Smallholder’s labor allocation for livelihood diversification: A case study in an upland village in northern Laos

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ABSTRACT
Livelihood diversification involves the well-characterized strategies of smallholder farmers to combine risk aversion under a market economy. Since livelihood diversification studies have focused on diversifying income sources to include non-farm and off-farm income, the benefit of adding subsistence-oriented farming to the livelihood portfolio has been underestimated. This form of livelihood diversification is broadly observable in Southeast Asia, and could be another risk aversion strategy to cope with unpredictable market conditions. This study examined the role of swidden farming in livelihood diversification through the analysis of individuals’ labor allocation in livelihood portfolio, annual working hours, and seasonal changes in working hours in a village in northern Laos. Information was obtained through direct interviews with 133 individuals. Interviews were conducted in 2017 and gathered information on demographic features, economic activities, and monthly working hours for individual in 2016. The results indicated: 1) Individual’s livelihood portfolio was determined by the assets that the ethnic group and each household held to a large extent; 2) Livelihood diversification took place at the individual level rather than at household level, through an increase in annual working hours, as well as monthly working hours during the peak period of labor demand; and 3) Labor demand for swidden farming was moderate, so villagers can incorporate it into their livelihood portfolio. The study highlighted that flexibility would be another facet of livelihood diversification. Swidden farming was likely to play a pivotal role in its flexibility, but it was not important as an income source.

Key words: swidden farming, subsistence-oriented farming, Southeast Asia, cash crops, pluriactivity

INTRODUCTION
The livelihood diversification of smallholder farmers is observable and well-characterized worldwide (Ellis 1998; Ellis 2000). Smallholders are often pluriactive, as they combine on-farm and off-farm activities to form a livelihood portfolio, which includes the components of their household activities (Eder 1993; Netting 1993). Ellis (1998) defines livelihood diversification as the process by which rural families construct a diverse portfolio of activities and social support capabilities in their struggle for survival and in order to improve their standards of living. This form of livelihood is also known for its contrasting purposes to achieve survival and capital accumulation (Ellis 2000). Either way, strategies of risk aversion are necessary to combat erratic natural conditions and socio-economic changes.

Non-farm income, or non-agricultural activities to earn wages, and off-farm income, which is typically wages or exchanges on other farms, is a major part of the smallholder’s livelihood; these activities typically complement agricultural production to sustain the farm household economy in a market economy. Therefore, livelihood diversification studies focus on income diversification and are seeking to grasp what is needed to achieve income diversification. However, income diversification is not only the option for risk aversion. Independent from a market economy in the livelihood portfolio, another livelihood strategy could be used to sustain well-being under unpredictable market situations (Ripoll-Bosch et al. 2014). Especially in Southeast Asia, it is one of the broadly observable forms of livelihood that includes subsistence farming.

Although swidden farming in Southeast Asia has been transformed in several ways in response to socio-economic changes, it aids in securing livelihood at the household level in some cases (Cramb et al. 2009). In Sarawak in Malaysia, where people have been involved in the cash economy since the late 19th century (Cramb 1989), Cramb (1993) found a mutual buffer effect between price fluctuations in cash crops, such as black pepper and rubber,
and swidden farming. Wadley and Mertz (2005) claimed that cash crop cultivation and swidden farming remain safer targets of investment for the Iban and other local communities in Malaysia and Indonesia, despite the availability of job opportunities and other alternative income sources. A study by Sulistyawati et al. (2005) in Kalimantan found that swidden farming is a safer strategy to moderate the impact of commodity price fluctuations. In southern Laos, subsistence wet rice farming remains an important cornerstone of the rural economy for livelihood diversification to non-farm activities (Martin and Lorenzen 2016).

The pursuit of labor allocation would provide a clearer image than the analysis on income diversification for such livelihood diversification that incorporates subsistence-oriented farming into the livelihood portfolio. Smallholders often rely on their own supply of labor (Netting 1993); thus, a means of labor allocation for diversification at the household and individual levels is critical for securing livelihood.

While household asset endowments shape livelihood diversification (Ellis 2000), labor is critical for livelihood diversification in rural areas of economically developing regions. In the Amazon, the capability of adding new livelihood reflects labor endowment in a household, as households with greater adult laborers have more diversified production systems (Perz 2005). In addition, the author pointed out that, given the importance of labor availability, the capacity for households to diversify their livelihood portfolio changes over the course of the household’s demographic life cycle, which includes changes to age structures. This life cycle effect on livelihood is supported by research on land use changes in the same region, as the proportions in livelihood portfolios transition to activities with lower labor requirements, such as annual crops transitioning to perennials and pasture, while the household is aging (Perz 2001; Perz et al. 2006).

