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RESEARCH PAPER

The Role of Land Tenure Change in Forest Degradation and Economic Development in Laos

Ek Vinay Sayaraj[1*] Thoumthone Vongvisouk[2] Saykham Boutthavong[3] Phongxiong Wanneng[4]

[1] Phd Scholar, Faculty of Forest Science, National University of Laos (NUOL), P.O.Box: 7322, Vientiane, Laos
[2] Associate Professor in Natural Resource Management, former lecturer at the Faculty of Forest Science, National University of Laos; currently working for the Department of Forestry, Ministry of Agriculture and Forestry, Laos
[3-4] Lecturer, Faculty of Forest Science, National University of Laos (NUOL), P.O.Box: 7322, Vientiane, Laos
**Corresponding Author ekvinay@gmail.com*

ABSTRACT

Laos has faced significant deforestation and forest degradation since 1975. While reforestation efforts have been made, issues such as forestland encroachment and land claims within National Protected Areas (NPAs), designated for biodiversity conservation, persist. These areas are increasingly used for cash crop cultivation, linked to changes in land tenure and household economic improvements. Understanding these land tenure change is essential for addressing encroachment, promoting economic development, and curbing deforestation. This study examines the factors influencing land tenure change and its impacts, using statistical analyses like comparative tests and path analysis. Drawing on smallholder slot and John Locke's land claim theories, the research focuses on villages within the Phou Hin Poun NPA. Results reveal significant changes in land access rights, closely tied to forestland encroachment. Encroachment, along with state capacity, with perceptions among smallholders that they can secure land access. Commercial cassava cultivation directly boosts household income but indirectly exacerbates forestland issues. The findings emphasize the need for stricter law enforcement measures to resolve forestland encroachment. Proper allocation of land for agriculture and improved crop productivity are recommended. This research provides critical insights for managing NPAs in Laos and offers lessons for other nations facing similar challenges.

Keywords: Laos, forestland encroachment, protected area, land tenure change, land claim, smallholder slot, state capacity, path analysis.

INTRODUCTION

Different land tenure forms affect different forest degradation and deforestation in varying degrees. Clear land tenure regime that manipulates environmental protection regulations contributes to reduce forest degradation and deforestation better than traditional land tenure or unrecognized by government (Pacheco & Meyer, 2022). Studying change in land tenure helps in understanding forestland change, and studying in forestland change helps in understanding land tenure change, too. Land tenure defines the relationships between individuals or groups regarding a bundle of land rights and various land use obligations, based on legal and cultural institutions.

These relationships determine who has the right to access, occupy, manage, benefit from, and set conditions—such as time spans and other relevant factors—for land use. Land tenure is complex and constantly changing. It is often classified based on the stakeholders who may hold rights, such as individual rights, communal rights, state rights, complex ownership, and vacant land.

Land tenure change is constantly evolving in relation to the land regime system. There are two main perspectives on land tenure change: one views it as progressing in an evolutionary direction, moving from low to high privatization, while the other sees it as change with no specific direction. The principal theories of land tenure change are built on four pillars: revolutionary theories, such as the works of (Zhang, 2021) institutional economics, including works by Spalding (2017); narrative methods, as seen in the works of L. V. Basupi et al. (2017); and statistical evidence, such as the works of Perego (2019), and Cazzuffi et al. (2020).

The causes of land tenure change are influenced by economic, social, political, legal (Cazzuffi et al., 2020), forestry (Thaler, 2021), and technological factors (Hull et al., 2022). The role of government is also an important driving factor of such change (Junquera et al., 2020; Vongvisouk et al., 2016). Forest clearance is also a cause of changes in forestland access rights, while strong forest rights contribute to reduce forest degradation (Reydon et al., 2021). Additionally, the commercialization of cash crops can support land tenure security (Perego, 2019; Cazzuffi et al., 2020).

The effects of land tenure change are similar to its causes. It affects economic, social, political, and legal systems (Libecap, 2018), particularly by increasing land tenure security (Boutthavong et al., 2016), recognizing land ownership, and promoting productivity and commercial agricultural production (Mdoda & Gidi, 2023). Land tenure change also contributes to changes in forestland. Long-term historical studies show that land tenure change can lead to forest area degradation (Junquera & Grêt-Regamey, 2020; Calmon, 2022), the replacement of natural forests by agroforestry (Thaler, 2021), and, in some cases, reforestation (Vangxaolee et al., 2020).

