Impact of changing of swidden-based farming to rubber-based farming on socio-economic performance in Luang Namtha province, Lao PDR

ผลลัพธ์ของความเปลี่ยนแปลงจากการทำฟาร์มแบบไร่เลื่อนลอยเป็นการทำฟาร์มแบบมียางพาราเป็นหลักที่มีต่อสภาพเศรษฐกิจ-สังคมของเกษตรกรในจังหวัดหลวงน้ำทา ประเทศสาธารณรัฐประชาธิปไตยประชาชนลาว

Avakat Phasouysaingam[1]
Anan Polthanee[2]
Arunee Promkhambut[3]
Satit Aditto[4]

Abstract

This study was to describe the context of selected villages and farming types and compare the socio-economic performance of farming practice at the household level among swidden-based farming alone (SBF), rubber-based farming alone (RBF) and both swidden and rubber-based farming (SRBF) in Luang Namtha province. The research applied qualitative and quantitative methods. Qualitative data collection was conducted in-depth interview from key informants and focus group discussion with respondents and quantitative data was conducted by face to face household (HH) interview with the total 195 households. The study of changing

[1] *Corresponding author: Email: a.phasouysaingam@nuol.edu.la*
[2] *Student, System Approach in Agriculture, Faculty of Agriculture, Khon Kaen University*
[3] *Professor, Faculty of Agriculture, Khon Kaen University*
[4] *Assistant professor, Faculty of Agriculture, Khon Kaen University*

swidden-based farming to rubber-based farming on socio-economic performance in Luang Namtha province was concluded that the patterns of farming system in the selected village were changed into three types of farming system: 1) swidden-based farming alone 2) rubber-based farming alone and 3) swidden and rubber-based farming system. The results of the study show that in comparison economic return, RBF performs with a better income than SBF. Because the highest net income of the household was found in RBF 1,890 US$/HH/year, secondly was SRBF 1,788 US$/HH/year. The solidarity declined when the farmers change swidden-based farming to rubber-based farming. The SBF and SRBF still sharing labor for farming practices while RBF still depend on hired labor only. Thus, it is recommended that in the development process, when the community change from subsistence to commercialization livelihood, the social welfare system should be prioritized to ensure household food and income security.

Keywords: agriculture extension, rubber-based farming, swidden-based farming, socio-economic performance

บทคัดย่อ

การศึกษานี้มีวัตถุประสงค์เพื่ออธิบายบริบทของหมู่บ้านที่เลือกและประเภทการทำฟาร์ม รวมถึงเพื่อเปรียบเทียบประสิทธิภาพทางเศรษฐกิจและสังคมในระดับครัวเรือนระหว่างรูปแบบการทำฟาร์มแบบไร่เลื่อนลอยเป็นหลักอย่างเดียว การทำฟาร์มแบบที่มียางพาราเป็นหลักอย่างเดียวและการทำฟาร์มแบบทั้งมียางพาราร่วมกับแบบไร่เลื่อนลอยโดยอาศัยวิธีวิจัยประเภทการเก็บรวบรวมข้อมูลปฐมภูมิโดยการสัมภาษณ์แบบกึ่งโครงสร้าง (Semi-structured interview) จากกลุ่มผู้รู้ (Key informants) การสนทนากลุ่มจากผู้มีส่วนร่วมและการสัมภาษณ์รายครัวเรือนโดยใช้แบบสอบถาม (Questionnaire) จำนวน 195 ครัวเรือน ผลของการศึกษาพบว่าการทำฟาร์มแบบที่มียางพาราเป็นหลัก อย่างเดียวให้รายได้สุทธิสูงสุด 1,890 US$ ต่อปี รองลงมาคือการทำฟาร์มแบบทั้งมียางพาราร่วมกับแบบไร่เลื่อนลอย ให้รายได้สุทธิ 1,788 US$ ต่อปี ในขณะที่ความสามัคคีในชุมชนยังมีสูงในกลุ่มเกษตรกรที่ทำฟาร์มแบบไร่เลื่อนลอยเป็นหลักอย่างเดียวและทำฟาร์มแบบมีทั้งยางพาราร่วมกับแบบไร่เลื่อนลอย เนื่องจากครัวเรือนยังต้องช่วยเหลือกันในการแลกเปลี่ยนแรงงานในการทำไร่เลื่อนลอย ในขณะที่การทำฟาร์มแบบมียางพาราเป็นหลักอย่างเดียวต้องจ้างเพียงแรงงานเมื่อเกษตรกรประสบปัญหาขาดแคลนข้าวครัวเรือนทั้งในการทำฟาร์มแบบไร่เลื่อนลอยเป็นหลักอย่างเดียวและการทำฟาร์มแบบทั้งมียางพาราร่วมกับแบบไร่เลื่อนลอย ยังสามารถแบ่งปันข้าวให้กันได้ แต่การทำฟาร์มแบบยางพาราเป็นหลักอย่างเดียวมีความจำเป็นต้องขอยืมข้าวหรือเงินเพื่อซื้อข้าว

