammouan	no	547	54.1 *	9.9	6.0	1.9	1.2
	yes	38	70.4 *	10.4	7.2	1.5	0.8
13 Savannakhet	no	967	37.0 *	12.2	4.8 *	1.5 *	0.6 *
	yes	42	53.6 *	12.8	7.6 *	1.8 *	0.8 *
14 Salavan	no	564	43.5 *	6.3 *	3.1 *	0.9 *	0.3 *
	yes	37	67.9 *	10.2 *	8.1 *	2.0 *	0.9 *
15 Xekong	no	186	75.6 *	14.0 *	9.4	2.2	1.2
	yes	47	89.9 *	8.2 *	7.4	2.2	1.1
16 Champasak	no	628	31.3 *	10.0	3.3 *	0.5 *	0.2 *
	yes	12	57.4 *	6.8	4.6 *	0.8 *	0.3 *
17 Attapeu	no	124	58.2 *	16.3	9.9	2.1 *	1.1 *
	yes	25	81.4 *	14.7	12.0	3.8 *	2.1 *
All villages	no	7752	56.9 *	11.7 *	5.8 *	1.6 *	0.7 *
	yes	872	82.7 *	9.9 *	7.9 *	2.4 *	1.1 *

* = significant difference between resettled and non-resettled villages at $p < 0.05$ (Non-parametric Mann-Whitney test).

In ten provinces, forest gain (relative to the village area) appears to be higher in resettled villages, and for areas with both forest loss and gain, which is the case in 12 provinces out of 17. These trends are also visible for the whole country. The difference in forest gain and both forest loss and gain between resettled and non-resettled villages is particularly high in the provinces that experienced more forest loss in resettled villages, namely: Phongsaly, Luang Prabang, Houaphan and Salavan. Inversely, the two provinces with less forest loss in resettled villages (Bolikhamxai and Xekong) show no significant differences in forest gain or forest loss and gain between resettled and non-resettled villages.