Forest cover in Laos has significantly declined over the past few decades. In 2000, 2005, 2010, 2015 and 2019 forests covered 60.9 %, 60.2%, 59.3%, 58% and 57.5% of the country, respectively (Department of Forestry, 2021), but by 2023, this had dropped to 47% (Chen et al., 2023). Studies have identified agricultural expansion, logging, and forest fires as key drivers of deforestation (Chen et al., 2023; Sayakoumman, 2024). The Lao government introduced a forest strategy between 1989 and 2000 with the goal of increasing forest cover to 70%, but the plan fell short due to poor economic conditions and the reliance of local communities on forestry for their livelihoods. Shifting cultivation, which clears about 300,000 hectares annually, and logging were major contributors to forest loss. Additionally, the government's efforts were hindered by ineffective management, lack of resources, and insufficient staffing and equipment. The strategy was later extended from 2000 to 2020, and again from 2020 to 2035, with the continued aim of achieving 70% forest cover (GoL, 2024).

To restore forest areas and improve the environment, the government introduced forest management policies that reclassified forests into three categories: 1) protected areas for

biodiversity conservation, 2) protection forests for conserving water resources and preventing natural disasters, and 3) production forests for timber management (National Assembly, 2019). These policies aimed to restore forests to more natural conditions while improving the livelihoods of communities living in forested regions (Danyo, 2019; National Assembly, 2019).

Since the early 1990s, the government has expanded protected areas to address deforestation. Currently, Laos has 24 NPAs covering a total of 4 million hectares across the country (Sayakoumman, 2024). The forests in NPAs vary in biodiversity and canopy development, all dedicated to preserving species and ecosystems (National Assembly, 2019). NPAs, which correspond to IUCN Category VI, allow villages to be located within their boundaries, with 343 villages currently residing in NPAs. These villages are consolidated and classified as Controlled Use Zones (CUZ), where residents receive government support for economic activities, such as cassava farming. However, concerns have been raised about the sustainability of NPA management, as forest cover continues to decline in these areas.

Research on land tenure change in two villages within the NPA is part of an effort to contribute to the scientific discussion on improving overall NPA management and specifically enhancing the state capacity for NPA management.

There is no conclusive evidence on the causes and effects of land tenure change. As Rudel & Hernandez (2017) suggest, policy priorities regarding land tenure remain inconclusive, particularly in least developed or Global South countries, where land tenure in remote areas is often insecure, especially in remaining resource or resource frontier regions. The studies mentioned above focus either on the causes or effects of land tenure change, but they occur in different spaces and times. Systematic research on a specific case, collecting field data to demonstrate statistically significant findings, would provide better insights into governmental policy implementation and contribute to academic research on land tenure change. This research, therefore, aims to systematically study both the causes and effects of land tenure change in relation to factors such as state capacity in forest and land management, commercial cassava cultivation, family economic development, and land tenure security, through the conceptual frameworks of 'smallholder slots' (Peluso, 2019) and John Locke's land claim (Sjaastad & Bromley, 2017). The following sections will discuss the research methodology, results of study, discussions and suggestions.

LITERATURE REVIEW

Path analysis was developed by agri-genetic researchers to study the causal relationships in the transmission of genes from parents. Since then, path analysis has been applied to various subjects, including social sciences. It demonstrates both direct and indirect effects with statistically significant evidence (Hadifar et al., 2024). Land and property rights-related path analyses include studies on the relationships between population increase and rice field conversion (Khairati & Syahni, 2019), carbon emissions resulting from land use (Yang & Liu, 2023), the impact of land use change on economic development (Surya et al., 2020), and the effects of property rights on water efficiency in dry rice fields (Feng et al., 2023). However, to the best of our knowledge, no

path analysis of land tenure change has been found. The latter two studies are reviewed here in an attempt to gain insights into land tenure-related path analysis.