Simultaneously, livelihood diversification requires greater labor investment from single individuals. There is often seasonality in labor demand in farming, but labor is scarce during peak season because laborers are often confined to family labor; additionally, the value of hired labor is greater than the standard wage, which is unaffordable for the smallholders (White et al. 2005). One way to accommodate other livelihoods while avoiding such a bottleneck is through labor smoothing (Ellis 2000). In a case from the Nigerian Savanna, where cultivated crops are highly diversified with a four-month rainy season, farmers reduce seasonal fluctuations in their working time by adopting varieties with early-maturity and weak sensitivity to day length. In addition, they extend the agricultural year by harvesting, processing, clearing fields, and some planting during the dry season (Stone et al. 1990). Another example is in southern Laos, where villagers who engage in wet rice production are employed as non-farm workers during the agricultural slack period (Martin and Lorenzen 2016). In addition, Cramb (1993) introduces a case of labor smoothing through swidden farming in Malaysia; relatively even distribution of monthly working hours because the peak seasons for dry rice and perennial crops, such as black pepper and rubber trees, do not largely overlap.

Given the importance of labor allocation, the types of livelihood chosen to fit with swidden farming and the extent to which such limited labor is allocated is the key to successfully diversifying livelihood into commercialization, while keeping subsistence-oriented farming in the portfolio year round. To discuss this issue, we examine a case in northern Laos where swidden farming is persistence while increasing opportunities for non-farm jobs and commercial farming.

The purpose of this article is to examine labor allocation in swidden-combined livelihood diversification through an analysis of the livelihood portfolio, annual working hours, and seasonal changes in working hours for individuals in a village in northern Laos. The current research is a case study on subsistence farming-based livelihood diversification that will be useful in livelihood diversification studies, and will contribute to labor allocation studies in farm-based societies. The research may also expand swidden farming studies by suggesting that this type of farming is the cornerstone, while subsistence and commercial farming are mutually supplemental.

MATERIALS AND METHODS

Swidden farming and livelihood changes in northern Laos

In northern Laos, swidden farming has faced pressure for eradication mainly due to the Land and Forest Allocation Policy that was implemented in 1996 for rural development (e.g. Fujita and Phanvilay 2008; Castella et al. 2013). The Laotian government aimed to increase household income by replacing swidden farming with permanent farming, including wet rice and cash crop cultivation. The villagers’ access to the forest was restricted, resulting in a shortened fallow period; further, a decrease in agricultural productivity was caused by an increase in labor requirements and land degradation. In addition, the policy increased population pressure due to the restricted access to the land. These actions made it difficult to continue the
Swidden farming system; in turn, subsistence-oriented livelihood was forced to be replaced with other livelihood activities. Simultaneously, infrastructure has been improved, accompanied by the spread of a market economy over the rural economy. Improvements in road conditions, increased communication due to the diffusion of mobile phones, and greater connections among neighboring countries regarding business has amplified the opportunities for smallholders to find valuable cash crops, as well as on-farm and off-farm jobs, instead of swidden farming (Bouahom et al. 2004). Rubber trees, maize, and bananas intended for the Chinese market expanded to lands that were formerly fallow forests used for swidden farming (e.g. Vongvisouk et al. 2014: Manivong and Cramb 2008). Younger generations have moved to urban areas seeking non-farm jobs, which has resulted in labor shortages within the household. Thus, swidden farming will decline due to labor competition, as workers engage in other activities instead of diversifying the household’s livelihood portfolio into non-farm and off-farm activities (Bouahom et al. 2004).

Swidden farming in northern Laos has been portrayed in a negative light in terms of agricultural productivity and as an income source. Roder (1997) claimed that, referring to Boserup (1965), swidden farming in Laos will shift to a more intensive agricultural system; as such, the shortened fallow period, caused by an increase in population pressure, will result in excessive labor requirements for weeding to maintain crop production. Bouahom et al. (2004) also stressed that due to the hardness caused by land use intensification on the slopes, the upland village will have to diversify their livelihood to include non-farming activities. However, swidden farming in northern Laos is still persistent in villagers’ livelihood portfolios to a decent extent. A study conducted in Luang Namtha province reported that swidden farming positively effects the household economy by expanding and intensifying farming practices through an increase in opportunities for purchasing fertilizers and seedlings; however, a number of households shifted entirely to cash crops or non-farm activities (Vongvisouk et al. 2014). Presumably, the villagers who retained swidden farming in their livelihood portfolio likely allocated profit, to some extent, from other income sources to purchase agricultural materials for swidden farming. In such a case, production from swidden farming, regardless of satisfying a sufficient level, could aid in food security rather than contribute to household income. Thus, a villager who can allocate a decent amount of labor to swidden farming are able to secure their life due to attenuate labor competition or self-exploitation.

The research site

The study occurred in Poung Pao village in the Phoxay district of Luang Prabang Province, approximately 80 km from the provincial capital (Fig. 1). As with other upland villages in northern Laos, the livelihood in Poung Pao is rapidly being commercialized and diversified in terms of cash income sources (Phouyyavong et al. 2019). While swidden farming is still a leading source for food, cash-earning activities such as cattle raising, cash crop cultivation, and non-farm jobs have become significant activities.

The residential area is approximately 400 m above sea level, and is surrounded by mountains ranging from 1000 to 1400 m in elevation. Distinct wet and dry seasons occur from May to September and October to April, respectively.
The annual rainfall fluctuates considerably, measuring 928 mm in 2006 and 2267 mm in 2011. Temperatures remain relatively stable throughout the year, but tend to be higher in the wet season and lower in the dry season. As of 2017, the village population was 826, with 132 households. Most villagers belong to the ethnic groups Hmong and Khmu; these are the predominant ethnic groups in northern upland Laos (Epprecht et al. 2018).