คำสำคัญ: ส่งเสริมการเกษตร, การทำฟาร์มยางพารา, การทำฟาร์มแบบผสมผสาน, ประสิทธิภาพทางเศรษฐกิจและสังคม

1. Introduction

Swidden-based farming or shifting cultivation is referred to the upland rice cultivation system in Laos. In 1991, about 1,638,000 household or 95 percent of total population practiced swidden-based farming system for subsistence (Bass & Morrison, 1994). Since the government of Laos declared the forest laws 1996 and implemented the land use zoning and land use planning, swidden-based farming was considered as a cause of forest degradation (Souvanthong, 1995). The intent of land use planning was to eliminate swidden-based farming to permanent land use system (Takai & Sibounheuang, 2010). The patterns of land use were changed according to economic access and geographical condition. In the lowlands, swidden-based farming were rapidly transformed to paddy field and cash crops (Lao's National Strategy Team, 2005), while upland areas still remained to practice the swidden-based farming with integration of food crops and somehow slowly transformed to cash crops.

Since 2000s, rubber tree *(Hevea brasiliensis)* was firstly grown in Luang Namtha province and was promoted to replace swidden farming (Manivong, 2007). The Chinese government also supported rubber extension by linking the Opium Replacement Program (ORP) along bordered provinces of Laos (Lu, 2015). The rubber planted areas for the whole country had rapidly increased over the last 10 years to 300,000 ha[5] in 2010s (Jefferson Fox & Castella, 2013). Luang Namtha province was the biggest planted province. The total planted area had expanded from 5,213 ha in 2005 to 33,973 ha in 2015 (Provincial Agriculture and Forestry Office, 2017).

[5] *Hectare (1 hectare = 10,000 square meter)*

Rubber tree extension in Luang Namtha province was firstly promoted under contract farming system called "2+3" model where villagers contribute the land and labour while company provides capital, markets, and technology. The farmers obtain a share by 30 to 40 percent of the latex while companies obtain by 60 to 70 percent (Hicks et al., 2009). According to National Agriculture and Forestry Research Institute (NAFRI), the net income for 1 ha was about 10.2 million KIP annually or 1,240 USD in 2010 (Southavilay, 2016). The incomes of the farmers under contract farming was very low and lower since the rubber prices have rapidly dropped from 2.1 in 2010 to 0.6 USD in 2015 (Shi, 2015).

Thus, this paper discussed the economic and social performance of the rubber farmers in the selected area to understanding of the risk of rapidly changed of livelihood. The farmers transformed from swidden-based farming to rubber-based farming alone received uncontained incomes; sometimes lower than poverty line while social characteristics were also affected by economic transition. The risks of rubber-based farming alone were firstly occurred in 1999 when the pioneer rubber trees were killed by suffering five-year frost (Fullbrook, 2009).

2. Objectives of the study

This study aims to describe the context of the village and the farming characteristic in the selected villages and aims to compare the socio-economic performance of swidden-based farming alone (SBF), rubber-based farming alone (RBF) and swidden-rubber-based farming (SRBF) in the household level.

3. Methodology

3.1 Study Area

The study area is located in Luang Namtha Province, because it has a highest rubber planted area in Laos. The province consists of five districts: Luang Namtha, Sing, Long, Viengphoukha and Nalae Districts. Luang Namtha district was selected as it has a highest rubber planted area and latex production compared to other districts of Luang Namtha province (Figure 1).