Land use change affects land economic development. Surya et al. (2020) found that while some research focused on land use change and urbanization (Romano et al., 2017), path analysis research was not found. Surya et al. (2020) aimed to fill this gap by studying the relationship between land use change, spatial relations, and their effects on sustainable development at the local level in developing countries. They selected Sulawesi, Indonesia, as the case study. Studying a specific location helps build understanding and provides better recommendations for similar-sized urban development policies. To examine multi-level and multi-factor relationships, path analysis was applied to test the relationships between various factors that influence spatial interactions and urban activities, further linking them to urban economies. Path analysis is a method of structural equation modeling used to estimate total effects, direct effects, and indirect effects between various variables. Modelers can create complex equations based on various multi-step causal and dependent variables simultaneously by determining reasonable causal links from one variable to another.

In a study examining the effect of property rights on water use efficiency, Feng et al. (2023) focused on property rights, dry rice field water management efficiency, and water governance in China, utilizing both theory and empirical data. Water for agriculture is crucial in developing countries, including China, where some parts of economic development remain agrarian. Property rights, particularly managerial rights to water supply infrastructure, determine access, use, and protection rights for irrigation systems. Property rights are critical for managing common resources such as irrigation systems, as they can stimulate investments in water-saving technology and repairs to irrigation systems, both of which are linked to water efficiency. However, at the local level, property rights cannot be generalized; they cannot be directly translated into water savings since various factors are involved. Therefore, Feng et al. (2023) applied path analysis to study a model reform project in Yunnan Province, China, particularly examining the direct effects of property rights reform on irrigation water savings, as well as the indirect effects through various factors such as water-saving technology, canal protection, water supply capacity, and farmer perceptions of water savings.

The reviews mentioned above show that path analysis is utilized for studying causal relationships between variables of interest, supported by theoretical frameworks. The next section discusses the theoretical framework for selecting relevant variables that are likely related to land tenure change.

CONCEPTUAL AND THEORETICAL FRAMEWORK

Peluso (2019) lays out a theoretical framework on the concept of the 'smallholder slot,' which relates to three factors: smallholders, land transformation, and resource frontiers. The political analysis focuses on the state, as all three factors are influenced and reproduced by state sectors. She analyzes and presents the importance of changing the trajectory of smallholder relational practices beyond the traditional role of farmers. The dynamics of commercial producers in frontier areas are elaborated upon. She uses the term 'smallholder' instead of 'farmer' for more

pleasant and polite discourse in struggles for farmers' rights. This creates a political reputation for farmers through production or reproduction in resource frontiers, where new land use practices and property rights emerge. Peluso (2019) applies the concept of 'smallholder slot' to explore how state practices and the history of small farmers and miners are revealed in Kalimantan, Indonesia. 'Smallholder slot' encompasses more than just smallholder production; it includes the political, economic, and social roles that small farmers hold. Pollutant miners exploit the 'smallholder slot' to conceal or superficially hide their activities, using discursive strategies to take advantage of state policies in creating legitimacy to seize opportunities and alter the real meaning of small producers. She recognizes that frontiers not only produce property rights, land use, or cash crop production but also create slots for smallholders. The concept of 'slot production' for smallholders involves their role in emerging property relations and land politics, especially in contexts marked by racial and violent dynamics. This transformation signifies that smallholders are not just agricultural producers but also influential players in the political landscape regarding land resources.

Further, Thaler (2021) conducted a comparative study examining the patterns of cash crop development and the replacement of natural forests with agroforestry systems in two locations: the São Félix district of the Amazon in Brazil and Berau in the Borneo Forest of Indonesia. The research highlights similarities in trends of agroforestry development aimed at exporting raw materials to the global market. Thaler (2021) utilized two projects implemented by The Nature Conservancy in these two tropical forests. He applied the 'smallholder slot' as a research method, using land rush households in Brazil and village levels as units of study. Dialectical materialism is the approach used to understand the 'smallholder slot'. Smallholders have been influenced and controlled by the state, non-governmental organizations, and market forces. He analyzes changes in frontiers through interactions such as commercial production versus subsistence reproduction and conservation versus reforestation. Both conflicts are resolved through the application of agroforestry with cash crops based on Polanyi's concept of farmer adaptation to the new economy, which refers to how farmers and agrarian communities respond to the pressures of emerging market economies by forming counter-movements and engaging with NGOs. These adaptations are critical as farmers respond to various economic, social, and environmental changes that challenge traditional agricultural practices and social structures.

Regarding John Locke's land claim theory, it emphasizes land development that benefits dual purposes: income gain and legitimacy for land claims from productive investments. However, literature reviews have found studies with vague narratives that do not clearly link causal and effect factors. In the following paragraphs, smallholder slot and land claim theories are discussed to form the conceptual framework for smallholder land claims for the study of causes and effects of land tenure change.