METHODS

Semi-structured household interviews were conducted in August 2017 with 53 out of the 132 households in the village. The participating households included those who were available at the time of the survey and were willing to be interviewed. Household heads were interviewed regarding family composition, the sex and age of each family member, economic activities, and monthly time use for each family member per economic activity in 2016. In addition, the number of plots and total area of arable land that the household owns were viewed as asset variables.

The monthly working hours for family members were estimated by the household heads if the family members were not available, as some had left the village for schooling, as temporary migrant workers, or to work in the fields. The cropping calendar for farming activities is very similar among households, and we cross checked the information with other households. Thus, we can secure the accuracy of time spent for farming activities. However, for non-farm jobs performed by other members of the household who temporarily stay in Luang Prabang or another urban area nearby, the household head could not indicate accurate working hours. Instead, the number of working days were indicated. Thus, we used 8 hours per day (official number of working hours per day in Laos) to calculate the time spent working non-farm jobs. Although it may not be an accurate working time for the non-farm job, 8 hours per day is common in daily labor in Laos and it should not cause any errors in the analysis. In addition, The economically non-active population in the village, which included those who were physically and mentally disabled, house makers, or permanently working in other regions, were excluded from the sample. As a result, 168 individual samples were obtained (Table 1). After excluding those aged less than 20 years old, 133 individual samples were ultimately analyzed. The annual working hours of those less than 20 years old was negligible, less than 1 hour/day on average for the year, as it consisted mostly of students who were studying in an urban area during the week.

Livelihood portfolio

There were 17 livelihood activities included as a result of the interviews (Table 2). In order to simplify analysis, these activities were divided into eight classifications based on their characteristics. Cattle were separated from...(Fig. 2)
livestock as an independent classification since cattle raising was the predominant economic activity, as well as a cash income source, in this village (Phouyyavong et al. 2019). There was only one woman who claimed to grow vegetables. Since the vegetable farming was an exceptional case in this village, it was excluded from the analysis. Swidden farming was mainly for self-sufficiency, while other activities were related to cash earning activities in the local market with the exception of livestock. Livestock was used for both earning cash and self-sufficiency. Forage cultivation was used for feeding cattle through a rotational grazing system (Phouyyavong et al. 2019).

Since villagers usually engaged in pluriactivity, the total number of individuals in the livelihood classification

| Livelihood               | Total | Hmong | Khmu | Household cash income (LAK*) |
|--------------------------|-------|-------|------|-----------------------------|
|                          | Female | Male  | Female | Male          | Mean | se   |
| Swidden farming          | 97     | 25    | 26    | 51            | 276,604 | 142,911 |
| dry rice                 | 97     | 25    | 26    | 51            | 276,604 | 142,911 |
| Forage cultivation       | 75     | 31    | 35    | 66            | 1,133,042 | 327,602 |
| Cash crops               | 35     | 16    | 17    | 33            | 283,019 | 283,019 |
| job’s tears              | 13     | 6     | 7     | 13            | 283,019 | 283,019 |
| maize                    | 21     | 9     | 10    | 19            | 283,019 | 283,019 |
| sesame                   | 1      | 1     | 0     | 1             | 283,019 | 283,019 |
| Plantations              | 62     | 24    | 27    | 51            | 1,133,042 | 327,602 |
| rubber                   | 47     | 21    | 23    | 24            | 1,490,612 | 524,508 |
| teak                     | 15     | 3     | 4     | 7             | 775,472  | 391,657 |
| Cattle raising           | 52     | 16    | 32    | 48            | 3,209,434 | 1,033,535 |
| Livestock                | 103    | 41    | 21    | 62            | 475,401  | 118,059 |
| buffalo                  | 6      | 2     | 1     | 3             | 471,698  | 330,593 |
| pig                      | 40     | 12    | 7     | 19            | 728,302  | 262,239 |
| poultry                  | 57     | 27    | 13    | 40            | 701,604  | 203,967 |
| NTFPs                    | 43     | 12    | 10    | 22            | 609,038  | 173,837 |
| Wage laborer             | 49     | 4     | 11    | 15            | 1,933,906 | 525,703 |
| off-farm laborer         | 25     | 4     | 6     | 10            | 1,801,699 | 682,847 |
| employee                 | 6      | 0     | 2     | 2             | 1,929,283 | 851,054 |
| trading (self-employment)| 8      | 0     | 1     | 1             | 3,495,283 | 1,775,964 |
| other non-farm laborer   | 10     | 0     | 2     | 2             | 509,359  | 233,920 |
| Other                    | 1      | 0     | 0     | 0             | 0        | 0     |
| vegetables               | 1      | 0     | 0     | 0             | 0        | 0     |
| Total                    | 517    | 169   | 179   | 348           | 348      | 96    |

* LAK: Lao Kip, Laos’ National Currency (1 US$=8,806 kip) according to Banque Pour Le Commerce Exterieur Lao Public, dated 15th October 2019
and engaging in economic activities was larger than the sampled population. Although annual income from swidden farming was less than that of other activities, this was the second most popular activity for the villagers following livestock raising; this implied that swidden farming was one of the main or complementary livelihoods in the individual’s livelihood portfolio.