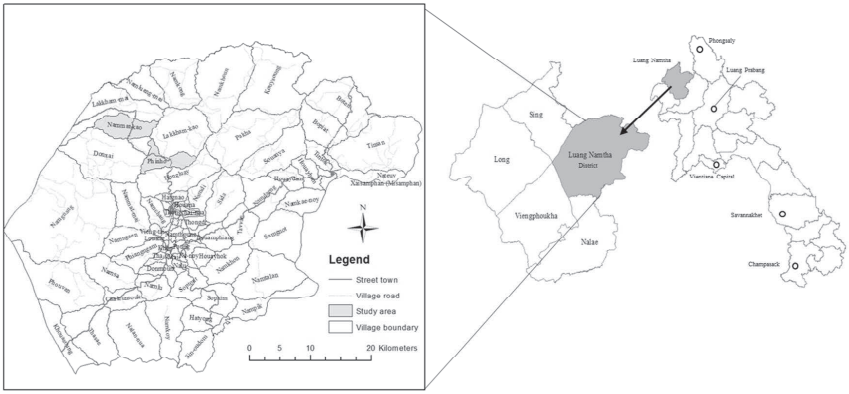

Figure 1 Location of selected study sites

Two villages (village A and Village B)[6] were purposive selected based on some villagers shifted from SBF to RBF, some villagers practiced both swidden and rubber-based farming (SRBF) and some farmers still practiced traditional swidden farming alone.

[6] *Pseudonym*

3.2 Household selection Method

The study selected the key informants who have known information related rubber plantation, markets, government policy and problems. The total six people within and outside selected villages were interviewed as key informants.

The participants for focus group discussion were selected according to the topic discussion. In this study, the focus group were mainly discussed about village history, origin of rubber and traditional swidden farming in selected villages. The total 4 groups were discussed to understand the changes and important events of selected villages.

The sampling of the households has followed the stratified random sampling method. All the lists with the names of farmers who practice swidden-based farming alone, rubber-based farming alone and both the swidden and rubber-based farming from two villages were separated into a single list for simple random sampling. The total sampling size of each farming type was computed using the following formula according to Yamane (1973). The results of calculation are shows in Table 1.

Table 1 Population size of households of different farming types in selected villages

Village	Total household number	Sample household number			Total
		SBF (N=27)	RBF (N=73)	SRBF (N=158)	
Village A	206	17	60	67	144
Village 2	52	7	1	43	51
Total (n)	**258**	**24**	**61**	**110**	**195**

3.3 Data Collection

Primary data collection was conducted in May 2017 by in-depth interview and focus group discussion and face-to-face household interview using questionnaire. Three major steps were sequently conducted 1) interview key informants was conducted with village head, village elders and rubber selling group were interviewed for collecting data of some physical, biological and socio-economic characteristics of the villages as well as history of changing swidden farming to rubber tree plantation in the villages. 2) focus group discussion was conducted with the representative of a different group of people such as wealthy, middle, poor, landless, lack of labor and women (15 people) were interviewed for collecting data on land use as well as socio-economic performance of three types of the farming system. 3) Face-to-face household interview was conducted in 195 respondents by using questionnaire for collecting data of the HH access to land, labor, capital, markets, productivity and income of three types of the farming in selected villages.

3.4 Data Analysis

Data received from key informants and groups discussion interview used the narrative analysis method to describe the qualitative information for the village context and historical review of resettlement and farming system change in the selected villages based on Reissman (1993).

The quantitative data from the total 195 respondents were used for agro-ecosystem analysis based on Rerkasem and Rambo (1988). Mean of production, productivity, net incomes were calculated for comparing between farming types (RBF, SBF and SRBF). The study also describe the equitability and solidarity of different types of farming based on Marten (1988); Rerkasem and Rambo (1988).

4. Results

The results of data collection were analyzed to describe the context of selected village and characteristic of farming systems after rubber trees were promoted to the selected villages. The study also compared the socio-economic performance of different farming types to understand the impact of changing swidden-based farming to rubber-based farming as follows:

4.1 History of rubber plantation in selected villages

Agriculture is a fundamental livelihood of the local people in Luang Namtha province and other upland areas. The livelihood activities of the villagers connect with swidden farming and forest use. According to focus group discussion, most of the villages located inside the forest before 2000 and have limited access to the urban area as the case of selected villages. The first ethnic group located in this area was Lanten ethnic minority since 1837 in village A. According to Schipani (2008), Lanten has originally come from China. They probably migrated to Lao PDR during the nineteenth century. They usually live near streams. They are sometimes called “Lao Houay or stream Lao”.