Both theoretical frameworks of the smallholder slot and land claim are customized to form the concept of smallholder land claims, as smallholders and state organizations interact and synthesize practices perceived as consistent with current governmental policies on cash crop production and forest protection in agricultural frontiers of villages near or within forest areas. Smallholder land claims refer to a social, economic, and environmental transformation in which

former peasants engage in land deals and micro-level property development to adapt to the emerging market economy. This phenomenon often occurs due to altered forest conditions, changing livelihoods, and the emergence of agricultural markets, leading individuals to seek new opportunities beyond traditional farming roles.

This interaction leads to changes in smallholders' land tenure and economic conditions. This study focuses on two villages within the Hin Nam Nor NPA. It analyzes relevant direct and indirect variables, including forestland encroachment, state capacity, cassava cultivation, land tenure change, perceived land tenure security, and perceived economic increase, as illustrated in Figure 01.

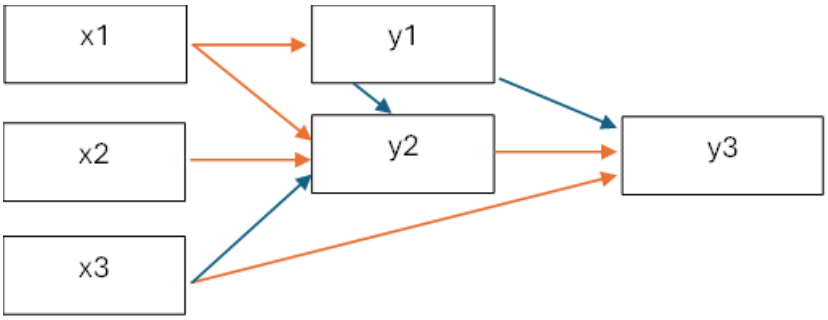

Figure 01. Conceptual framework of path analysis

The following equations:

$$\text{Model: } y1 \sim x1$$

$$y2 \sim x1 + x2 + x3 + y1$$

$$y3 \sim y1 + y2 + x3$$

RESEARCH METHODOLOGY

Research sites

This study was conducted in Khammoune Province, located in central Laos. The field survey focused on two villages, Nakang and Houaykeo, both situated in Khounkham District within the Phou Hin Poun NPA. The Phou Hin Poun NPA, covering 150,000 hectares, was officially established in 1993. Nakang and Houaykeo were selected for data collection due to their long histories, with both villages being over 600 years old. This area exemplifies a typical NPA scenario where villages with unequal power dynamics were merged, with Nakang, the larger village, assuming authority while Houaykeo followed its lead. This partial NPA has been studied and is being prepared for proposal as a UNESCO Global Geopark, but the villages are also actively involved in cassava production, which has contributed to forest encroachment and subsequently to land tenure change.

Population and model variables

This research focuses on a quantitative method that is analyzed in two steps. Firstly, statistical hypothesis testing is conducted to certify land tenure change. Secondly, path analysis is

applied to test the relevant variables. The unit of measurement is smallholder households living in two villages located in the NPA called Phou Hin Poun, including Nakang village with 113 households and Houaykeo village with 75 households, for a total of 188 households. Both villages are within Khounkham District, Khammouane Province. The variables in the equations include three endogenous variables: y1 represents land tenure change in one parcel of land, y2 represents the perceived improvement in family economy since the time since forestland encroachment and cassava cultivation, and y3 represents beliefs about better land security since forestland encroachment and cassava cultivation. There are also three exogenous variables: x1 represents forestland encroachment, x2 represents the state capacity of relevant governmental organizations, and x3 represents households engaged in commercial cassava cultivation.

Data collection

This study applied various techniques for data collection and analysis. The data collection methods included individual household interviews, in-depth discussions with key informants, and secondary data reviews of both official reports and previous research papers, as well as participatory observations from 2017 to 2023. The forest encroachment has been widely started from 2018 to 2023. After compiling the data, data manipulation and re-checking were conducted by organizing a focus group meeting with seven participants. The participants represented village authorities: including chief of village, village land managers, the village women's union, village public security, agricultural group, village trade union, and the village Lao Front Organization. In addition, telephone calls were made to clarify any unclear data.