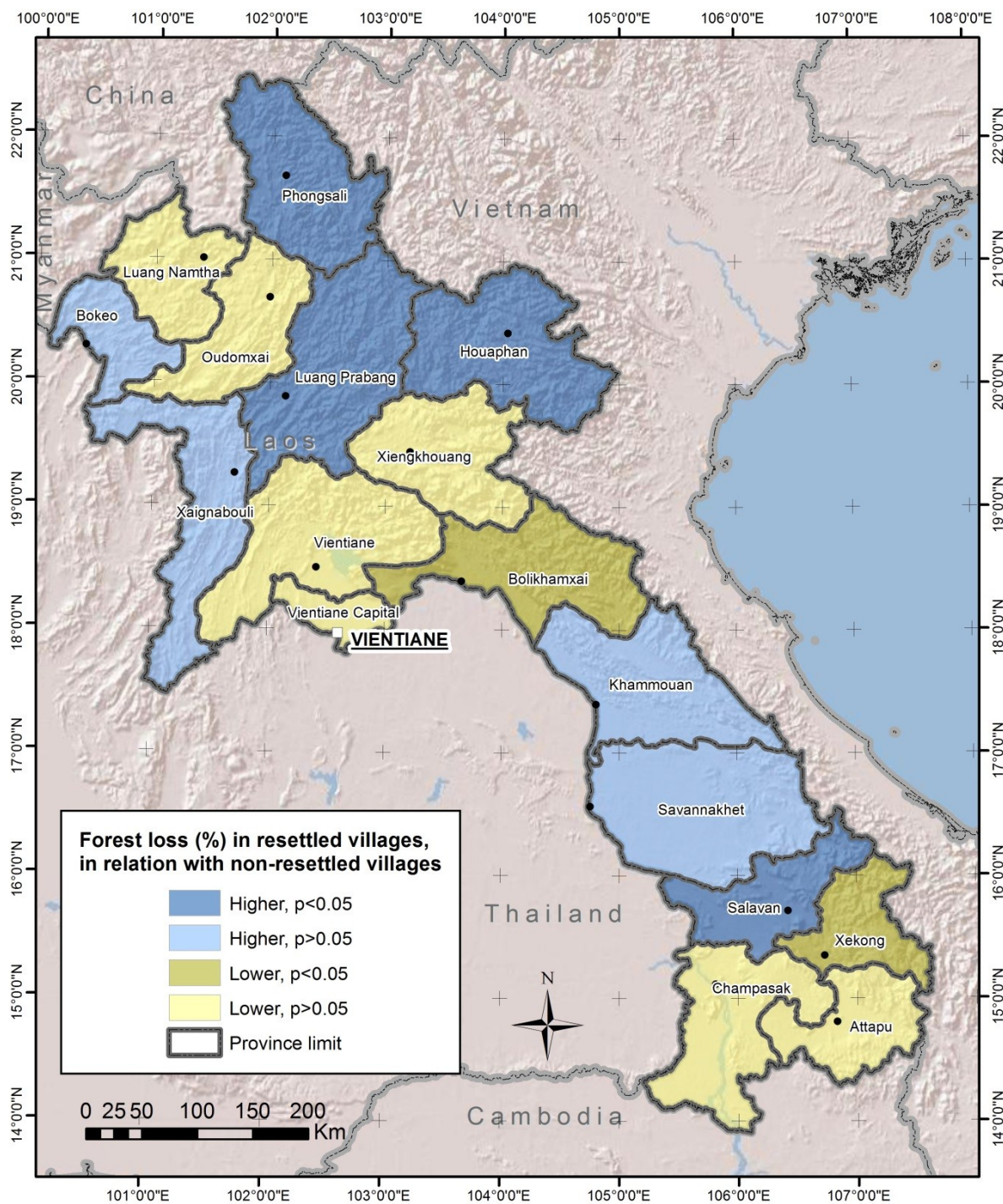


Figure 5. Comparison of forest loss in resettled and non-resettled villages by province.

4.4. Summary of Findings from National Assessment

We found out that, for the whole of Laos, there is a trend of resettled villages being located at higher altitudes, in less accessible and more forested areas. Many resettled villages are located in the North and the far South-East of the country. Resettled villages also experienced a slightly higher proportion of decline in living conditions and persistent engagement in shifting cultivation. Furthermore, ethnic minorities are overrepresented in resettled villages, especially the Mon-Khmer family, which is also overrepresented in villages with lowered living conditions.

Northern provinces on average have more forest cover, which is also true for villages dominated by ethnic minorities. In the country as a whole, the average absolute forest loss per village is higher in resettled villages, but not relative to the baseline forest cover. However, we observed higher relative forest loss in four provinces, among them three Northern provinces, and the inverse trend in two provinces. Furthermore, forest gain occurs more in resettled villages than in non-resettled villages in 10 out of 17 provinces, and patches that experienced both gain and loss also occur more in resettled villages in 12 out of 17 provinces.

These results show that there is a relationship between resettlements, high forest cover and ethnic minorities, but also that forest losses vary in relation to resettlements. The considered case studies enable a finer analysis of how resettlements can contribute to forest cover change.

4.5. Case Studies Review

Table 6 shows the observations made by different case studies. Because these studies had different objectives, the relations between resettlements and land use change can only be addressed qualitatively. Different changes were observed, including land shortages and fallow shortening, but also agricultural intensification with more paddy cultivation and other commercial crops, and regeneration of forest in abandoned areas. Among cases of resettled villages, three non-exclusive trends are observed. The persistence of shifting cultivation, the shortening of fallows, and forest regeneration in abandoned areas. Fallow shortening goes along with continuing shifting cultivation when land availability is reduced, especially if land planning has been performed. Conversely, fallow period shortening was not mentioned as significant, and was thus not a prominent observed impact in the case of resettled villages without land planning [29]. Intensification has been observed in villages with land planning but no recent resettlement. Nevertheless, most of these studies provide little information on direct impacts of resettlement and land planning on land use, with the exception of the study by Castella et al [28].

Table 6. Case studies of resettlement, land planning and impacts in Laos.

Publication	Study Period	Provinces	Villages	Resettlements	LFA/LUPLA	Observed Land Tenure, Use and Cover Changes
Castella <i>et al.</i> 2013 [28]	1973–2009	Luang Prabang	14	Yes (2009)	Yes	- Pursuit of shifting cultivation with shortened fallow periods led to disappearance of secondary forest and degradation around villages - Forest regeneration in abandoned area
Linguist <i>et al.</i> 2007 [39]	1962–2002	Luang Prabang, Oudomxay	9	No	Yes	- Development of paddy rice in valley bottoms and terraced slopes - Physical (suitable land, water) and socio-economic (initial investment) limitations to this development - Mon-Khmer groups only recently engaged into montane paddy cultivation
Watanabe <i>et al.</i> 2004 [43]	1999–2000	Luang Prabang	3	Yes (1972, 1991)	Yes (1996)	- Land shortage, fallow shortening, soil degradation and decrease in crop yields - No information on forest cover change

Table 6. Cont.