ANALYSIS

Livelihood portfolio

To visualize the similarity of each individual’s livelihood structure, a non-metric multi-dimensional scaling (NMDS) was performed. NMDS is one type of multivariate data analysis that is widely applied in ecological studies and is increasingly being used in the social sciences (Woods et al. 2018; Hout et al. 2013). Since it does not require assumptions on the distribution of the underlying data, NMDS is a widely applicable ordination technique in multivariate data analysis (Jiang et al., 2010; Gu et al. 2018). The sum of the individual’s monthly working hours for each livelihood category was used to determine annual working hours for each individual and livelihood category. Then, the data were ordinated using the metaMDS function with Bray-Curtis dissimilarity in the vegan package in R version 3.6.1 (permutation=100). The relative location of each individual’s livelihood structure was plotted in the ordination space, then over-layered with the location of the livelihood categories. The location of a livelihood structure closer to a livelihood category can be interpreted as an individual uses more time for that category than other livelihoods.

A permutation-based analysis of variance (PERMANOVA) was implemented in the vegan function adonis (permutation =999). The distance matrix was calculated using Bray-Curtis dissimilarity, then the influence of variables such as ethnic group (the Hmong or the Khmu), age, sex (male or female), landholding size (ha), household size, and household (household’s categorical ID) were tested. The ethnic group variable is used as an index of mixed assets that include natural capital (land), human capital (skills and knowledge), and financial capital. These ethnic groups have contrasting capitals stemming from livelihood history (Phouyyavong et al. 2019): the Hmong have communal lands in the natal village while the Khmu do not; the Hmong possess the knowledge to grow forage crops and raise cattle to a larger extent than the Khmu; the Hmong have more financial capital from lucrative agriculture (e.g. opium cultivation) than the Khmu. The household was used as a categorical variable that indicates if all individuals that belong to the same household have a similar livelihood structure; the variable also represents the household’s assets that villagers were reluctant to report. Households are likely to use more land than stated, as they often cultivate unauthorized land (Phouyyavong et al. 2019).

Annual working hours

ANOVA type III was performed in the car package in R to test if mean annual working hours vary based on demographic variables (sex, age cohort [20 to 29 years old, 30 to 39 years old, 40 to 49 years old, 50 to 59 years old, and older than 60 years old], and household size), as well as socio-economic variables such as ethnic groups, number of plots, landholding size (ha), annual income (Lao kip (LAK)), and number of livelihood activities. In addition, the omega squared was computed to estimate the effect size of each variable using the sjstats package in R. The omega squared is less biased, and is therefore recommended for estimating the effect size in n-way ANOVA (Ialongo 2016). Then, Tukey’s HSD test was implemented for the variables with a larger effect size.

Monthly working hours

The peak months for monthly working hours based on ethnic group and sex were identified by visualizing the monthly changes in working hours over the course of the year. The ratio of the number of individuals who engaged in each livelihood category was calculated for sex, ethnic group, and month; then, we extracted the livelihood categories that were a particularly large portion of its ratio. Finally, ANOVA type III was performed to examine which variables (sex, ethnic group, age cohort, and livelihood categories) are significantly related to monthly working hours during the peak period. Next, the effect size of each variable was estimated by calculating omega squared. Tukey’s HSD test was implemented on the variable that was likely to explain its working hours to demonstrate the differences in hours between the categories.
RESULTS

Livelihood portfolio of individuals

The result of the NMDS was interpretable for analysis since the stress value was less than 0.2 (Clarke 1993). The livelihood portfolios of individuals belonging to the same ethnic group were closer in distance, although some individuals overlapped or were close to one another regardless of ethnic group (Fig. 3). The results can be grouped into three types. The first type diversified their livelihood portfolio into commercial farming with a plantation, forage crop cultivation, cattle raising, or cash crops; they are mostly Hmong. The second type included those that were persistence to subsistence-oriented with swidden farming and NTFPs. The third type, that were leaving farming to become wage laborers, were mostly Khmu. Of the 45 individuals who included wage laborer as part of their livelihood portfolio, 15 individuals (33 %) spent more than 50 % of their working hours as wage laborers, and 5 individuals (10 %) devoted all of their working hours as wage laborers.

All of the demographic and socioeconomic variables were significantly related to the individual’s livelihood portfolio at a 1 % significant level (Table 3). R-squared values, which were the sums of the squares column divided by its total, among these variables were higher in household and ethnic group, and lower in age, sex, household size, and landholding size. The R-squared values of household and ethnic group were 0.50487 and 0.14728, respectively, whereas this value ranged from 0.01263 to 0.02455 for other variables. This could be interpreted as household and ethnic group variables can explain 50 % and 15 % of the distance between samples, respectively, whereas other variables explained less than 3 % of the distance. The higher R-squared value of household and ethnic group indicated that household members and individuals belonging to the same ethnic group were likely to have similar livelihood portfolios.

Annual working hours

The differences in annual working hours among age
cohorts and the number of livelihood activities were remarkable, although the effect sizes of other variables related to demography, assets, and annual income were small (Table 4). The effect sizes suggested that 14.5% and 17.0% of the variance in age and the number of livelihood activities was attributable to the differences in annual working hours, while other variables explained less than 1.0% of the difference between them.