For the interviews, every household was interviewed either at their houses or in their gardens; when interviewing in the gardens, village authorities accompanied the researchers. For data analysis, every factor included in the model is informed by the results of literature reviews and collected data. For example, data on the state capacity of relevant governmental organizations was collected through questions about the frequency with which families interact with governmental staff related to forest and land management, and the data was manipulated into a binary format indicating whether the household perceives government work as low or high efficiency.

Regarding data on forestland encroachment and cassava cultivation during 2018-2023, the researcher, along with village authorities and heads or representatives of households, visited and measured the area of land. For data on the perceived increase in household economy after cassava cultivation or forestland encroachment, as well as beliefs about increased land tenure security, smallholders were asked to explain their perceptions and rate their scores from 1 to 5, indicating from very low to very high. Later these scores were converted to standard scores from 0 to 1.

DATA AND RESULTS

This research was conducted in two steps of analysis. Firstly, hypotheses were analyzed to confirm whether land tenure has statistically changed. Lastly, causal and effect links to the land tenure change were analyzed using path analysis techniques. The path analysis also included hypothesis testing under the following conditions:

H0:$\Sigma(\theta) = S$ empirical data is consistent with the model or variance and covariance are consistent with the empirical data.

H1 $\Sigma(\theta) \neq S$ empirical data is inconsistent with the model or variance and covariance are inconsistent with the empirical data.

if P-value <0.05 refuse to H0, next step model must be adjusted until statistical significantly. The analysis using computer software called Jamovi Version 2.3.28 as tool based on hypothesis as following:

H0: Pij = 0 Variable in the equation has relational coefficient as 0, this means this parameter should be eliminated from the equation.

H1: Pij ≠ 0 Variable in the equation does not have a relational coefficient different from 0; this means this parameter should be included in the equation (P-value <0.05 refuse H0).

There are two variables for testing land tenure change: land tenure before 2017 (represented as n0) and land tenure after 2023 (represented as n1). For the path analysis, there are six variables: 1. Whether smallholders encroach on forestland (x1), 2. Whether the state is in a high or low capacity status (x2), 3. Whether smallholders grow cassava for commercial purposes or not (x3), 4. The land plot that smallholders have access to (y1), 5. The level of belief in land security resulting from smallholder practices (y2), and 6. The level of perceived household economic improvement (y3). The criteria for translating the meaning of the variables are indicated in the following Table 01:

var	Description of variable	Meaning of scores
x1	Smallholders encroach to forestland or not	0 Do not encroach to the forestland 1 Encroach to the forestland
x2	State capacity	0 Low efficient 1 High efficient
x3	Cassava cultivation	0 Do not grow cassava for commercial 1 Grow cassava
y1	Land plot that smallholder access	Number of land plot
y2	Level of belief of the smallholder if their practice assisting for land security	1 Very low 2 Low 3 Medium 4 High 5 Very high

y3	Perceived economic improvement level	1 Very low 2 Low 3 Medium 4 High 5 Very high
n0	Land plot that smallholders had access right before 2017	Integer
n1	Land plot that smallholders had access right after 2023	Integer

Table 01: Meaning of scores

ANALYSIS AND DISCUSSION

The results of the study, based on the objectives, are shown as follows:

Comparative of changing land plot of smallholders had accessed for garden before 2017 (n0) and after 2023 (n1) that there is a land struggle for commercial cassava cultivation

For data distribution, the Shapiro-Wilk test was conducted to assess the P-value. If the P-value is smaller than 0.05, it indicates that the data distribution is not normal. The study showed a P-value of <0.001 for both the period before 2017 and after 2023, indicating that the empirical data does not follow normal distribution. The Wilcoxon rank test was applied to assess the differences in the data. If the P-value of the Wilcoxon rank test is smaller than 0.05, it suggests that the data from the two periods are different or that the data have statistically significant changes. The results show a P-value of <0.001, meaning that the garden land access rights of smallholders changed significantly from 2017 to 2023 when the struggle for commercial cassava cultivation occurred.