Publication	Study Period	Provinces	Villages	Resettlements	LFA/LUPLA	Observed Land Tenure, Use and Cover Changes
Seidenberg <i>et al.</i> 2003 [44]	1989–1997	Huaphan	3	No info.	No info.	- Land shortage, reduction of fallow periods, deforestation of secondary forests mainly - Increase of paddy, orchards, and livestock
Thongmanivong <i>et al.</i> 2005 [45]	1952–2000	Vientiane	1	No	Yes (2000)	- Forest area nationalized and village access rights removed - Dense forest converted to degraded forest and shrub through shifting cultivation and logging (1952–1981) - After 1981, intensification, abandonment of shifting cultivation and shrub-to-forest regeneration
Yokoyama 2004 [29]	2001	Luang Prabang	14	Yes	No	- Persistence of shifting cultivation coupled with NTFP recollection, especially by Mon-Khmer groups

4.6. Resettlements and Land Distribution in Two Resettled Villages: A Case Study in Luang Prabang

This section is based on the case study performed by Stich (2013; [41]). The two surveyed villages, Sopchia and Houay Si Nhoua, are intimately linked by the resettlement process. In 1999, land use planning was performed in Sopchia, and villagers were given land use certificates and the village boundaries were fixed [42]. In 2003, three villages (Houay Si Nhoua, Houaypot and Moklaharn) were “clustered” into a new administrative unit, the *khum baan*, or village group. Next, 93 households from these villages were relocated to a new site called “new” Houay Si Nhoua, in the framework of the VRCS, which stipulates that villages with less than 50 households must be merged into larger villages [42]. The new dwelling site was located near the paddy fields of Sopchia, in an area which the Sopchia villagers considered part of their territory. The state did not grant newcomers any access to land, since Sopchia villagers already held titles stemming from the LFA performed in 1999. This situation led to land conflicts and some villagers moved back to their former production areas (in Thadthong) that had been occupied in the meantime by another resettlement event. LUPLA in Houay Si Nhoua was performed in 2008 [42]. In 2009, the Phonexay DAFO authorities allowed part of the Houay Si Nhoua villagers together with the other village’s population to move back to their old sites [42]. In 2011, a more participatory process of land use planning updates, Participatory Land Use Planning (PLUP), was performed in both villages with the help of The Agro-Biodiversity Initiative (TABI) project, supported by the Swiss Agency for Development and Cooperation (SDC). This process defined areas of fallow rotation (4 in Sopchia and 6 in Houay Si Nhoua), where shifting cultivation is now allowed. A revision of the PLUP was done in Houay Si Nhoua in 2012 as the first PLUP was only partially implemented because agricultural land was not included [41].

As a result of these changes, the newcomers from the three villages resettled at the new Houay Si Nhoua site near Sopchia were considered migrants, and the village of Sopchia was not registered as resettled. Inversely, the people who moved back to the Houay Si Nhoua old site (originally from three villages) were registered as “clustered” into a resettled village. “Clustered” is a term used in Laos

when people move from neighboring villages and are grouped together with the destination village into a *khum baan* (cluster). This means that though only three households per village were labelled “resettled”, most people labelled as “clustered households” or reporting to have undergone migration were indeed relocated due to the resettlement policy (Figure 6). This means that by 2013, 69% and 58% of people residing in Sopchia and Houay Si Nhoua respectively were newcomers that were not born in the village [41].

By 2013, around half of the 55 surveyed households from Sopchia and Houay Si Nhoua had lived for less than 15 years in the two villages, while nearly the other half were living there for more than 30 years (Figure 7). The household survey found land access to be highly unequal between original settlers and newcomers, especially regarding access to highly productive paddy rice land in the case of Sopchia: 64% of the households who had access to paddy rice land had been living for more than 20 years in the village, 18% between 10 and 20 years, and only 18% had resided there for less than 10 years. This shows that newcomers are unlikely to get access to highly productive, irrigated land [41].

In Sopchia, 24% of the surveyed households reported having experienced land losses, and 35% in Houay Si Nhoua [41]. In Sopchia, the main reasons mentioned for land loss were the LUPLA process (29%), and land left to other households (29%). The latter indicates that land was redistributed to another household by DAFO authorities, or sold to another household to avoid redistribution. Fallow is mentioned in 14% percent of the cases. Fallow has to be linked to LUPLA, since after the LUPLA process, land owners with fallow left for more than three years lose their land rights to that plot. In Houay Si Nhoua, the reasons for land loss are more diverse. A total of 50% of land loss is directly or indirectly linked with the LUPLA process, with households mentioning LUPLA, the establishment of a conservation area, the allocation of land to another household or land loss for not paying taxes the most prominent explanation for drivers of land loss. Reasons linked with the resettlement process (meaning here “moved to another village” or migration) account for a total of 40% of the land loss cases [41].