The mean annual working hours of the individuals in their 30s (30 to 39 years old) and 40s (40 to 49 years old) was significantly larger than that of the other age cohorts (Fig. 4). Those aged 30 to 49 years old spent 1170 to 1982 hours a year in 95% confidence intervals (95% CI), whereas the range of mean annual working hours for other age cohorts were from 776 to 1231 hours. In the confidence interval, 7.4% of working hours of individuals aged 30 to 49 were compatible with 13.3% of that of other age cohorts. In addition, mean annual working hours for individuals increased with the number of livelihood categories (Fig. 5). The annual working hours of the villagers with one or two livelihood categories ranged from 548 to 1031 hours in 95% CI, whereas those with 5 to 7 categories were from 1212 to 2342 hours. Converting mean annual working hours to daily working hours, the upper figure of daily working hours for individuals aged 30 to 49 years old was 5.4. In addition, the upper figure of mean annual working hours for individuals with the most diverse portfolio was 2342 hours, which can be converted to 6.4 hours per day.

Assets and annual income were not strong variables in explaining the difference in annual working hours. The 95% CI for Hmong and Khmu ranged from 1032 to 1626 hours and 848 to 1450 hours, respectively. For approximately 70% of those, the intervals were compatible. In addition, returns of work could be small since the effect size of annual income was $\gamma = 0.003$; however, working hours

| Table 3. PERMANOVA analysis on livelihood portfolio |
|---------------------------------------------------|
| df | Sums of squares | Mean squares | F. Model | $\mathbf{R^2}$ | Pr ($\spacebar F$) |
| Demographic variables |
| Age (years) | 1 | 0.698 | 0.6983 | 5.503 | 0.01953 | 0.001 |
| Sex | 1 | 0.877 | 0.8777 | 6.917 | 0.02455 | 0.001 |
| Household size | 1 | 0.510 | 0.5105 | 4.023 | 0.01428 | 0.002 |
| Socioeconomic variables |
| Landholding size | 1 | 0.452 | 0.4517 | 3.560 | 0.01263 | 0.005 |
| Household | 49 | 18.049 | 0.3684 | 2.903 | 0.50487 | 0.001 |
| Ethnic group | 1 | 5.265 | 5.2652 | 41.493 | 0.14728 | 0.001 |
| Residuals | 78 | 9.898 | 0.1269 | 0.27686 |
| Total | 132 | 35.75 | | 1.00000 |

| Table 4. Results of ANOVA type III on annual working hours |
|---------------------------------------------------------------|
| Sum of Squares | Df | F value | Effect size* | Pr ($\spacebar F$) |
| (Intercept) | 92769 | 1 | 0.2954 | 0.58781 |
| Demographic variables |
| Sex | 878186 | 1 | 2.7960 | 0.09708 |
| Age cohort | 5344914 | 4 | 4.2543 | 0.00295 |
| Household size | 366109 | 1 | 1.1656 | 0.28245 |
| Socio-economic variables |
| Ethnic group | 1038179 | 1 | 3.3054 | 0.07153 |
| The number of plots | 531496 | 1 | 1.6922 | 0.19578 |
| Landholding size (ha) | 687933 | 1 | 2.1903 | 0.14149 |
| Annual income (LAK) | 1775983 | 1 | 5.6544 | 0.01898 |
| The number of livelihood | 11674233 | 1 | 37.1686 | <0.00001 |
| Residuals | 38004682 | 121 | | |

*:Estimated by omega squared. This ranges from −1 to 1. No effect=0.
and annual income were positively correlated.

**Monthly working hours of individuals**

There was seasonality over monthly working hours and three peaks in labor demand regardless of ethnic group and sex (Fig. 6). The working hours, which combined ethnic group and sex in 95% CI, increased to 103 to 145 hours in March, then dropped to 76 to 94 hours in April when the rainy season began. After that, it increased to 148 to 209 hours in June, then gradually decreased to 51 to 71 hours in October. In November when the dry season began, the monthly working hours increased to 95 to 134 hours.

This seasonal pattern of monthly working hours was clearly consistent with the cropping calendars of swidden farming, forage cultivation, and plantation (Fig. 7). A decent number for individuals from both ethnic groups worked in swidden farming. In addition, the Hmong were more likely to engage in forage cultivation and plantation than the Khmu. They conducted land preparation and seeding before the wet season, and harvested after the wet season from November to December. During the cropping season for dry rice, they continued to weed the fields. The pasture was burned to replant forage crops or facilitate re-germination before the rainy season arrived. Then, workers weeded throughout the rainy season. The teak plantations were also weeded during the rainy season, and the weeding and tapping of rubber trees occurred during this time as well. The villagers claimed that they never applied agrochemicals such as herbicides, pesticides, or fertilizers regardless of cultivated crops.

Other clear differences between the ethnic groups occurred in non-seasonal work such as cattle raising and wage laborers, as villagers allocated smaller amounts of labor towards them. The Hmong, especially the Hmong male, participated in cattle raising, whereas the Khmu worked non-farm and off-farm jobs throughout the year. The number of individuals who worked for livestock, particularly poultry and pigs, was larger for both ethnic groups throughout the year. Mean monthly working hours for cattle raising by the Hmong male ranged from 36.43 to 43.69 in 95% CI. The Khmu worked as wage laborers for 6.91 to 7.46 hours per month in 95% CI. Both ethnic groups spent only 1.67 to 1.75 hours a month in 95% CI with livestock.