According to the focus group discussion, the second ethnic group resettled in this area was Khmu since 1985. This groups of people came from a different direction and did not come at the same times. The third group was Hmong ethnic that came in 1996. This Hmong group came from the same place with Hmong group in Hat Yao village[7]. Hmong was the first farmer that grows rubber tree in village A since 1993.

[7] *A history of Hat Yao village was reported by Alton, Bluhm, and Sananikone (2005)*

Table 2 Summary important events of the village settlement and rubber tree plantation in the selected villages

Year	Important events
1837	Lanten ethnic resettled in village A
1985	Khmu ethnic migrated to present location; they came from a different area within the province and other provinces
1993	Farmers trial to grow the first rubber trees in the village. They brought the seedling from China
1996	Hmong resettled to the village for growing rubber trees
2000-2003	Government starts to promote the rubber plantation
2003	Aka moves to village B for rubber plantation, supported by the government giving the land 1 ha per household
2003-2007	Chinese company comes to the villages for promoting rubber plantation under contract farming
2008-2016	Villagers expanded the rubber plantation by themselves on the swidden land. Some farmers sell the rubber directly to company and rubber collectors with higher income compared to contract farming
2016	Villagers start to terminate the contract farming system by paying back the initial planting cost and formed as rubber selling group for market access

Source: Survey, 2017

Aka is living in village B since 2003. This ethnic use to live inside Nam Ha national forest conservation area. After rubber extension program, the village was encouraged to move out from forest area to along the road in the present location. The government also provided the initial support as a subsidized loan for rubber plantation[8].

[8] *One hectare per household, farmer will pay back after rubber harvesting*

In overall, before 1990s, the livelihood of upland people has very slowly changed from subsistence to commercialization in agreed with Fox et al (2009). In 2001-03, the government supported the rubber plantation with subsidized loan. After that 2003-07, Chinese private companies came for extension with contract farming and provide the technical training to the farmers. According to Shi (2008), a reason behind the investment of rubber in Luang Namtha because of the increasing of market demand in Xishuangbanna of Yunan province, China that located nearby Luang Namtha province. The livelihoods of the people were rapidly changed from swidden-based farming to rubber-based farming. The farmers then started to transform their fallow lands to rubber plantations on their own. Moreover, the farmers under contract farming also terminated the contract farming by returned the fund to company or sell the rubber plantation to company and cleared new forest for rubber plantation.

4.2 Patterns of landscape in selected villages

The land use of selected villages and other northern part of Laos were changed as the same patterns. Phanvilay, Thongmanivong, Fujita, Fox, and Center (2006) also stated that the farmers cleared the formers swidden land and fallows for rubbers plantation and cultivated upland rice in first few years on the rubber field. According to the survey, the present land uses in selected villages were classified to five zones (Figure 2) as follows:

- Zone 1: This zone is a residential area that located along the riverside and roadside. The villagers normally grow vegetable in the riverside and raise poultry and pig surrounding the house.
- Zone 2: This is a very large area of rubber plantation that predominated the major landscape in selected villages. One household owns the rubber plantation more than 1 hectare (ha) and some households still continue to grow as much as they can depending on household labors and

access to the plantation. Villagers normally make a common road that can travel by motorbike.

● Zone 3: This is a few remaining swidden farming near the villages. Most of the swidden lands in this zone are replaced by rubber tree plantation.

● Zone 4: This zone is newly transformed from forest to swidden land and became rubber tree plantation respectively. The villagers clear forest land for growing rice at the same time, also mixed with rubber trees. The lands can grow rice continuously up to 3 years before moving to another forest land for growing swidden rice. According to FGD with village's organization, villagers are now not allowed for further clearing the forest for swidden and rubber plantation.

● Zone 5: This zone is mainly covered by forest and mountainous region. The selected villages have borders both eastern and western with Nam Ha national conservation area where the forest is highly protected. However, the boundaries of the village are not yet clearly defined and very hard to monitor by the authority because of limited access to this zone.