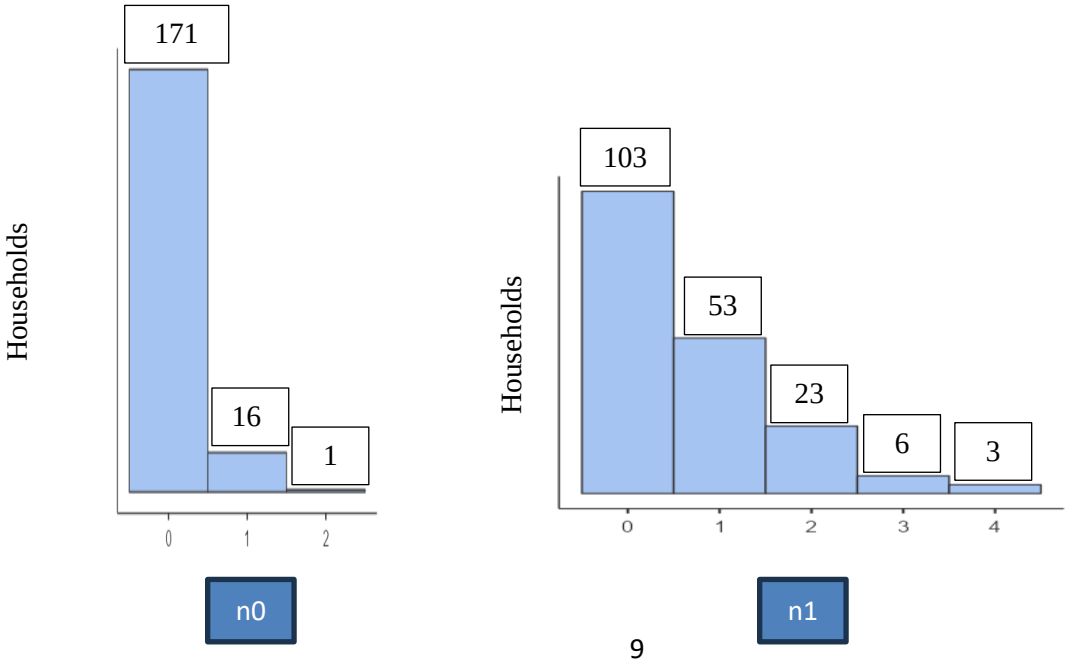

Figure 2: Household access to agricultural land plots

Before 2017, more than 90% of smallholders did not have access to garden land; only 17 households had land rights. Among these, 16 households had only one plot, and two households had two plots. However, after the struggle for commercial cassava cultivation, by 2023, smallholders had significantly greater access to garden land. Nearly 30% had access to one plot each, more than 10% had access to two plots, six households had access to three plots, and three households had access to four plots (see Figure 2). Then, we analyzed the causes and effects of the land tenure change by application of a path analysis as follows:

Path coefficients

Path analysis shows coefficients that represent the degree of relationship between variables, as shown in Table 2.

equation	variables		Influencing variables		Path coefficients		
			Causes	Residual	Residual var. coef.	Causal var. coef.	
	causes	effects	R^2	rs=$1-R^2$	$\sqrt{(1-R^2)}$	β	P-value
1	x1	y1	0.700	0.300	0.548	0.837	<0.0001
	y2					0	
2	x1	y2	0.703	0.297	0.545	0.835	<0.0001
	x2					0.095	0.0180
	x3					0	
3	x3	y3	0.824	0.176	0.419	0.855	<0.0001
	y1					0	
	y2					0.114	0.0006

Table 2: Path coefficients

Path analysis diagram with statistical test number

Path analysis shows standardized coefficients that represent the degree of relationship between variables, as shown in Figure 3.

