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*Article*

# Multiple Risk Management during Agricultural Production Shortages in a Mountain Village in Northern Laos—Roles of Forest Resources, Livestock and the Market Economy

**Isao Hirota** [1,*]

[1] Faculty of Applied Biological Sciences, Gifu University, Japan; i_hirota@gifu-u.ac.jp
* Correspondence: i_hirota@gifu-u.ac.jp; Tel.: +81-58-293-2902

**Abstract:** In areas with strongly seasonal climates, local people often use complex strategies to manage agricultural production shortages, including diverse activities such as hunting, selling and consuming non-agricultural products, and wage labor. We surveyed all the households in a village in northern Laos to evaluate how such livelihood activities varied during years with differing agricultural production conditions. We compared two years with normal rice production conditions (2010, 2012) and one year with a severe rice shortage (2011) due to a rodent outbreak. Earning wages inside and outside the village was the most important activity for mitigating rice shortages, followed by selling livestock and using/selling non-timber forest products. Villagers also borrowed rice from a village rice bank. Most cash income was earned from selling rice. We concluded that a balance of traditional risk management activities under the swidden system (e.g., raising livestock) with the more recent rice bank system and wages from the market economy will be critical for the sustainable development of mountain villages in northern Laos. Permanent crops and monocultures tend to make local livelihoods more dependent on a single crop, but maintaining the traditional swidden system will help local people to manage agricultural production shortages.

**Keywords:** Risk management; Laos; livelihood; swidden; upland rice; rice bank; NTFPs; market economy; livestock

## 1. Introduction

Mainland Southeast Asia is characterized by distinct dry and rainy seasons, and the livelihoods of local people in the area have been formed under these strongly seasonal conditions. For many people, livelihoods are still dependent on the natural environment and agricultural production is unstable because of the fluctuation of precipitation. In the mountainous areas of northern Laos, although local people are mainly engaged in upland agriculture such as swidden, they also collect forest products, raise livestock, fish or hunt. Upland rice production often fails to meet food demands, and these additional activities supplement and interlink with each other [1]. For example, forest products with a commodity value are mainly collected in the fallow forests of the swidden land. Cows and water buffaloes are raised in fallow forests and they use fallow forests of different ages because they forage in young fallow land but look for shade in older fallow forest in the daytime to keep cool [2]. Therefore, a patchy arrangement of fallow forest of various ages is important for raising livestock.

Recently, the market economy has spread into the mountainous area of northern Laos and the cultivation of commercial crops such as maize, rubber, bananas, or eucalyptus is expanding in mountain villages. The cultivation areas of commercial crops are large and permanent agriculture on

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hill slopes is now widely conducted. Consequently, local people have become engaged in simpler aggregated activities and many of the activities relating to swidden agriculture have become fragmented [3,4]. However, the introduction of the market economy is also beneficial for local people. It provides various opportunities to obtain cash income not only from commercial crops but also working outside their village [5]. Therefore, it is important to evaluate the dynamics of livelihood change from various aspects for the future sustainable development of local livelihoods.

As mentioned above, local people in the mountainous area of northern Laos historically have engaged in various activities to alleviate different risks from inconsistent agricultural production. The roles of the composite livelihood systems, which can be observed in various regions in tropics, have been studied by many researchers. Case studies in difficult environments for agriculture have been conducted in the Asian arid zone [e.g. 6,7] and Africa [e.g. 8].

However, these studies have analyzed each activity in the composite livelihood system independently. Within the system, each activity is correlated with the others and the strategies for the alleviation of agricultural production shortages are important and often differ in response to the shortage. In addition, although these studies pointed to the importance of cash income from forest products, they were conducted in normal years and did not focus on the strategies of local people to combat extreme shortages of agricultural products. The analysis of these strategies is important for sustainable development in the mountainous area of northern Laos, but little research has been conducted there. Therefore, this study focused on understanding how local people deal with shortages of agricultural production when the production is extremely low and clarified the significance of composite livelihood activities for sustainable development in the mountainous area of northern Laos.