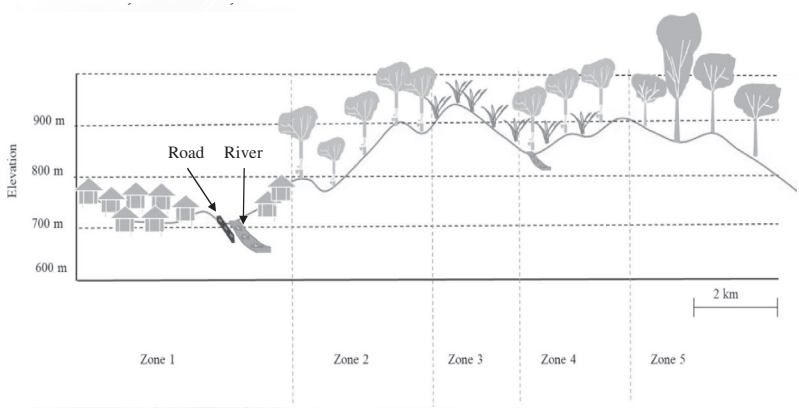

Figure 2 A transect of present landscape in the selected villages

4.3 Farming characteristic in selected villages

The driving factors of farming system changed in Luang Namtha Province were due to the appropriated location nearby Chinese border, market demands for natural rubber and rubber extension policies (Liu, Jiang, Feng, & Li, 2016). Nowadays, three types of farming were practiced in the selected villages such as swidden-based farming alone, rubber-based farming alone and both swidden and rubber-based farming. A small portion (12%) was swidden-based farming. About 57 percent of villagers practice both swidden and rubber-based farming and about 31 percent of villagers completely changed to rubber-based farming alone.

Swidden-based farming (SBF)

This is a small HH group of the villages. The reasons behind the swidden-based farming are the rice sufficiency for household consumption and these farmers hold the limited of the lands that were not enough for growing rubber trees. Swidden-based farming is well known as diversity sources of food (Pathumphone, Sanitchon, Polthanee, & Promkhambut, 2016). In the selected village, farmers grow rice integrated with vegetables such as cucumber, sesame, maize and other vegetables food. Household income come from different sources such as harvesting cardamom (*Amomum* spp.), collecting non-timber forest products (NTFPs), working as a labor in the other rubber-based farming households within the village or other villages nearby.

Rubber-based farming (RBF)

This group of farmers has completely changed from swidden-based farming to rubber-based farming. The farmers have no more land for swidden rice cultivation. Some household of rubber-based farming has temporary employed as a labor for tapping in the other village when their rubber incomes were not sufficient for buying food and household consumption.

Some of them also grow cardamom along the slope of riverbank for the household income.

According to the focus group discussion, the farmers in rubber-based farming don't want to return to swidden farming again because swidden-based farming requires more labor than that of rubber-based farming. Within the rubber plantation, the farmers can generate greater income than swidden-based farming if the prices of rubbers greater than 0.49$ per kg. The rubber-based farming system so far completely depends on the incomes from rubber selling to buy rice, food and household expenditure. The farmers have the land approximately 2.3 ha per household with the minimum area 0.5 ha and maximum 6 ha. The farmers sell the rubber in form of cup lump that can easy transported from their plantation.

The managements of farming practice, farmers mostly work on their own rubber plantation; tapping, weeding, collecting cup lump. The rest of time, are taking care of cardamom, hiring for tapping in other villages and collecting broom grass after the tapping season. The skills of tapping of rubber-based farmers were higher than swidden-based farmers. One farmer can tap more than a hectare with the alternate daily tapping or third daily depending on the latex prices and income needed. The farmers tap the rubber latex between 3-6 AM and then manage their plantation such as weeding and collecting the rubber cup lump.

Swidden and rubber-based farming (SRBF)

The swidden and rubber-based farming is a major group of farmers in the selected villages. This group of farmers decided to engage in both swidden and rubber farming due to the falling of rubber prices in 2015. A case of rubber farmers in response to the falling prices were presented by Vongvisouk and Dwyer (2017). Many rubber farmers in Sing district of Luang Namtha province decided to lease the rubber plantation for Chinese

investors converted to banana plantation. However, land lease for banana plantation were not allowed by the local authority in the study site, the rubber farmers were suffered with serious food shortage in 2015. Thus, the farmers decided to retain swidden farming for household consumption and working in their own rubber plantation, cardamom collection, maize production and collecting NTFPs with the rest of time.

Swidden rice and rubber normally have no conflict in term of time. The farmer can work on both rubber tree plantation and swidden rice at the same day. Tapping started in early morning 3-6 AM. After that farmers get rid of weeds in the plantation or/and go to swidden land for weeding. Maize and other vegetable can also integrate in the swidden farm. Collecting bamboo, broom grass or mushroom and cardamom were taken in the rest of time or on the afternoon. However, working load were more than normal farming. Swidden farming require more labor input during clearing fallow land, planting the rice seed and harvesting. During these times, farmers cannot work on rubber plantation.