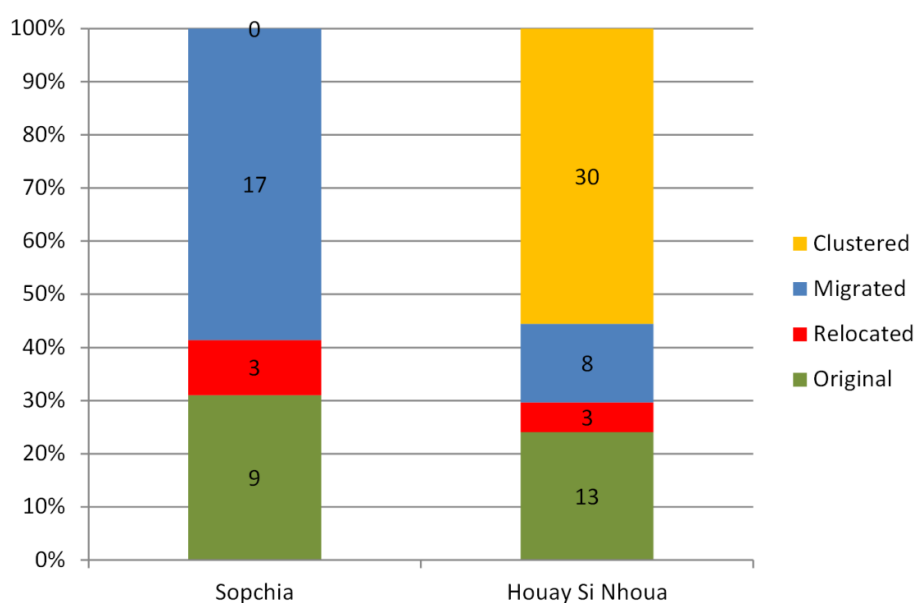


Figure 6. Origin of households in Sopchia and Houay Si Nhoua (Source: Stich [41]).

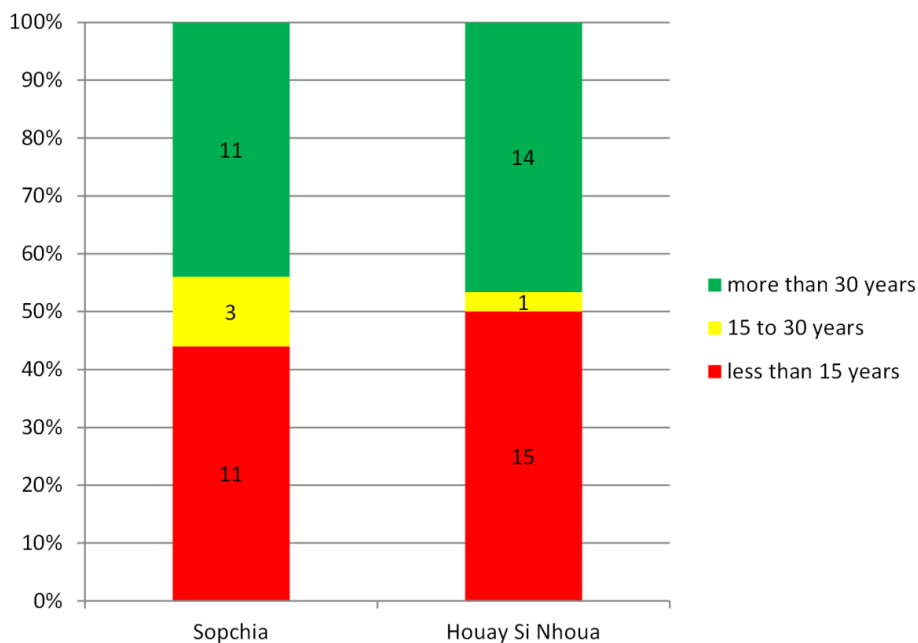


Figure 7. Settlement duration of households in Sopchia and Houay Si Nhoua (Source: Stich [41]).

As stated in the methods section, it was not possible to get direct information on forest cleared by surveyed villagers. An observation of forest losses in the village areas by year of loss (Figure 8) using the Hansen *et al.* [13] data shows that in Sopchia, little forest loss has occurred between 2000 and 2012. However, in the case of Houay Si Nhoua, important forest clearings are visible along track roads from 2005 to 2007. A total of 97.8 hectares were cleared during that time, accounting for 46% of all forest clearings from 2000 to 2012. This also partially covers the period between the resettlement and LUP (2008) and PLUP (2011) processes. Other areas of cleared forest appear in 2009 and 2010 in more remote sites, just after the conclusion of the LUPLA process and the return of some villagers to their initial areas, totaling 66 hectares (31% of forest clearings). One can also observe that the most densely forested areas (North-West of Houay Si Nhoua area), were left untouched.