## 2. Materials and Methods

A survey was conducted in Keng Kip village, Xieng Ngeun district, Luang Phabang province (19.673061°N, 102.276059°E, altitude 380 m) from August–September 2011, February, August–December 2012 and February 2013. In this study, the conditions of the village in 2010, 2011 and 2012 were compared. The village was located on the Khan River which is a branch of Mekong River. In the area near the village, a bamboo species (*Dendrocalamus membranaceus*) that is a dominant species in fallow forests in the area flowered gregariously in 2011, and a subsequent rodent outbreak occurred. Rodent outbreaks following the gregarious flowering of bamboo are often observed. In northern Laos, several researchers have reported on the relationship and the damage it causes [e.g. 9,10]. The approximate area of gregarious bamboo flowering in this study is shown in Figure 1. The area covered about 1500 km$^2$. The rodent outbreak had a great impact on the agricultural production of villages located inside the area. Table 1 shows the impacts of rodents on agricultural production in the area reported to the district agriculture and forestry office by villagers in 2011. The Pak Pa and Don Kham villages on the map are not included because these villages belonged to the Phonsai district, and no data on the damage were available. Although the data were anecdotally reported to the district office and there was a lack of actual measurement, the reports indicated the actual situation to some extent and showed the important impacts of the rodent outbreak. The district office received reports from these villages as part of a petition for government help. Local people in the area mostly cultivated upland rice (*Oryza sativa*), Job's tears (*Coix lacryma-jobi*), sesame (*Sesamum indicum*) and maize (*Zea mays*) on their land for agricultural production, and there was rodent damage also to these crops.

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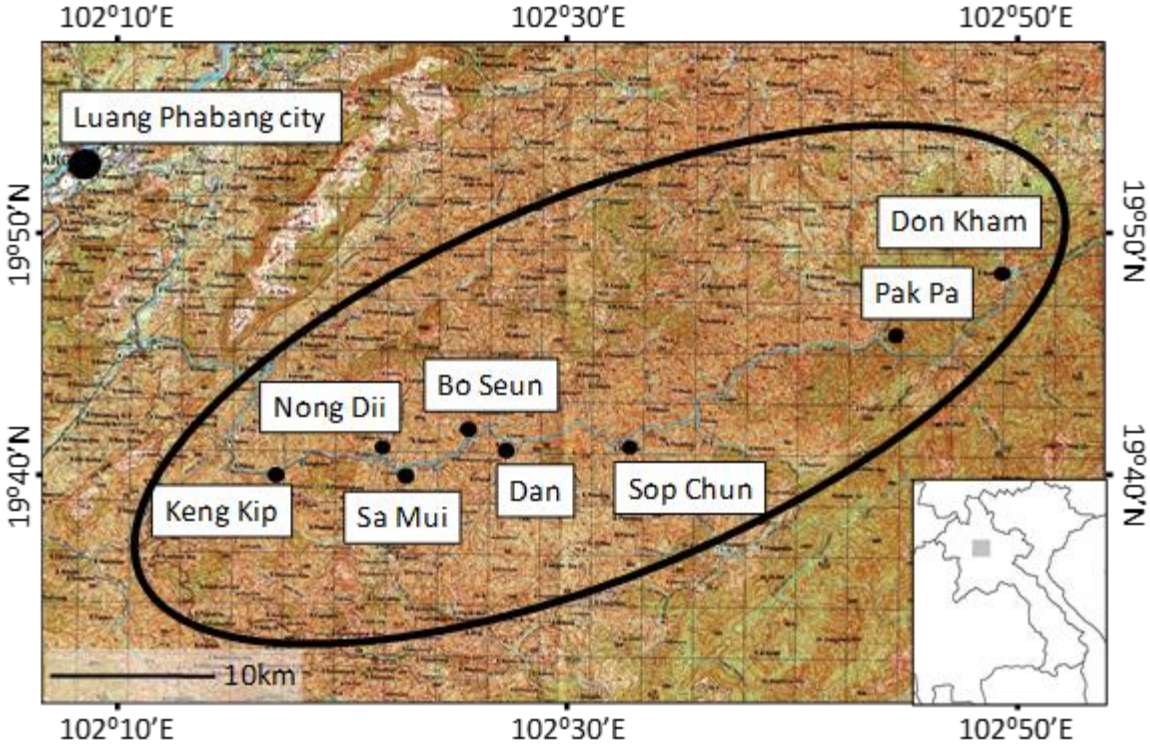


**Figure 1.** Location map of the study site, Keng Kip village, in northern Laos. Black line indicates approximate area of gregarious bamboo flowering.

