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Use of Natural Biological Resources and Their Roles in Household Food Security in Northwest Laos

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Abstract

The present study focuses on agriculture-forestry-based livelihood systems of Northwestern Lao people through village studies, including semi-structured group interviews, questionnaire survey, participatory observation and wealth ranking in Luang Namtha province. The study also examined the use of natural biological resources and identified their roles in household economy. The study revealed that lowland, hillside and mountain villages have different sets of farming practices including lowland paddy and shifting cultivations and natural biological resources use under the given agro-ecological setting, and natural biological resources play a crucial role in household food security in terms of providing an important source of cash income, particularly for poor people. Multiple functions of forest resources including bio-diversity conservation, fallow for coming cultivation and production of non-timber forest products should be further examined in order to guide development toward environmental conservation, food security and poverty alleviation.

Keywords: agriculture-forestry-based livelihood, biological resources, food security, non-timber forest product, Northwest Laos, shifting cultivation, wealth ranking

I Introduction

Land locked Lao PDR (hereafter Laos), located in Mainland Southeast Asia, is a mountainous country with 70 percent of its land area located at elevations over 500 m above sea level. Forest coverage in Laos was estimated to be greater than 50 percent of land area in 1995, compared to its neighboring countries the natural environment in Laos is relativity rich [FAO 1997]. The total population of 5.2 million people (2000) consists of more than 40 ethnic groups, of which Lao Lum (Lowland Lao), the dominant ethnic Lao and related groups, con-

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stitutes about 60 percent. The average population density is 22 persons/km^2, the lowest of all Southeast Asian nations.

People in Laos have been traditionally engaged in subsistence farming, combining lowland rice cultivation in the plains with shifting cultivation of upland rice on slope lands. In addition to the production of staple foods, farmers have small vegetable gardens and raise livestock to meet their daily needs. Their farming is generally characterized as low input and extensive use of land. It is also relatively vulnerable to pests and disease, as well as to the changes in natural environment such as adversities of climate.

Agricultural statistics [Lao PDR, MAF 1996; 1998; Lao PDR, MEPFSSC 1990; 1991; 1992; 1994; 1996; 1997; 1999] show that the national average of the annual per-capita rice supply (calculated by deducting 60 kg/ha of seed for the next year's production and 13 percent for post-harvest loss from production) was 320 kg/person. Production varies from year to year and from region to region, however (Fig. 1). In the northern region, where mountainous areas are more dominant than in other regions, production fluctuates yearly between 227 and 313 kg. This is much lower than the national average rice consumption of 255 to 390 kg/year/person. This indicates that the mountainous areas in the northern region are most prone to rice shortage in the country.

Rural people in these areas have adopted practical means to cope with rice deficiency. Several researchers already pointed out that natural biological resources play quite significant roles in household food security [Falconer *et al.* 1989; de Beer and Mcdermott 1989; Broekhoven 1996].

Natural biological resources, which are defined as all the biological materials that may be extracted from natural ecosystems and utilized within the household, marketed, or that have social, cultural or religious significance, play an indispensable role in diversifying daily

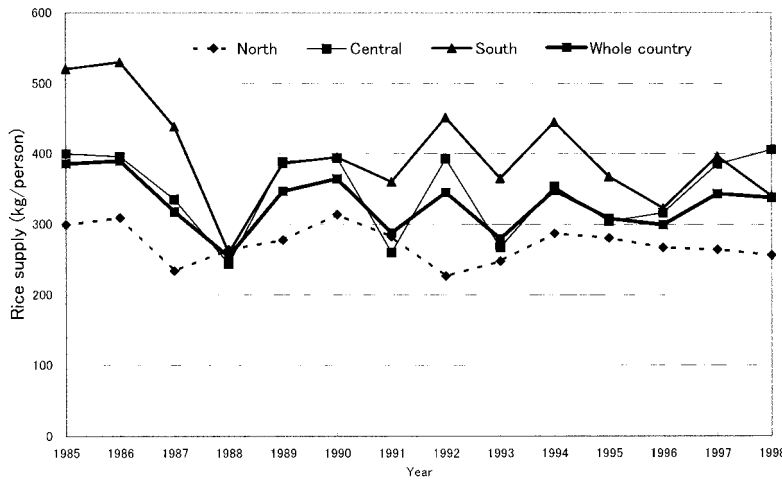


Fig. 1 Year-to-year Fluctuation of Rice Supply in Laos

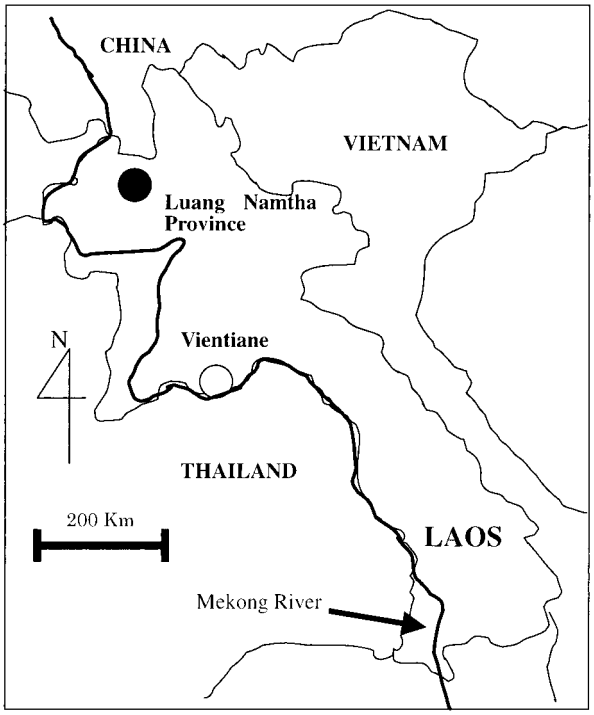


Fig. 2　Map of Study Area

diet of local people. This is a meaningful contribution to their food security because, though household access to staple food items is an important part of household food-security, it is also important to consider other food items that comprise households' daily diet. For example, Danes [1998] noted that despite the fact that farmers in Laos give high priority to achieving self-sufficiency in rice production, they also place considerable importance on collecting other wild food items like vegetables and meats, which supply vitamins, minerals and protein in their daily diet.