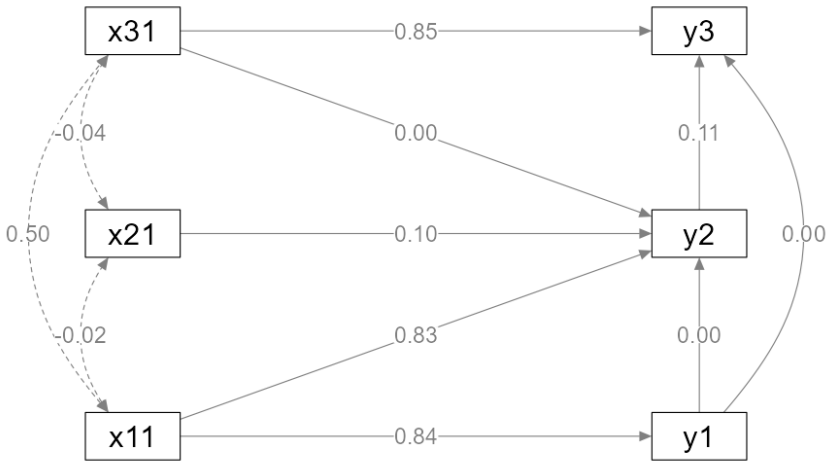

Figure 3: Path analysis diagram

Testing for measurement errors and consistency yielded Chi-Square = 4.42, P = 0.6196. The consistency level of the data in the model included: Comparative Fit Index (CFI) = 1; Tucker-Lewis Index (TLI) = 1.020; and Relative Non-centrality Index (RNI) = 1.010. These values indicate a good-fitting model. The degree of errors in the model is represented by the Standardized Root Mean Square Residual (SRMR) = 0.015 and the Root Mean Square Error of Approximation (RMSEA) = 0.000. The overall test of p-value must be > 0.05, the results indicate Chi-Square > 0.05; hence, the model is consistent with the empirical data, and the measurement errors and degree of consistency are statistically acceptable.

Correlation of variables

The path analysis shows coefficients that represent the degree of correlation among couple variables, as shown in Table 3.

Type of correlation	x1 y1	x1 y2	x2 y2	x1 y3	x2 y3	x3 y3	y2 y3
A. Total (Sample Moments)	0.835	0.828	0.061	0.463	-0.038	0.885	0.506
B. Causal and effect:							
B.1 Direct Effects DE	0.835	0.829	0.092	0	0	0.855	0.113
B.2 Indirect Effects IE				0.104	0.010		

Total Effects: TO	0	0.829	0.092	0.104	0.010	0.855	0.113
C. unreasonable correlation	0	-0.001	-0.031	0.359	-0.048	0	0.393

Table 3: Correlation

The model can explain causal correlation for 99.99%, including three sub-equations, as detailed in the following explanation:

Path 1: Number of land plots that smallholders accessed from 2017 to 2023 (y1) $R^2 = 0.700$

The number of land plots that smallholders accessed (y1) can be explained by the number of smallholder households that encroached on forestland (x1), accounting for 83.70% of the variation. This means that for each additional household that encroaches on forestland, the number of accessed plots increases by 1.44. However, the number of accessed land plots does not have a statistically significant effect on land security and does not significantly impact household economic improvement.

Path 2: Level of belief among smallholders regarding whether their practices contribute to land security (y2) R^2=0.703

The level of belief among smallholders regarding whether their practices contribute to land security (y2) can be explained by the number of smallholder households encroaching on forestland (x1) and state capacity (x2) by 70.30%. The model shows that forestland encroachment (0.835) explains land security better than state capacity (0.095), while cassava cultivation is not statistically significant in relation to land security in this context. The equation demonstrates causal links as follows:

i. When the number of smallholders encroaching on forestland (x1) increases by one household, the level of belief in land security (y2) increases by 2.03 times (more than two levels), indicating a strong belief in land security.

ii. An increase in state capacity (x2) from low to high relates to the belief of smallholder households in land security, which increases by only 0.3 levels, suggesting that state capacity does not significantly enhance the level of land security.

Path 3: Perceived economic improvement level (y3) R^2=0.824

The level of perceived household economic improvement (y3) can be explained by the level of belief in land security (y2) and the number of smallholder households that grow cassava for commercial purposes (x3). The equation explains the level of perceived household economic improvement (y3) at 82.40%. Households engaged in commercial cassava cultivation (0.8546) explain the level of perceived economic improvement better than the level of belief in land security (0.1136). The equation demonstrates causal links as follows:

i. If the number of smallholders growing commercial cassava (x3) increases by one household, the level of perceived household economic improvement (y3) increases by 2.12 levels (more than two levels), indicating a significant improvement.

ii. An increase in the level of belief in land security (y2) by one level would result in an increase in the perceived economic improvement level (y3) of only 0.12 levels, suggesting that the level of belief in land security does not significantly change the perceived economic improvement level (y3).

Additionally, the perceived household economic improvement (y3) is also indirectly affected by both forestland encroachment and state capacity through belief in land security, statistically significant at 95%.