**Table 1.** Total area and area damaged by rodents of upland rice, Job's tears, sesame and maize reported to the agricultural office of Xieng Ngeun district in 2011.

| Village name | Upland rice | | Job's tears | | Sesame | | Maize | |
|---|---|---|---|---|---|---|---|---|
| | Total area (ha) | Damaged area (ha) | Total area (ha) | Damaged area (ha) | Total area (ha) | Damaged area (ha) | Total area (ha) | Damaged area (ha) |
| Dan | 48.0 | 38.4 | 25.2 | 18 | 18.7 | 13.4 | 13.4 | 12.3 |
| Nong Dii | 34.4 | 20.4 | 5.2 | 4.2 | 5.8 | 3.8 | 9.8 | 4.8 |
| Sa Mui | 20.4 | 14.8 | 5.9 | 5.55 | 11.3 | 7.1 | 11.0 | 9.1 |
| Bo Seun | 44.0 | 36.91 | 2.0 | 1.8 | 52.7 | 41.7 | 26.1 | 21.7 |
| Sop Chun | 47.3 | 24.2 | 28.7 | 23.8 | 14.4 | 11.1 | 6.6 | 4.8 |
| Keng Kip | 19.95 | 11.0 | 10.7 | 10.7 | 7.8 | 4.7 | 14.3 | 9.7 |

In the study village, there were 38 households and its population was 210 in 2010. One household was divided into two because of marriage and in 2011 the total number of households in the village was 39 and its population was 213. In 2012, two households moved to other villages, with 37 households remaining, with a population of 204. The village was composed of the Khamu ethnic group. The Khamu people are the second largest group in northern Laos and they are well known as traditional swidden farmers [11]. The people of the village also were historically engaged in swidden aquiculture.

To learn the dynamics of livelihood strategies to cope with a drastic shortage of agricultural production, interviews were conducted with all households. The interview concerned the agricultural production, collection of non-timber forest products (NTFPs), fishing, hunting, working outside the village, borrowing and lending rice, employment inside the village, jobs, salaries, and

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livelihood strategies of each household, and the damage experienced from the rodent outbreak. These items were used in an interview survey to clarify the situation in 2010, 2011 and 2012. In the present study, the year 2010 was determined to last from after harvesting of rice in 2010 to before harvesting rice in 2011 and so on, because the local economy in the village rotates mainly around rice and the defined year fits the dynamics of local livelihoods well. To verify the damage reported by villagers, the location of the swidden field of each household was identified and the area was measured using GPS and GIS software (ArcGIS 10, ESRI, Redlands CA). After the area calculation, an interview of damage was conducted again to fill in potential information gaps of damage between the interview and the actual damage because the villagers were likely to report more damage than actually occurred to get support from the government.

## 3. Results and Discussion

The rodent outbreak was observed during the planting season of crops in swidden fields, from late April to May. Although the detailed ecology and system of rodent outbreaks related to bamboo flowering is not clear yet from previous studies [e.g. 10,12], rodents are considered to aggregate to eat the seed of bamboo species and subsequently invade swidden fields and attack upland crops. In the area, the dominant plant species in fallow forests was *D. membranaceus*. The species mainly flowered in January and February, and the seed matured during April and May when swidden farmers planted upland crops. Villagers reported that the rodents ate seed and young shoots of rice, Job's tears, sesame and maize. The rodents appeared mainly at night and villagers dealt with them all night. In the swidden fields, severe damage was found in the southeastern block of village swidden fields. One reason was that when many households cultivated land together, they could protect their crops from rodents together. However, if the size of the plot was small and few households cultivated land together, then the labor force was also smaller and the damage was likely to be greater. According to the villagers, rodents came to attack in large numbers, too many to kill, although villagers also caught rodents for food. In cases where there was not enough rice for consumption by the household, villagers ate cassava, glutinous maize, wild taro and wild yam in addition to rice.