4.4 Economic performance of different farming types

Production and productivity

The swidden-based farming system is a complex system. The productivity of swidden rice is normally fluctuation depending on rainfall, length of fallow, soil fertility, weeding control and varieties.

The study found that an average swidden rice productivity of the SBF was 1,376 kg/ha/year. The results of this study are similar to the study of Sodarak (1999) that referred to the average productivity of 1,400 kg/ha/year for swidden rice in the short period of fallows. The SRBF received better productivity average 1,636 kg/ha/year. The average productivity of SBF was only 1,376 kg/ha lower than SRBF that received average 1,636 kg/ha (Table 3). In comparison of the Laos agriculture development strategy 2020 that has

identified the target on annually rice production by 1,680 kg/household for sufficient household consumption (Ministry of Agriculture and Forestry, 2015), the SRBF and SBF were still below than the national target.

Table 3 Rubber and rice production per household and productivity in selected villages

Description	SBF		RBF		SRBF	
	Mean	SD	Mean	SD	Mean	SD
Rubber						
Production (kg/HH/year)	-	-	4,222	2,736	3,358	1,561
Productivity (kg/ha/year)	-	-	2,160	1,474	1,787	1,441
Swidden rice						
Production (kg/HH/year)	1,262	663	-	-	1,498	683
Productivity (kg/ha/year)	1,376	648	-	-	1,636	995

Remark: SD = Standard Deviation

The productions of rubber are also unstable depend on the age of rubber tree, variety, climate and tapping technique. The average productivity of the selected villages, RBF has higher productivity than SRBF, 2,160 kg/ha/year and 1,787 kg/ha/year respectively. The report of Manivong (2007) also indicated that the average productivity of farmers in Hat Yao village, Luang Namtha province was ranged from 734 to 2,750 kg/ha in 2004. The productivity intends to increase every year depending on the age of the tree. However, the household in selected villages were suffered from falling prices in 2015. They intended to tap rubber more frequency and extended the harvesting period from five months to six or seven months in 2016. Thus, the production of rubber (Table 3) for both RBF and SRBF are higher than common situations.

Gross and net income of three types of farming

The incomes of each farming types came from different sources as the integration of farming and non-farming incomes that including cardamom, collecting NTFPs and employing in the rubber plantation for tapping. The study demonstrated that the highest income of the household was found in RBF 2,597 US$/HH/year and secondly was the SRBF 2,495 US$/HH/year. Rubber provided the highest proportion of gross income for RBF and SRBF compare to the swidden rice. The cost of rice per kilo was approximately only 2,500 LAK or 0.3 US$ while the prices of rubber cup lump per kilo were between 4,500 to 5,500 LAK (0.55-0.67 US$) in 2016.

In the calculation of this study, the cost of rubber tree was approximately 300 US$ consisting of seedling and materials tapping. However, the costs of rubber were different in each year. The farmers spend at least seven years without return. The farmers spend more cost during first two year (Goswami & Challa, 2007). Manivong and Cramb (2008) calculated the Net Present Value (NPV) with estimated over 35 years of rubber plantation. With the prices 0.52 US$ per kg, farmers lost the opportunity labor cost by 474 US$ with any discount rate 5 percent. With the price 0.74US$ per kg, farmers received the profit by 2,194 US$/ha with discount rate by 5 percent. In compared with this study, rubber tree can provide the highest income for households.

Table 4 Household income (US$) of three types of farming in 2016

Description	SBF		RBF		SRBF	
	Mean	SD	Mean	SD	Mean	SD
Rubber cup lump	-	-	2,051	1,281	1,578	734
Swidden rice	413	225	-	-	434	198
Cardamom	155	311	51	118	173	203
Employ in tapping	345	579	292	806	193	414
Gathering vegetable and NTFPs	345	735	203	795	117	450
Gross income (US$/HH/year)	1,258	1,095	2,597	1,769	2,495	885
Total costs (US$/HH/year)	-	-	713	434	717	391
Net income (US$/HH/year)	1,258	1,095	1,890	1,640	1,788	866
Net income (US$/capita)	297	308	307	232	323	238

Remark: exchange rate 1 US$ = 8,500 LAK; SD = Standard Deviation

In contrast, swidden farming use small input costs (in kind) in the farming system compared to rubber. The farmers use very common tools such as small hoe for weeding, knife for cutting the wood, and the traditional tool for harvesting. These tools were used for more than 10 years. Labor was also shared with the relatives and neighboring. Thus, swidden farmer almost pay nothing for swidden rice cultivation except gasoline for motorbike. In agreed with Chazee (1993), the cost and income from swidden farming was commonly low. Only surplus production would be sold to the market but income per capita in this survey of three types of farmers were almost similar.