Considering the yearly forest loss since 2001 of both villages, as well as in the neighboring villages of Houychia, Houmeung and Tadthong (see also Figure 1), we observe a similar pattern, except for Sopchia, which performed LUP in 1999 (Figure 9). The villages of Tadthong and Houychia have also been resettled, but not Houmeung. Though we do not have information on when LUPLA was performed in all villages, the village of Tadthong shows the same timing for peaks of forest loss as Houay Si Nhoua, which corresponds to a period after which villagers returned to their original homes.

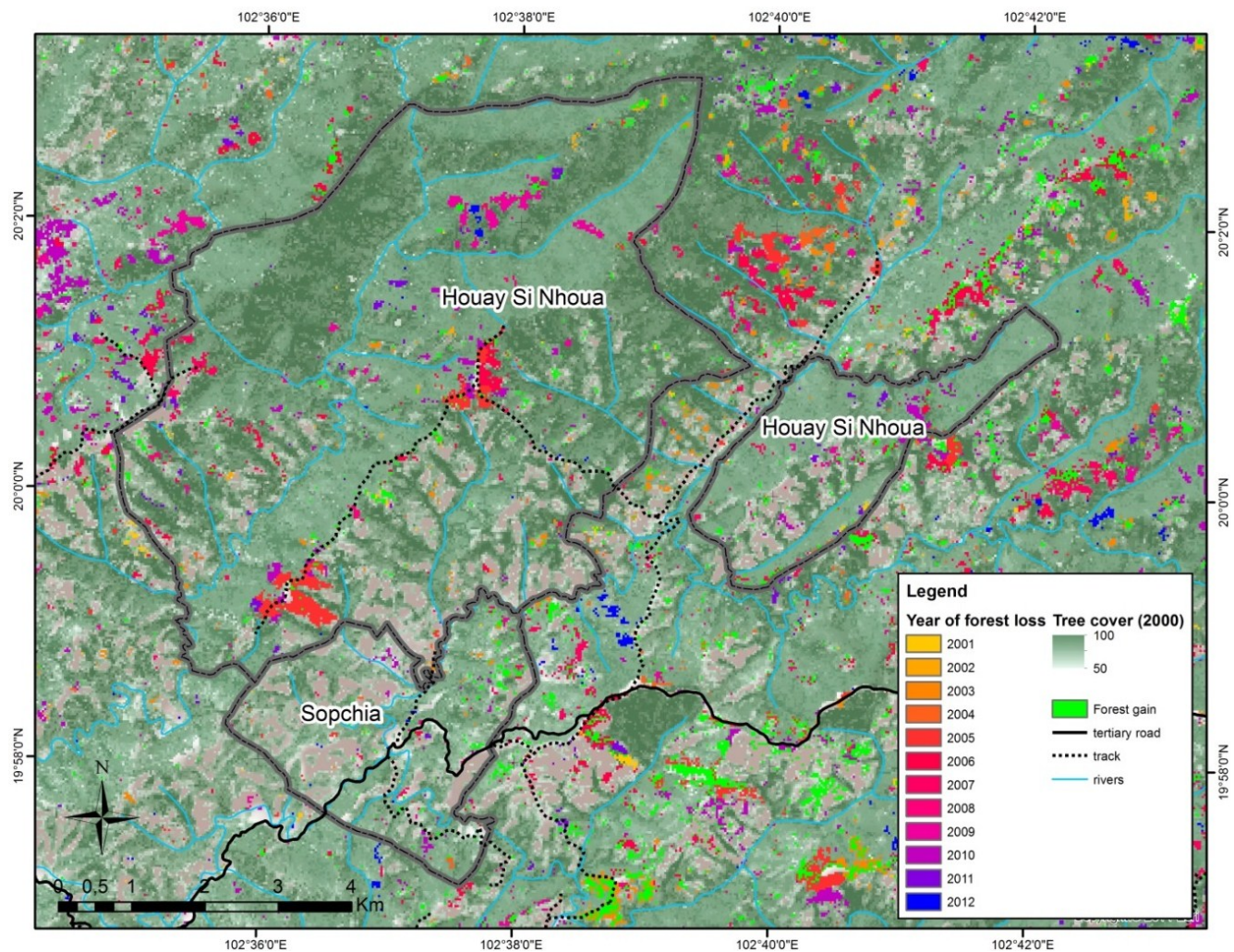


Figure 8. Forest cover change in Sopchia and Houay Si Nhoua by year of forest loss. Forest cover and years of loss after Hansen *et al.* [13].