Table 2 shows the average number of months of rice shortage in 2010, 2011, 2012. Generally, in northern Laos, even when there is not enough rice in a household, people sell rice to earn much needed cash. Thus, to clarify the situation of self-consumption inside a household, it is not enough to ask about the amount of buying or selling rice and it is necessary to ask about rice shortages in a household. Table 2 indicates that even in 2010 and 2012, the average rice shortage of the village was 2.6 and 2.1 months, respectively. However, the rice shortage in 2011 was more severe and lasted for 5.8 months, almost half a year on average. The months of rice shortage in 2011 were significantly more than those in 2010 and 2012 (Tukey test, at the 5% significance level). The number of households with enough rice throughout the year was 14 (36.8%) in 2010, 1 (2.6%) in 2011, and 17 (45.9%) in 2012, respectively. In 2011, local people covered the rice shortage by eating other upland crops as mentioned above, and through other activities such as working inside or outside the village, selling their livestock, collecting NTFPs for sale and self-consumption, selling teak owned by themselves as timber, fishing and hunting. Table 3 shows the most important and second most important kinds of activity villagers recognized for buying rice. Most villagers thought wages from working inside and outside the village were the most important activity for covering rice shortages, followed by selling livestock, collecting and selling NTFPs and a salary. The second most important activities by villagers were collecting and selling NTFPs followed by wages from working inside and outside of the village, selling livestock, selling timber, fishing and hunting. Wages came from various activities such as driving trucks or boats, constructing roads and buildings, digging holes for seedlings in rubber tree plantations in other villages, making handicrafts, harvesting and processing timber, helping with weeding and harvesting in swidden fields and transporting rice after harvesting inside and outside the village. Among NTFPs, broom grass (*Thysanolaena maxima*) and paper mulberry (*Broussonetia papyrifera*) were recognized as important plants by villagers. In this area, the Khamu people are well-known as the ethnic group with good techniques for processing

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timber, and other ethnic groups such as the Hmong people often asked them to process timber. The Khamu people can earn cash from other groups, and it was observed that the skills of the Khamu people in the local networks between ethnic groups contributed to their severe rice shortages. In addition to the activities mentioned above, money was also transferred from relatives in other villages in five of the village households. It was also observed that one household could not earn any money and was dependent on help from relatives inside and outside the village because the family members were all old and could not engage in any work.

**Table 2.** Average months of rice shortages in 2010, 2011 and 2012.

| | 2010 | 2011 | 2012 |
|---|---|---|---|
| Average of months of rice shortage | 2.62[a] | 5.86[b] | 2.1[a] |

Different alphabet means significant difference at 5% level.

**Table 3.** The most and second most important activity to cover rice shortages mentioned by villagers.

| Activity mentioned by Villagers | 1st | 2nd |
|---|---|---|
| Collection and Selling NTFPs | 6 | 15 |
| Wages | 19 | 13 |
| Selling Livestock | 13 | 8 |
| Fishing | | 1 |
| Hunting | | 1 |
| Salary | 1 | |
| Selling Timber | | 1 |

Borrowing rice was also observed in the village, using a system based on a 'rice bank'. In the village, more than half of households did not have enough rice through the year even in a normal year as was shown in Table 2 (14 households in 2010 and 17 households in 2012) and borrowing rice was common in the village. If villagers wanted to borrow rice, they borrowed rice before harvesting their own rice in swidden fields and they returned the rice after their harvest. The rice which most villagers borrowed was stored in the village and was managed by a village head. When returning rice, villagers paid interest on the borrowed rice at a rate of 40%. Thirty households used the rice bank in 2011. Only five households borrowed rice from relatives in 2011, because the interest rate in that case was 100% and higher than the rate from the rice bank because of rice shortages in the whole village. Thus, borrowing rice from relatives inside the village was limited to cases of urgent need and small amounts.

Figure 2 shows the comparison of cash income in 2010, 2011 and 2012. The items are incomes from rice, commercial crops, livestock, NTFPs, wages from working inside and outside the village, fishing and borrowing rice. The item of borrowing rice was included in the figure because it represented the situation of many villagers in 2011, and was treated as cash income to compare with other items in the figure. Maize, Job's tears and sesame were included in the commercial crops. The price of rice, maize, Job's tears and sesame were calculated as 2000 kip/kg, 1000 kip/kg, 2500 kip/kg and 10000 kip/kg, respectively, based on most interview results on the price of these items. As shown in Figure 2, rice was the most important item for cash income in the village. Even in 2011, rice was sold inside and outside the village. As shown in normal years like 2010 and 2012, rice was the main cash income source as well as being the staple food, and it was important for local people to exchange rice for cash. In normal years, the income from rice was followed by NTFPs, commercial crops, livestock and fishing. The production of rice and commercial crops in 2010 was lower than that in 2012, because drought during the sowing period damaged these crops according to villagers. However, villagers did not consider that the fluctuation was severe. However, in 2011, the situation

