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学位論文の要旨（論文の内容の要旨）
Summary of the Dissertation (Summary of Dissertation Contents)

論 文 題 目
Dissertation title

Analysis of the Relationship between Rubber Tree Plantation and Forest Resource Dependency: A Case Study of Smallholder Rubber Plantation in Northern Laos

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Transformation of the shifting cultivation to other permanent agricultures is a key development policy in upland of Northern Laos to contribute to the main goal of the Lao government to graduate from the least developed country by 2020. In practical, number of strategic and action plans have been produced by different government leading agencies in order to facilitate the poverty reduction. Among those, the main goals of the Strategic Framework for National Sustainable Development Strategy for Laos and the National Biodiversity Strategy to 2020 and Action Plan 2010 are to maintain diverse of biodiversity and to ensure that valuable environmental resources are conserved in order to permit social economic development, the improvement of livelihoods, and poverty reduction in a sustainable manner.

In line with the main goal, LuangNamTha Province is facing great challenge on poverty reduction and sustainable use of forest resources. Increasing market demand for NTFPs on the one hand creates favorable conditions for forest resource-based poverty alleviation. On the other hands, also continue increasing pressure on forest resources at the same time. Leading by strong demand for natural rubber from China, rubber tree plantation has given new economic opportunity to agricultural households and the former shifting cultivators. In addition, it is perceived that rubber tree plantation would also contribute to diminish the pressure on forest resources by reducing forest resource dependency among smallholder rubber households with supportive income from rubber. This research attempts to observe the relationship between rubber tree plantation and forest resource dependency through labor allocation decision for NTFP collection, and the values of collected NTFP and NTFP income shares. Although this research may not address the forest resource conservation or sustainable management of forest resource directly, however, this research might illustrate the direction of forest resource dependency among smallholder rubber production in a long-term perspective and also contribute to fill the information gap of the government strategic plans.

Besides rubber tree plantation, smallholder also allocated labor for upland rice shifting cultivation, livestock production, NTFP collection, and off-farm employment. We firstly developed a system labor share equation from theoretical framework for labor allocation of agricultural household in developing countries. This model permit us to observe the interaction on labor allocation decisions among five livelihood activities mentioned above, in respond to changes in the labor productivity of each activity, with respect to different stages of rubber tree cultivation. We found that labor share for NTFP collection was not influenced by changes of its labor productivity regardless of stages of rubber tree cultivation. However, at unproductive stage, labor share for NTFP collection decreased with increasing area of plantation per adult labor and with increasing the productivity of labor for off-farm; while labor share for off-farm increased with higher level of education. At the productive

stage, labor share for NTFP collection decreased with increasing the productivities of labor for livestock and off-farm. However, labor share for NTFP collection did not respond to changes in the productivity of labor of rubber tree cultivation.

The latter finding was unlikely to elucidate the current situation occurring in the study areas. This is because working hours allocated for NTFP collection captured the efforts households devoted for NTFP collection. It was however, unlikely to capture the real-term of forest resource dependency. By the real-term we meant forest resource dependency implied the absolute term of NTFPs that have been collected, utilized, or marketed by the households. This is because, by definition, working hours for NTFP collection was including hours required for travelling to the collection sites, and hours for searching and collecting. Since sample households are residing in the villages with different length of the distance to the forests. Therefore, those far from the forests required more number of hours to travel to the collection sites and thereby, reduced the number collecting hours and resulted in smaller amount of collected NTFPs. As consequences, the greater amount of working hours for NTFP collection was unlikely to imply the greater amount that can be collected. In addition, sample villages were also facing different size of forest which may affect the availability of the forest resources.

Therefore, to improve the definition of the forest resource dependency, we employed the ratio of the values of the collected NTFP and NTFP income to total household income as other two indicators to capture the real-term of forest resource dependency. At the same time, the technical constrain was not allowed a system equation to work with these two indicators. As consequences, the results were estimated by using a conventional approach that widely used to investigate factors influencing on forest resource dependency in developing countries. Results showed that, at unproductive stage, area of plantation per adult labor displayed insignificant results with NTFP income share and NTFP collection value share at unproductive stage. At productive stage, age and education displayed negative and significant results with NTFP income and NTFP collected value shares. The productivity of land of rubber tree cultivation revealed insignificant result with NTFP income share; however, it showed strong negative and significant result with NTFP collected value share. In addition, age and education also displayed negative and significant results with NTFP income and NTFP collected value share.

The strong correlation between the productivity of rubber tree cultivation and NTFP collected value share led us to analyze technical efficiency of rubber tree cultivation at the productive stage in order to observe the current efficiency level and the potential efficiency of smallholder rubber tree cultivation across the sample villages. Results showed that the current level of efficiency of rubber tree cultivation among smallholder in the study sites remained being low on average. This result implied the large potential efficiency that could be further improved in the near future. Also, we found that efficiency in rubber tree cultivation was not so largely different across the sample villages, however, the large gap of efficiency was observed among the sample households within each village. The smallholders in the Hadyao village where it was well-known as the first rubber cultivation village in Northern Laos was significantly gained the highest efficiency among other sample villages. Finally we found that technical efficiency in rubber tree cultivation was negatively influenced by female and positively influenced by age below 50 years old.

In conclusion, time competition between rubber tree plantation and forest resource extraction has emerged since at the unproductive stage especially among those are holding large area of plantation per adult labor. In addition, forest resource dependency at this stage was likely to decrease with increasing economic opportunity of off-farm employment especially among the group leading by better educated household head. Create incentives and favorable conditions for households to access to off-farm jobs would provide ad hoc livelihood alternatives, and, thereby, decreased their efforts on forest resource extraction. In practical, the government should introduce ad hoc supportive programs to improve education level of the household head in order to facilitate off-farm jobs accessibility and decrease households' livelihood pressure during waiting for rubber income.

At productive stage, rubber tree plantation allowed households to have steady income source to support their life in several ways for a long-term; this including substitute some subsistence NTFPs by commercial products at the market. Hence, additional increasing the productivity of rubber tree cultivation was likely to further decrease forest resource dependency among smallholder rubber households. This result tends to imply that economic benefit of rubber tree cultivation and a reduction of forest resource dependency could be

maintained in the same direction. Result showed the large potential efficiency of rubber tree cultivation implied a high possibility to sustain a reduction in forest resource decency in a long-term. This stage called for a better-planned long-term policy. This is because productive stage not only displayed the current situation of the productive stage, but also mirrored the future situation of the current unproductive stage. Since collection and store up rubber latex also combined as important components of rubber tree cultivation along with tapping which could determine the ultimate amount of rubber income obtained at the final stage. And female have taken as key actors for the collection and store up activities. Therefore, improving the capacity of young female would not only perceive to maintain the income from latex sales but would also reduce burden for male and enhance their capacity which is perceive to ultimately contribute to improving the efficiency of rubber tree cultivation as a whole. Since Hadyao village was perceived as the best performer for rubber tree cultivation among other sample villages. Therefore, further improve the capacity of young female would further enrich knowledge and experience that could be shared by this village.