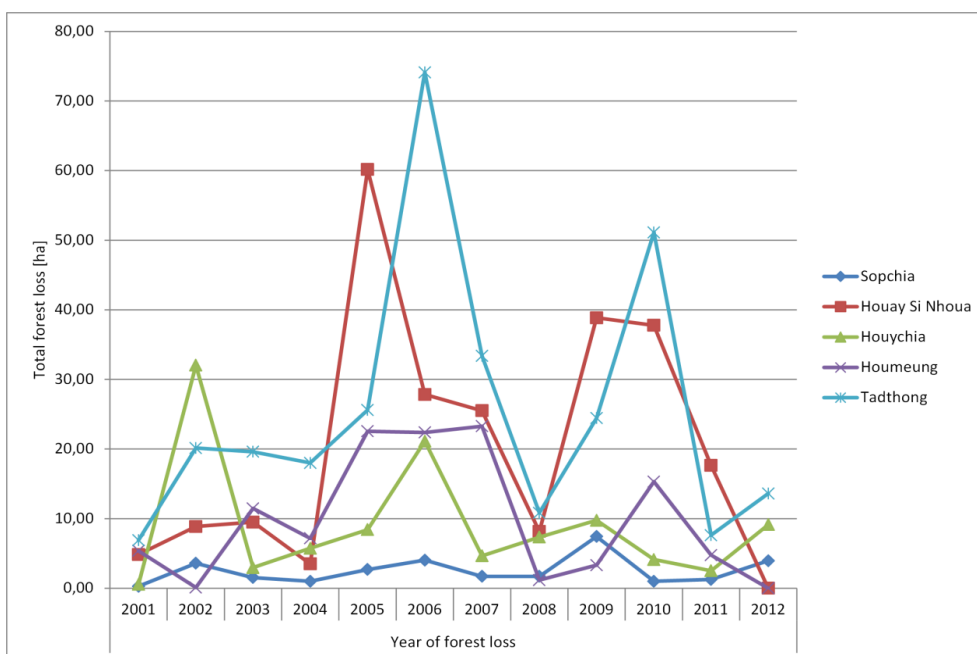


Figure 9. Yearly forest cover loss [ha] in five villages from the case study area.

4.7. Discussion

Despite a common desired effect of resettlements on development and conservation, resettlement policies have had different impacts across the country on the local landscape. At the national scale, we found that forest loss is occurring in resettled villages, with important differences observed throughout the country. In four provinces (Luang Prabang, Phongsaly, Houaphan and Salavan), the relative forest loss rates are higher in resettled villages. Three of these provinces are located in Northern Laos, which has few flat areas, difficult access, high poverty and a significant proportion of ethnic minority groups. On the other hand, there are provinces (Bolikhamxai and Xekong) where relative forest loss is lower in resettled than in non-resettled areas.

Possible explanations of these observations must be linked with the different drivers of forest cover change in Laos. In the Northern provinces, where cultivation is mostly performed by smallholders, resettlements might have a comparatively larger effect than other drivers of forest loss. This might be confirmed by the observation that resettled villages in these areas also experience more forest gain than non-resettled ones, suggesting that forms of shifting cultivation might still take place there. In other cases, however, forest loss can be linked to the expansion of cash crops, like clearings to establish rubber plantations in Luang Namtha, or sugarcane and bananas in Oudomxay [30]. Some areas have experienced significant clearing of forests in agricultural development concessions given to foreign companies. For example, in the province of Attapeu, about 5000 hectares of forest were cleared between 2007 and 2009 for a Vietnamese company to establish rubber plantations [46]. Finally, in the central provinces of Bolikhamxay and Khammouane, large dams on the Nam Theun and Nam Ngouang rivers have been at the origin of most recent resettlements, and these might have a different dynamic than in the Northern provinces.

Considering villages in the provinces with higher forest loss in resettled villages to be predominantly inhabited by smallholders would support the hypothesis that changes linked with resettlements contribute to forest cover change. In other regions, however, this contribution appears masked by other forest cover changes linked with the expansion of large- or middle-scale cash crops and other development initiatives like hydropower.

Unfortunately, the LCA2011 does not provide information on the former locations of resettled villages and their actual used areas. The village polygons used in the national assessment of this study are extrapolated areas and delineate likely areas of influence of villages, dividing up all space and allocating it to each village. This implies on the one hand that observed land use might not necessarily be related to the villages' populations. On the other hand, areas of former village locations, which are now likely to be left fallow, are counted in one or the other village. These areas can show forest gain, or forest loss, depending on the resettlement time. Thus, the actual impact of resettlements on forest cover change is masked by the merging of resettled and abandoned areas. A clearer figure could be obtained by using actual used areas of villages before and after resettlement at the scale of a district or province where these are available.

Existing case studies also show different outcomes of resettlements, and a close relationship between those outcomes and land planning processes. Especially in the study by Castella *et al.*, [28] resettlement and LUP led to a segregation of landscapes between regenerating forests and areas with

fallow shortening and degradation. Fallow shortening would especially occur after land planning, which leads to the enforcement of regulations on land use.