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of cash income from rice, commercial crops, livestock, wages from working inside and outside of the village and borrowing rice was different from that in normal years. As mentioned above, the production of rice and commercial crops decreased in 2011 because of a rodent outbreak while income from livestock, wages from working inside and outside the village and borrowing rice increased to cover the rice shortage. Income from fishing in 2011 and 2012 was higher than that in 2010, however, the amount did not contribute more to the total income than other items. The village was located on the Khan River and fishing was a common activity. The data indicated that fishing contributed more to food consumption than to cash income.

For NTFPs, income in 2010, 2011, 2012 was not significantly different. In previous studies, NTFPs have been considered as important sources of cash income [e.g. 13,14]. In this study, NTFPs were also an important cash income source in normal years and in the year of severe rice shortages. However, because of the limitation of seasonal collection of NTFPs, they did not increase in importance in the severe year like other items such as cash income from livestock, wages from working inside and outside the village, and borrowing rice. The latter items were ways to generate cash easily and these were available through the year. Livestock included cows, water buffalo, pigs and poultry. Among these livestock, cows and water buffalo were raised in the swidden system especially in young fallow fields. In previous studies, fallow fields were considered to be important habitat for NTFPs [e.g. 15] and many researchers have pointed out the role of fallow forest in the swidden system from the viewpoint of collecting NTFPs. This study revealed the importance of fallow forests in the swidden system for raising livestock. NTFPs played an important role in normal years and livestock were important in the year of severe rice shortages. Fallow forest, therefore, contributed both in normal years and in years of severe rice shortages.

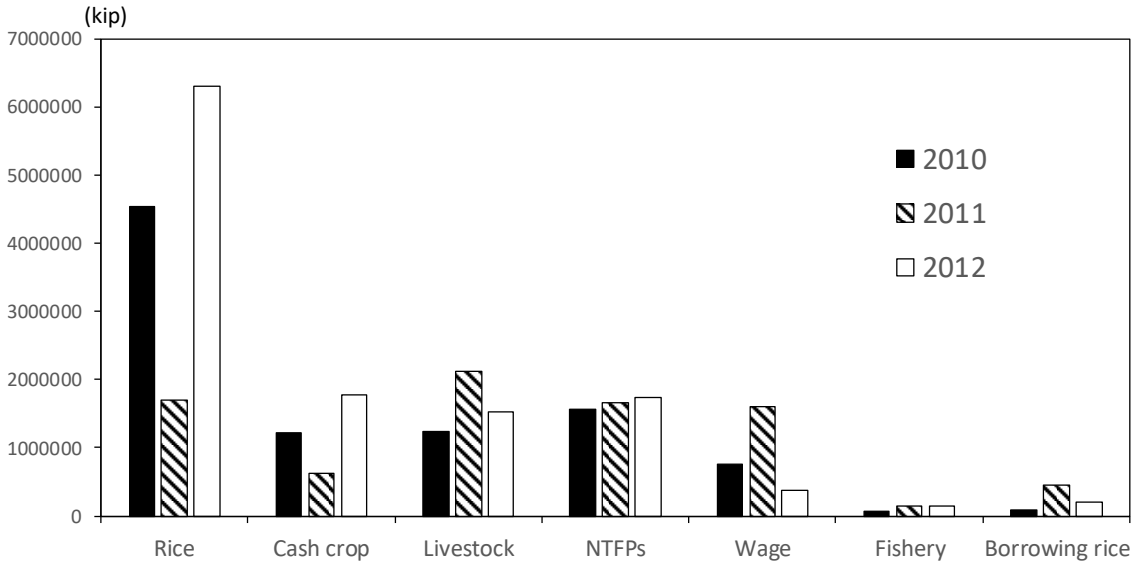


**Figure 2.** Incomes from rice, commercial crops, livestock, non-timber forest products (NTFPs), wages from working inside and outside the village, fishing and borrowing rice in 2010, 2011 and 2012.