Land tenure in the two villages within the Phou Hin Poun NPA, particularly regarding the plots that smallholders traditionally accessed, has changed from land that smallholders could only access to land that they can benefit from, exclude others from, and manage for cassava cultivation. The number of accessible plots increased from 18 to 129, while forestland encroachment involvement of 77 households, resulting in a total area of land use change of 108.78 hectares. This change is statistically significant. Smallholder households encroaching on forestland subsequently induced land tenure change, with a high standardized score. Additionally, land tenure change is also influenced by state capacity. Low state capacity enables smallholders to exploit strategic positions and opportunities that arise from a state's weaknesses. In weak states, the lack of effective governance and service provision can create gaps that smallholders can utilize, either through land grabs or local connections that respond to unmet needs for land access. Since the relationship between state capacity and forestland encroachment is negative, low state capacity subsequently affects forestland encroachment. Indeed, low state capacity can lead to increased forestland encroachment. When state institutions lack the ability to enforce laws or provide land management, individuals may exploit forest resources without regard to regulations, leading to higher rates of encroachment. This situation poses threats to biodiversity and overall land management, as highlighted in discussions regarding socio-economic causes and anthropogenic impacts on land cover. This study result conforms to the government's evaluation (GoL, 2024).

It is also consistent with the standardized score of the relationship between forestland encroachment and land tenure security. The relationship indicates that smallholders' beliefs about forest encroachment help secure land tenure. However, land security does not directly relate to the effects of land tenure change in a statistically significant way. This finding does not support the study by Boutthavong et al. (2016), and land tenure change also does not directly and statistically significantly affect household economic improvement.

However, the factor of forestland encroachment that directly affects land tenure change also has a direct and statistically significant impact on land security, and it indirectly affects household economic improvement as well. Similarly, commercial cassava cultivation has a high standardized score related to perceived household economic improvement. It is positively related to forestland encroachment and negatively related to state capacity. Nevertheless, commercial cassava cultivation is not statistically significantly related to land tenure security, which contradicts the studies of Perego (2019), and Cazzuffi et al. (2020). Because this case of commercial cassava cultivation was linked to illegal forestland encroachment, smallholders did not feel confident about securing land tenure in the future, even though they currently have access to the forestland.

In conclusion, weak state capacity, combined with the smallholder slot, allows the government to prioritize cassava as a crop and implement livelihood improvement policies as channels for accessing land and improving household economic situations. These findings support

Peluso (2019) concept of the smallholder slot and John Locke's theory on land claim (Sjaastad & Bromley, 2017). However, the land access rights are not secure, leading to a trade-off with forest loss (Thaler, 2021). The role of the state significantly influences this change (Junquera et al., 2020; Calmon, 2022).

This research presents a case study utilizing the path analysis method, offering insights into its application. Beyond other sectors, land tenure change can also be examined using path analysis, which highlights the relationships between cause-and-effect factors similar to those in other fields. The study suggests that path analysis is likely to become a widely used research method in forest management studies overall.

CONCLUSION

Land tenure change occurred in villages within the Phou Hin Poun NPA, where smallholders accessed more land for commercial cassava cultivation after encroaching on forestland. Other relationships include how weak state capacity including law enforcement led smallholders to believe they could acquire greater land tenure security, as well as the indirect impact on improving household economic conditions, which supports the direct impacts of commercial cassava cultivation on enhancing these conditions as well. This research provides essential information to state organizations responsible for managing the NPA, land management, and livelihood improvement for smallholders, contributing to the effective management of the protected area.

Although state capacity for forestland and land management slightly affects smallholders' belief in land tenure security compared to forestland encroachment and commercial cassava cultivation, it remains a vital foundational factor. If the government strictly and closely manages the forest, smallholder farmers would be unable to encroach on and convert the forest into cassava plantations, while also ensuring sufficient land plots for cash crop production, securing land tenure, and generating income for smallholder households. In addition, land tenure change is cyclically revolutionary, but it should not occur in designated forestland. The government should immediately halt encroachment to stop the link to land tenure change. For the smallholder economy, which is supported by commercial cultivation and land tenure security, the government should allocate non-forestland to secure rights and increase cassava productivity.

The results of this research not only benefit the NPA management sector, but also provide valuable lessons for forest management in other similar countries and open new avenues for the theory of smallholder land claims for academic exploration and discussion.

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