**Livelihood portfolio and working hours during the peak period**

The livelihood portfolio of individuals during the peak period from May to August was classified based on swidden farming (S), forage cultivation (F), and plantations (P) (Table 5). The livelihood portfolio was more varied among Hmong individuals, while the Khmu were inclined to include swidden farming. In total, 79% of Hmong and 72% of Khmu individuals who worked during the period were engaged in swidden, forage, plantation, or some combination. Forty five % of the employed Hmong and 67% of the employed Khmu embraced livelihood portfolios that included swidden farming (S, SF, SP, and SFP). In addition, 37% of the Hmong worked for forage, plantations, or some combination (F, P, and FP).
The effect sizes of all factors were remarkably small except for livelihood combination (Table 6). The effect size of livelihood combination suggested that 31.8% of the variance in livelihood combination was attributable to the differences in working hours in the peak period (Table 6). The effect sizes for individuals with more than 2 livelihood categories in their livelihood portfolio were significantly larger than those for individuals who devoted their working time to swidden, forage, or plantations (Fig. 8). Monthly working hours for individuals with livelihood portfolios that included swidden, forage, or plantations was 111 to 142 hours in 95% CI, whereas the portfolios that included two
of them was 169 to 243 hours, and 206 to 442 hours in portfolios that combined all of them. Approximately 50% of the double and 16% of the triple were compatible. Mean monthly hours can be converted to daily working hours as 3.7 to 4.7 hours in single, 5.6 to 8.1 hours in double, 6.9 to 14.7 hours in triple combinations of swidden, forage, and plantations.

The labor allocation for swidden, forage, and plantation widely varied among individuals when placing more than 2 into their livelihood portfolio. The ratios in monthly working time during the peak period from May to August between the livelihood categories were wide in the range of distribution (Fig. 9). As an example, the range of the ratio for individuals with swidden and forage (F/S) was 2.7 to 0.9; this indicated that while there was an individual who allocated 2.5 times more working hours to swidden than to forage, another individual used only 7% of the working hours of swidden for forage.

In the swidden-combined livelihood portfolio (SF, SP, SFP), the results were mixed (Fig. 9). In the combination of forage and swidden, more than 50% of individuals allocated longer or similar hours to swidden, as revealed by the medians of F/S in SF and SFP which were 0.3 and 0.0, respectively. Conversely, more than 50% of individuals did not spend longer hours for swidden in the combination of plantations and swidden. The medians in both P/S in SP and SFP were 0.2. In the combination of forage and plantation, individuals spent more hours on forage in FP, whereas it was the opposite in SFP.

**DISCUSSION**

**Plausible determinants of individual’s livelihood portfolio**

Although swidden farming and forage cultivation were not critically important as household income sources, villagers devoted a significant amount of time to its cultivations. Reflecting this reality of rural economy, the individual livelihood portfolios can be roughly divided into

| Table 5. The number of individuals who worked during the peak season from May to August by livelihood combinations |
|---------------------------------------------------------------|
| **Swidden (S): Swidden and other livelihoods without forage cultivation and plantations** | Total | Hmong | Khmu |
| | 173 | 48 | 125 |
| **Forage (F): Forage cultivation and other livelihoods without swidden farming and plantations** | 44 | 35 | 9 |
| **Plantations (P): Plantation and other livelihoods without swidden farming and forage cultivation** | 38 | 37 | 1 |
| **SF: Mixed of swidden, forage cultivation and other livelihoods without plantations** | 59 | 43 | 16 |
| **SP: Mixed of swidden, plantation and other livelihoods without forage cultivation** | 30 | 20 | 10 |
| **FP: Mixed of forage, plantations and other livelihoods without swidden farming** | 31 | 31 | 0 |
| **SFP: Mixed of swidden, forage, plantations and other livelihoods** | 29 | 29 | 0 |
| **Other: Cattle raising, cash crop cultivation, livestock raising, NTFPs collecting or wage laborer** | 128 | 65 | 63 |
| **Total** | 532 | 308 | 224 |

| Table 6. A result of ANOVA type III on monthly working hours |
|-----------------------------------------------|
| **Sums of Squares** | **Df** | **F value** | **Effect size** | **Pr (F)** |
| Intercept | 280912 | 1 | 44.7041 | <0.00001 |
| **Demographic variables** | | | | |
| Sex | 37116 | 1 | 5.9066 | 0.016 | 0.01543 |
| Age cohort | 103275 | 4 | 4.1088 | 0.052 | 0.00276 |
| Household size | 33993 | 1 | 5.4096 | -0.001 | 0.02042 |
| **Socio-economic variables** | | | | |
| Ethnic group | 19161 | 1 | 3.0493 | 0.012 | 0.08139 |
| The number of plots | 683 | 1 | 0.1087 | 0.029 | 0.74182 |
| Landholding size (ha) | 3898 | 1 | 0.6203 | -0.001 | 0.43129 |
| Annual income (LAK) | 79192 | 1 | 12.6025 | 0.001 | 0.00004 |
| Livelihood combination | 1828300 | 7 | 41.5648 | 0.318 | <0.00001 |
| Residuals | 3104203 | 494 | | |