The case study performed in Luang Prabang highlights further the issue of land access before and after resettlement. Though migrants recently settled in Sopchia, no important forest losses could be observed within the village boundaries during this time. Two reasons could explain this: First, migrants kept access to their former lands or returned to their initial villages, and second, the population already established in Sopchia had sufficient access to intensive, permanent agriculture areas. In this case, the resettled population had no access to land with intensification potential and returned to their formerly used areas.

Can the observed forest losses in Houay Si Nhoua be attributed to the persistence of shifting cultivation? If this were the case, a more or less regular pattern of forest clearing that characterizes shifting cultivation would be visible each year. Instead, we found two forest loss peaks, one shortly after resettlement and the other just after villagers returned to their former fields. Both peaks were also found just before the LUP and PLUP processes. These observations suggest that both resettlement and LUP policies have a direct impact on forest cover: After resettlement, villagers' strategy would be to clear more forest to establish new fields, but before the LUP process which, once concluded, does not allow them to clear forest any more. Land shortages after completion of a resettlement and LUP cycle would then lead people either to clear forest in more remote areas where they are not likely to be caught and fined by DAFO authorities, or negotiate for permission to return to their initial cultivation areas.

Furthermore, resettlement alone does not imply abandonment of used areas, as our case suggests. Reporting villages as resettled implies their physical relocation, but in some cases can mean administrative merging with no changes in settlement configurations. Given these considerations, determining whether resettlement is curbing shifting cultivation or not is dependent on the definition of resettlement as reported in the LCA2011 (physical relocation or administrative merging), as well as what exactly was reported as shifting cultivation (especially whether long or short fallow periods are included as determinants). This makes the observation that only 27% of resettled villages were reported to practice shifting cultivation difficult to interpret.

Rather than an abandonment of shifting cultivation, resettlements are likely to contribute to "respatializing" shifting cultivation by clustering forest clearing years together due to relocation and the land allocation process. This might lead to fallow shortening by disrupting the regular shifting system. While forest losses near resettled villages might be offset by gains in abandoned areas to some extent, other areas experience fallow shortening and degradation, which in turn has an impact on yields and livelihoods. The considered case studies suggest two pathways of change occurring shortly after resettlement and LUP: (1) separation of land into abandoned and overused and degraded areas [28], and (2) persistence of use in the areas supposed to be abandoned with modified patterns of shifting cultivation.

Did intensification take place in resettled and planned villages? No such processes were observed in our case since resettled villages had no access to land with intensification potential. In the six case studies reviewed from the literature, resettlement and LUP never corresponded with agricultural intensification, but intensification processes did occur where only planning had been performed. There are three possible explanations to this lack of intensification: (1) intensification is a middle-term

process which cannot occur shortly after resettlement and planning when land access is still insecure, (2) the involved households were unable to perform the initial investments needed for intensification and lacked support to do so, and (3) recent resettlements have occurred in areas with little physical potential for intensification.

Can examining the geography of resettled villages provide answers or differentiate between these possible explanations? We observed an overrepresentation of ethnic minority groups in resettled villages. Among them, groups belonging to the Mon-Khmer ethnolinguistic family are by far the most heavily involved in resettlements. Also called “middle-Lao”, these groups traditionally occupy middle altitudes and high slope areas, and are linked with shifting cultivation [24]. Being on average poorer than other groups, Mon-Khmer minorities might be particularly vulnerable to resettlements and their impacts, and face more socio-economic limitations to intensification. However, as stated by Lestrelin [33], they also develop resistance strategies which, as was observed in our case study, could lead villagers to return to their areas of origin and engage in modified shifting cultivations systems with possibly shorter fallow periods.

Our third hypothesis, that resettled villages are not necessarily located in the most accessible areas, is confirmed by the observation that resettled villages are still more remote, located at higher altitudes and have higher forest cover than other villages. Because farmers are likely to settle where land is available, this suggests the presence of voluntary, traditional resettlement, rather than “forced” resettlement. The case of Sopchia and Houay Si Nhoua demonstrates this: While local authorities intended to resettle people to Sopchia, which is more accessible and is more suitable to intensive agriculture, land resources were already occupied by its original population. On the one hand, this confirms the observation by Vandergeest [22], who showed that paddy land owners—mostly ethnic Lao—have been the main beneficiaries of LUPLA processes and land titling up to now. On the other hand, this situation forces the resettled farmers to occupy “intermediary” sites, with better access to markets and services than their old sites but not necessarily bearing the potential for intensification. As a consequence, villagers are either pushed to migrate elsewhere (as observed by Baird *et al.* [11]), or clear forest at sites less suitable for cultivation and more prone to erosion and degradation. This means that recently resettled villages are also less likely to engage in intensification in the short term.