4.5 Social performance of different farming types

Solidarity

The solidarity is referred to the ability of the social system to make and implement decisions about its agroecosystem management (Rerkasem & Rambo, 1988). A study of Simaraks, Supateera, and Samart (1991) indicated that the high solidarity was found when the community widely exchange the labor for farming practices and low when the exchange labor was lessened.

In this study found that exchange labor for swidden farming were linked to food security. Swidden farming normally have very low yields, it requires a lot of labor to grow in the large area to have sufficient production. According to the Lao agriculture strategy plan, one person consumes 280 kg per year of paddy rice or in average 1,680 kg per family per year (Ministry of Agriculture and Forestry, 2015). The yields in swidden farming were varied depending on weeding control, soil fertility, rainfall and variety. An average rice yield of selected villages was only 1,576 ± 940 kg per hectare. To have enough rice for households consumption, farmers have to grow swidden rice in at least one hectare that would require approximately 120 man-days. Less labors households are unable to produce enough rice for households without the labor sharing among swidden cultivators.

Referring to this study, the households in swidden-based farming have still maintained in exchange labor for their swidden rice and temporary employ their own labor in another people's rubber plantation or work in their own rubber plantation as well as households in swidden-rubber-based plantation. The households in rubber-based farming have completely changed from exchange labor to hire labor. Cramb et al. (2009) also confirmed that labor exchange is declined when the swidden farming were replaced by the potential cash crops.

Solidarity in the selected village also demonstrated in term of sharing the rice production to assist rice shortage household. The system before rubber, all household in swidden farming share their own rice production after harvesting in a village barn by 30 kg. The rice shortage household can borrow for consumption or use as seed then return in the same amount after harvesting.

However, this type of solidarity was terminated after rubber tree were grown in the villages. The rice shortage household can only borrow rice from relatives or friends in the village. According to the study, the household in swidden-based farming and swidden-rubber-based farming are rarely borrowed the rice from relatives or friends because of rice sufficiency. Some household in rubber-based farming were found that have frequently borrowed rice from relatives or friends because of uncertain income from rubber caused by prices fluctuations.

A similar case of solidarity study was reported by Simaraks et al. (1991). The exchange labor was widely practiced in the traditional rice practice in Hin Lat village, Northeast Thailand. The solidarity was also declined when the livelihood of villagers changed from self-sufficiency farming to commercial farming system.

Equitability

Equitability is referred to how the community fairly sharing of farming production (Marten, 1988). A frequency distribution of the income were measured as community equitability (Rerkasem & Rambo, 1988). Referred to the study, land is an important part of household's income and food security. Better equitability was found in the swidden farming system before rubber plantation. According to the focus group discussion, there were two land allocations systems in the village including reserved fallow and not reserve fallow (collective right). In the reserved fallow system, farmers respect the

tenure right on fallows of other farmers. Every household had their own fallow that reserved depending on the household labor and ability to use the land. In the non-reserve fallow system, there was no specify land plot allocated for a household. The land and fallow belonged to a group of farmers that would allocate to every household year by year. These land use systems had a good equitability. Every household had the land according to the capacity.

Equitability on land holding were changed after the rubber plantation. Every household shifted the fallow land to rubber plantation and break down the traditional land use system. The village's organization decided to reallocate the new land for villagers for rubber plantation and perform with rubber extension policy since 2001. The ratio of reallocation of the land mainly considered the number of people in the family limited to one person per one hectare of land. In the reality, every ethnic group in each village act in different land reallocation policy were unable to control. The study found that only 40 percent of farmers reflected a fair reallocation (Table 5).