*: Estimated by omega squared. This ranges from -1 to 1. No effect=0.
three types, based on annual time allocation to each livelihood category: 1) having diversified its livelihood portfolio into commercial farming, 2) persistence to subsistence-oriented, and 3) leaving farming. The portfolio that reveals on-farm diversification is likely to allocate more working time towards income-generating activities such as cash crops, plantations, forage cultivation for feeding cattle, and cattle raising. The portfolio geared towards subsistence-oriented farming devotes working time to swidden farming and NTFPs to a large extent. In addition, some villagers devoted their entire livelihood to wage labor. These results were consistent with our observations in the village (Phouyyavong et al. 2019), as well as, partly, the findings from the previous research involving land-use analysis (Vongvisouk et al. 2014) and qualitative research (Bouahom et al. 2004) conducted in other parts of northern Laos.

The most influential factors that determined the individual’s livelihood portfolio were the assets that each ethnic group and each household had; this was indicated in that assets variables, such as ethnic group and household, explained 65% of the distance between the livelihood portfolios. This suggests that assets, such as land, skills, and financial capital that stem from livelihood history, are likely to exert influence on an individuals’ decisions regarding livelihood choice and time allocation. In addition, the range of variety in land type, as the Hmong have communal land while the Khmu do not, could have a positive effect on livelihood diversification to a larger extent than landholding size. Earlier studies also found that diversity in land type is more important for livelihood diversification than landholding size (Martin and Lorenzen 2016; Perz 2005).

Livelihood diversification takes place at the individual rather than at the household. In other words, the individual engages in multiple economic activities, rather than the household consists of members who engage in different
single activity. Maintained a similar livelihood portfolio among household members allows individual to be pluriactive. This is also supported by the finding that effect sizes of age, sex, and labor availability in a household were smaller as explanatory variables for individuals’ livelihood portfolio. This indicates that work is not divided into sex and age to a large extent; household members are likely to work together on their own fields, and share a wide variety of agricultural practices regardless of age and sex.

The results contrast with previous research in livelihood combined subsistence-oriented farming: labor capability to add new livelihood reflects the number of adults in a household (Perz 2005); the younger generation tends to engage in arduous work, while elderly are devoted to relatively light work that requires skill and knowledge (Perz 2001); and younger generations, especially women, are willing to participate in non-farm work (e.g. Bouahom et al. 2004; Martin and Lorenzen 2016). This may be partly due to a biased population, as this study excluded the younger people who are permanently working or studying outside of the village, and did not include the elderly’s small activities, such as handcrafts, into the analysis. Another reason may be the assignment of roles in farming. As an example, hill seeding in swidden farming often requires both sexes, as men dig a hole and women place several rice seeds into the hole. In this case, it may be difficult to conduct swidden farming if one sex engages in other activities.

**Livelihood diversification along with an increase in annual working hours**

In addition to assets being the most important variables determining an individual’s livelihood portfolio, the annual working hours at the individual level is likely to be another variable that heavily influences livelihood diversification. Age and the number of livelihood impact annual working hours to a large extent. Individuals aged 30 to 49 years old work longer hours than other age cohorts, which is likely due to competition in labor allocation with childbearing and childrearing for younger generations, and physical working capacity for older generations. In other words, the elderly work less because of aging, whereas the livelihood portfolio is unlikely to be different than other generations. In addition, villagers are likely to accommodate a wide variety of livelihoods by working more. This type of livelihood diversification is also reported in the Nigerian Savanna (Stone et al. 1990).

Whereas the working hours increase with livelihood diversification, the amount does not seem to be higher than in other agricultural societies. This suggests that the extent of labor intensification is moderate. Working hours for an adult with wet rice and other cash crop cultivations totaled 5.4 hours among the Paori in Hainan, China (Jiang et al. 2006), 6.2 hours for an adult male among the Sundanese in West Java (Moji 1980), 6.7–7.1 hours among the Kebupaten in central Java (Hart, cited in Moji 1980), and 6.3 hours among Javanese in East Java (Edmundson, sited in Moji 1980). The annual working hours among the Kofyar in the Nigerian Savanna with diverse and intensive farming was estimated as 1,599 annual hours, which is equivalent to 4.4 hours/day (Stone et al. 1990). Out of these cases, innovative technologies (e.g. high-yielding varieties) that improved labor productivity were only introduced in Hainan. Whereas a portion of the variation is attributable to methodological differences, working hours in the current village are equivalent or lower than most of the traditional farming systems, except for the case mentioned in Nigeria. The current village case is situated in the lower half of the range of the agricultural societies reviewed (Minge-klevana et al. 1980).

In terms of productivity, hard work in diversification is less likely to increase income. In addition, as seen in other cases (Perz 2005; Ripoll-Bosch et al. 2014), when livelihood includes subsistence-oriented farming and forage cultivation without directly increasing income, it is possible that the villagers are investing their time in order to secure future returns (Ellis 2000).