5. Conclusions

Throughout the developing world, land policies might have unexpected effects and contradict other policies such as conservation. In the case of Laos, such policies are intended to curb both poverty and forest loss by accelerating forest transition through development, which leads paradoxically to forest loss in specific areas.

To fulfill development and poverty eradication objectives, the resettlement of villages to more accessible and more clustered areas should be accompanied by land planning and agricultural intensification processes. An optimal combination of the three is, however, seldom observed. In practice, villagers cannot be relocated to the most productive areas, as they are already occupied by farmers who went through the land allocation process and have strong land tenure rights. Thus, resettled villagers—often with socio-economic limitations—end up relocated into “intermediary sites”, where intensification potential is also limited. As a consequence, few livelihood improvements are

seen, as in the case of Houay Si Nhoua. These effects cannot be attributed to a mere continuation of shifting cultivation but to its transformation into an intermediary land use system in which villages appear caught between the impossibility of maintaining their traditional practices considered undesirable, and the impossibility of getting fully engaged in intensification.

Notwithstanding these observations, resettlements might well be successful in some cases. As a matter of fact, no unusual forest loss could be observed in Sopchia, despite the arrival of immigrants. This is largely because these migrants continued to use land at their area of origin. Therefore, the choice of the resettled site, the land tenure rights of the population already there as well as the provision of development services and their continuity, appear crucial for the success or failure of a resettlement in terms of both livelihood improvement and forest conservation.

How do resettlements along with land use planning contribute to the transformation of shifting cultivation systems and ultimately impact forest cover? Understanding the relationships between these processes is crucial. Logically, resettlement should precede planning, but planning can itself lead to further resettlement and migrations. As we observed in the case of Houay Si Nhoua, trial-and-error in LUP can lead to further migrations and the need for additional resettlement/LUP cycles, each one taking its toll on forest cover with people clearing forest to secure their land access and livelihoods. In this case, shifting cultivation switches from a regular pattern of forest losses and gains to a pattern of local forest loss peaks, linked with villagers' strategies to cope with resettlements and land use regulations. This does not necessarily lead to more forest loss, but its concentration in specific areas might lead to land degradation. On the other hand, losses are likely to occur mainly in secondary forests. This "respatialization" also highlights somewhat of a paradox: Is the periodical clearing of small land patches an indicator of the persistence of shifting cultivation, or is it the outcome of several cycles of resettlement and LUP processes? The respective impacts of shifting cultivation and of resettlements appear somewhat blurred in this case.

These considerations show that some spatial as well as temporal configurations appear to be particularly critical in terms of land governance in the context of resettlements. Spatially, "intermediary" sites with middle access and altitude but average or poor intensification potential are likely to be chosen as resettlement sites. Temporally, the delay between resettlement and LUP may lead to forest loss peaks. Controlling land and people puts pressure on social-ecological systems and an excessive burden on local populations which, even if temporary, can lead to leakage effects that contradict the policy's objectives. When these spatial and temporal configurations persist due to an initiated but unachieved development policy, they might lead to "failed development traps" which have more negative impacts than either non-development or successful development. An important question for future research to answer would be to know whether these configurations persist in time or are parts of a necessary pathway to development in a longer term.

Our multi-scale approach provided some insights into the relations between resettlement policy and forest cover change in Laos. Still, many questions remain unanswered. Patterns of forest cover change could be examined in a larger number of villages with known boundaries and detailed information on resettlement stories and LUP processes, and include cross-analysis of the impact of resettlements, LUP and the combination of both on forests. Furthermore, other drivers of forest loss could be identified, especially in relation with land concessions that were granted by the Laotian authorities to industrial companies [47].

In tropical forest environments, the importance of internal, rural–rural migration has often been overlooked [5]. While cases from other regions like Latin America show migration of people from one region (often non-forested) to another (often forested), the case of Laos highlights the importance of small-scale, village-to-village migration for forest cover change, more relevant to the Southeast Asian context. Small-scale migrations, forest cover changes, livelihood strategies, land governance and agricultural practices are still often addressed by different academic disciplines and managed by different administrative sectors, and relationships between them need to be understood better. Though livelihood approaches are increasingly integrative in terms of economic and social capital, migration and land use practices, a further level of integration in terms of both scale and sector is required to understand the interplay between land policies, small-scale migration, forest cover and agricultural intensification.

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Author Contributions

Corinna Stich and Sithong Thongmanivong performed fieldwork in Phonexay district. Joan Bastide and Michael Epprecht prepared the LCA2011 data for analysis. Sébastien Boillat analyzed the data in relation with forest cover and wrote the paper. Andreas Heinimann contributed to the introduction and the discussion.

Conflicts of Interest

The authors declare no conflict of interest.

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