Figure 2 shows that the wages from working inside and outside of the village were also important for villagers in the year of severe damage to upland crops. As shown in Table 3, villagers recognized wages were important in the year of severe shortages. As mentioned above, these activities included various jobs such as truck driver, boat driver, road and building construction, digging holes for rubber tree seedlings in rubber tree plantation in other villages, making handicrafts, bringing and processing timber, helping weed and harvest in swidden fields and transporting rice after harvesting inside and outside the village. Among these activities, the income source from activities relating to swidden agriculture such as helping with slashing (6.0%), weeding (18.5%), harvesting (17.3%) and transporting (11.4%) was the highest cash income source (totaling 55.2%) in 2011. Wage income from physical labor such as building or road construction and digging

holes for seedlings in rubber tree plantations was of secondary importance. The income from physical labor counted for 33.9% of the total wage. Villagers considered these activities important (Table 3) and saw them as easier ways to get money than other activities such as working in swidden fields. Physical labor activities were correlated to market demand in northern Laos. Although Keng Kip village was not located along the paved or major roads and only had a minor road and the Khan River for access and was far from a city, villagers were developing more opportunities and access to markets by using trucks, motorbikes and boats. The influence of the market economy was growing and their livelihoods began to diversify into market-based livelihoods, although they also kept traditional swidden systems and continued to cultivate upland rice and raise livestock in fallow forests which had various kinds of NTFPs.

Although wages from processing woods counted for only 4.3% despite the special skills of the Khamu ethnic group, there is an indication that the data may underestimate the actual situation because villagers also obtained processed woods with a commercial value as part of the fee for their labor, in addition to cash, which is difficult to calculate and convert to a cash equivalent. As shown in Figure 2, borrowing rice also supplemented the livelihood of villagers and the rice bank in the village worked to some extent in the year of severe damage to upland crops.

In this study, risk management of a drastic decrease of agricultural production in a mountainous village of northern Laos where local people were heavily dependent on the natural environment was analyzed by comparing two normal years with a year with severe rice shortages. In northern Laos, swidden agriculture has been traditionally conducted and its agricultural production is unlikely to meet demand. In such an area, local people face a chronic rice shortage and it is considered that the livelihood system of the agricultural society traditionally includes systems of risk management to mitigate rice shortages. However, because of recent influxes of the market economy, the system of agricultural production and local livelihoods has become more market-oriented and the society is becoming dependent on cash. Under this change, the present study tried to clarify how the traditionally formed system of risk management works in the present day.

Previous studies conducted in Mainland Southeast Asia have suggested the importance of NTFPs to cover rice shortages [e.g. 13]. These studies were conducted in normal years and risk management in severe years has not been studied in detail. Some studies mentioned the importance of job opportunities to generate cash [16]. However, these studies discussed and focused on job opportunities and did not examine the traditional swidden system. The present study also indicates the importance of NTFPs and in addition, in severe shortages, suggests the importance of raising livestock, wages and borrowing rice, rather than relying on NTFPs because of the limitation of seasonal collection. Raising livestock is traditionally included in the swidden system and forms an important income source in severe shortage years. This study pointed out that the inclusion of livestock into the traditional swidden system enables villagers to deal with more severe damage to agricultural production and works as backup risk management system in the area in addition to collecting NTFPs from the traditional swidden system. The importance of wages and borrowing rice cannot be ignored. The rice bank system was introduced from outside and the system works reasonably well. Other studies have suggested the same kind of the system works in other regions [e.g. 17]. In northern Laos, the traditional swidden system is starting to disappear and the expansion of the rice bank system will play a more important role in risk management. The growing importance of wages in mountain villages is related to the diversification of job opportunities.

In the risk management system in the study village in a severe year, we clarified that the practice of raising livestock provided by the traditional swidden system, the recently introduced rice bank system and wages influenced by the recent influx of the market economy will become more important. For the sustainable development of mountain villages of northern Laos, the balance of these systems is critical. Recently, permanent crop land and monoculture have expanded and livelihood of local people and the local economy has become more dependent on single crop. This development is common in northern Laos; however, it is important to maintain parts of the traditional swidden system including various kinds of land use and fallow forests with different

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ages, activities around the collection of NTFPs and raising livestock to manage risk for future sustainable development in the region.

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