**Seasonality and competition in labor demand**

As opposed to cases in Malaysia, Nigeria, and southern Laos where farmers combine crops with varying peaks in labor demand (Cramb 1993), shift agricultural practices to avoid overlapping of the peak season (Stone et al. 1990), and participate in non-farm work during the agricultural slack period (Martin and Lorenzen 2016), Pung Pao village had a clear peak period. This is mainly due to overlap in the cropping season for swidden, forage, and plantations. It was found that the more livelihoods in their portfolio, the more work they needed during that period. In particular, individuals whose portfolios contained all of the above mentioned livelihoods worked longer than those who had only one or two. This indicates that livelihood diversification occurs by working harder during the peak period rather than by labor allocation during the slack period. In other words, competition in labor demand is absorbed by self-exploitation.
Whereas the monthly working hours increased with livelihood diversification, its amount does not seem to be extraordinarily higher than other agricultural societies. The daily working hours for an adult during the peak season was 9.5 hours in Hainan (Jiang et al. 2006), and 7.4 hours in the Nigerian Savanna (Stone et al. 1990). The upper figure in the triple combinations for someone who implemented two or three activities on the same day was very difficult to recall; thus, it could be overestimated as those working hours are among the range of mean monthly hours in the double and triple combinations.

Although we can neither deny nor support the predictions from Roder (1997) and Bouahom et al. (2004) that swidden farming will be replaced with other intensive farming or non-farm jobs, it is reasonable to say that swidden farming accounts for a major portion of livelihood, and labor demand for swidden is not as elevated as they had stressed. Weeding during cropping season is arduous, which is critical for dry rice production (Roder 1997). Shortened fallow periods with population pressure increase the labor demand for weeding, which results in diminishing productivity. However, in the case of the Poung Pao village, labor demand for weeding was less likely to be higher than other livelihoods such as forage and plantations. In addition, daily working hours for swidden and other cultivations is likely to be acceptable for villagers, as their daily working hours were 4.0 to 5.3 hours.

On one hand, saving labor for weeding could result in a decrease in labor productivity in the village. Conversely, it is plausible that fallow periods may not be shortened as much as the previous research expected. As widely observed in other areas in northern Laos (Pravongviengkham 2004), swidden farming is likely to be expanded to unauthorized land, such as conservation forests (Phouyyavong et al. 2019). Although labor productivity of swidden farming, in addition to other cultivations, must be further examined, swidden farming could potentially be combined with other commercial farming regarding labor allocation.

Despite the limitation of this cross-sectional study, which does not necessarily aim to provide a clear image for the transition of livelihood in the long run, labor allocation for multiple livelihoods could be changing in a smallholder’s long-range view as claimed in Ellis (2000). Although there was a tendency in the individual’s labor allocation to pursue swidden, forage, and plantations, it is rather risky to say that livelihood is diversified to commercial farming or returning to subsistence. There was a wide range of variations in the labor allocation among individuals, and labor allocation may be changing along with socio-economic changes.

Some villagers claimed that swidden farming was simply idle due to competition in labor with other livelihoods, such as in a case in Malaysia where individuals left swidden farming for a couple of years when the market price of black pepper was high (Cramb et al. 2009). Flexibility to socio-economic changes could be an important facet of livelihood diversification, as socio-economic as well as natural conditions realize its flexibility should be needed to pay greater attention, even if it does not explicitly increase income (Ripoll-Bosch et al. 2014). It is well characterized that an increase in income does not necessarily improve the nutritional status of smallholders (Immink and Alarcon 1993; Wirsing 1985).

CONCLUSION

Assets, such as land, skills, and financial capital that stem from the livelihood history of both ethnic group and household, are likely to exert influence on individuals' decisions regarding livelihood and labor allocation to a large extent. In addition, an increase in annual working hours at the individual level could help diversify livelihood. However, the extent of increased annual working hours does not seem to be higher than other agricultural societies; thus, the extent of labor intensification is unlikely to be high.

There were clear peaks in labor demand, mainly due to overlap in the cropping seasons of swidden, forage, and plantations. Competition in labor demand at the peak period was absorbed by an increase in working hours at the individual level. However, its amount does not seem to be extraordinarily higher than other agricultural societies. In addition, daily working hours for swidden and other cultivations is likely to be acceptable for villagers. Although labor productivity for swidden farming, in addition to other cultivations, must be examined, swidden farming could be a possible option to combine with other commercial farming practices to satisfy labor demand.

This paper cannot propose that livelihood in northern Laos is in a transitional stage, moving entirely towards commercialized livelihood. However, the labor allocation may be changing along with socio-economic changes. Flexibility to socio-economic changes could be an important facet of livelihood diversification, so that socio-economic as well as natural conditions realize its flexibility should be needed to pay greater attention.

This study demonstrated that subsistence farming plays a pivotal role in the livelihood diversification process through an analysis on labor allocation, whereas a series of
studies on livelihood diversification is inclined to focus on income diversification, then which often resulted in undermining subsistence farming in livelihood diversification. Swidden farming is likely to secure livelihood, although it has been cast in a negative light. In addition, we have contributed an important case study focused on Laos to labor allocation studies, as there are few that examine seasonality in smallholder’s livelihood, particularly in Southeast Asia.

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