Table 5 Land use allocation of the villagers in the different farming types

Type of farming	Number	Fair (%)	Unfair (%)
Swidden-based farming	24	33	67
Rubber-based farming	61	38	62
Swidden-rubber-based farming	110	43	57
Total	195	40	60

Rubber extension increased the land use competition and conflict among the villagers (Shi, 2008). Scarcity of the land induces the farmers to manage the land more intensively (Cramb et al., 2009) and generates the

income from different sources. The study found that the incomes of different farming types were not equal. The farmers in the rubber-based farming received major income from rubber production, cardamom, vegetable production and gather non-timber forest products. In contrast, the farmers in the swidden-based farming received the incomes from swidden rice production as in kind, cash incomes from cardamom, vegetable production in swidden farm and employing for tapping. The most advantage is the farmers in swidden-rubber-based farming due to these farmers received more diversity sources of incomes. They received both income from rubber tree plantation, swidden rice production and also gathering NTFPs from the wild.

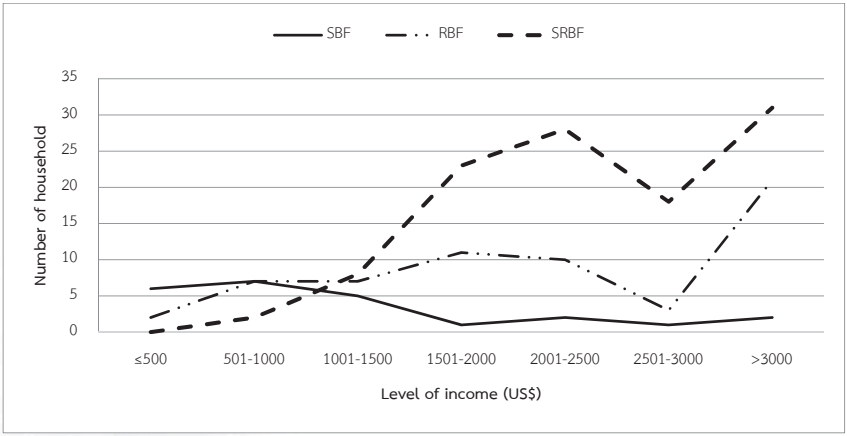

Figure 3 Distribution of incomes of three farming types

The distribution of income (Figure 3) indicates the equitability of three type farming within selected villages. The study found that the distribution of rubber-based farming and swidden and rubber-based farming had the same pattern but SRBF had higher equitability then other types of farm

due to majority of households had annual incomes between 1,000 to 2,000 USD and some households received more than 3,000 USD. The households in swidden-based farming had mainly received annual incomes between 500-1,000 USD. This farming type had highest variation and lowest equitability. In the overall village, the patterns of annual incomes distributions had demonstrated with a low equitability in agreed with Rerkasem and Rambo (1988) and Marten (1988). The report of Simaraks et al. (1991) are also agreed that low equitability caused by the different groups of households that had different opportunities to receive and adopt the technologies and supporting projects while the households had the access to the resources differently.

5. Discussion and Conclusions

The study of changing swidden-based farming to rubber-based farming on socio-economic performance in Luang Namtha province was concluded that the patterns of farming system in the selected village were changed into three types of farming system: swidden-based farming alone, rubber-based farming alone and swidden and rubber-based farming system. The swidden-based farming system was a small proportion in the villages, only 12 percent of farmers were found. They also preferred to grow rubber tree but they have not enough land and labor. Rubber-based farming has a second proportion of farming in the villages, about 31 percent of respondents grow only rubber tree without growing swidden rice. The rubber and swidden-based farming were the highest proportion of the farming system in the villages. About 57 percent of respondents grow both rubber tree and swidden rice. The study collected primary data by interview 195 households by using simple random sampling method.

The results of the study showed that in comparison economic return, RBF performs with a better income than SBF. Farmers who practiced rubber-based farming system earned net income approximately 1,890 US$/HH annually while the swidden-based farming earned net income only 1,258 US$/HH annually including rice production and other sources of incomes. However, rubber-based farming normally received unstable annual income, due to fluctuation of rubber prices. Thus, growing rubber alone or practice swidden farming alone may not sustainable for economic development. Farmers should have a channel to produce rice for food and rubber for income.

The solidarity declined when the farmers changed from swidden-based farming to rubber-based farming. The SBF and SRBF still sharing labor for farming practices while RBF still depend on hired labor only. The SRBF has better equitability than other type of farming because the distributions of annual incomes of this farming were found between 1,000-2,000 US$. Thus, it is recommended that in the development process, when the community change from subsistence to commercialization livelihood, the social welfare system should be prioritized to ensure household food and income security.

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