Another contribution of natural biological resources to household food security is as a source of cash income. Local people sell natural biological resources and use the cash to buy rice to supplement their own production and achieve food security. But the significance of this role may differ by the environmental setting of the settlement and the economic conditions of the household.

Even in Laos, environmental degradation has become a prominent problem in the last decade due to increased population pressure and expansion of agricultural land induced by changes in the economic system and spread of market economy [Chape 1996]. Consequently, the Lao government has adopted policies to curb environmental degradation. These include measures to stabilize shifting cultivation, to designate protected areas, and to allocate agricultural and forest land to households. These policies aim to improve the na-

tional economy and protect the natural environment by intensifying agricultural production and conserving forest resources. Little consideration has been given to the rural population's use of natural biological resources. This indicates that the government's understanding of rural livelihoods is limited to farming activities, and lacks the scope to include a wide range of non-farm activities, including the utilization of natural biological resources.

The present study, therefore, aims at examining the use of natural biological resources and identifying their roles in household economy, particularly from the viewpoint of contribution to food security at the household level. A better understanding of household use of natural biological resources may contribute to establishing sustainable livelihood systems based on an agriculture-forestry complex in the mountainous regions of Laos.

We selected Luang Namtha province, the northwestern part of Laos as the study area (Fig. 2). This part of the country still has a relatively rich natural environment, and natural biological resources are expected to play a significant role in people's livelihood. Moreover, it borders with China, which is the main importer of natural biological resources. This also suggests that cross-border trade in natural biological resources should be observed widely.

II Field Survey

The field survey, conducted during the period between May 2000 and September 2001, consisted of village studies, market surveys and collection of data from related government agencies. This was done by some of the authors in collaboration with staff of the Provincial Agriculture and Forestry Office (PAFO). The language used for the field survey was mainly Lao, and we asked village headmen to serve as translators between Lao and indigenous languages, when necessary.

The village studies consisted of 1) semi-structured group interviews, 2) questionnaire surveys, 3) participatory observation, and 4) wealth-ranking analysis.

Semi-structured group interviews of village leaders were carried out in 13 villages in May and June, 2000. This aimed at collecting preliminary information on history of settlement, socio-economic conditions, agriculture, natural biological resources use, social organization, and market access. The 6 study villages were then chosen for the following survey.

Questionnaire surveys of all households were carried out in the study villages during the period from July to November, 2000, and were supplemented by a second survey during the period from July to September, 2001. The questions included cash income, farming activities, collection and use of natural biological resources, rice balance and measures for achieving food security. The survey was done at the house of each informant. This also provided us with a chance to observe living conditions. We arranged for both the household head and his spouse to attend the interview in order to obtain precise information within a short period of time.

Participatory observation on hunting and gathering of natural biological resources and

daily diet was carried out at selected households during the periods from August to November, 2000 and July to September, 2001. This provided information to confirm the results of the questionnaire survey and in-depth information on natural biological resources collection and use.

Wealth-ranking aimed at classifying all households into three economic classes. We asked village leaders to take part in wealth ranking. They judged all households of their village as wealthy, middle or poor household, from the viewpoint of land holdings, ownership of durable consumer goods and other property, rice balance, and family labor supply (see more in details in Jackson and Ingles [1998]).

Market surveys were carried out at the central market of Luang Namtha town twice a month during the period from August 2000 to July, 2001. We prepared a list of goods sold at the market particularly from the viewpoint of whether they are natural or cultivated.

III　Study Area

III–1 *Diversity of Livelihood Systems in an Agriculture-forestry Complex*

Luang Namtha province has rich forest resources. The Provincial Agriculture and Forestry Office reported that 59 percent of the province was covered with forest in 1995, of which 12.5 percent was National Bio-diversity Conservation Area, 7.3 percent was Provincial Bio-diversity Conservation Area, and 5.6 percent was District Bio-diversity Conservation Area. The remaining forests are mostly village forest lands which include *pa sanguan* (conservation forest) and *pa pongkan* (protected forest). These forests are mixed deciduous forest and regenerated forest after shifting cultivation.

This province is home to various ethnic groups. These include the Lao, Tai, Lue of the Tai-Kadai language group, the Khmu and Khabit of the Mon-Khmer language group, the Akha of Sino-Burmese language group, and the Hmong and Yao of Hmong-Mien language group. These ethnic groups are commonly classified into three major groups. Lao Lum (Lowland Lao) are people speaking Tai-Kadai languages, Lao Theung (Midland Lao) belong to the Mon-Khmer language group, and Lao Soung (Highland Lao) belong to the Tibeto-Burman and Hmong-Mien language groups.

The agro-ecological landscape has three zones: lowland, hillside/valley and mountain (Table 1).

The lowland zone occupies the intermountain basin of Luang Namtha, which is an area of flat land mostly covered with paddy fields. We can observe scattered forest along the riverside and settlement, which mostly consists of useful varieties including fruit trees. The major inhabitants are Lao Lum groups, including Black Tai and Tai Lue, who have been engaged in irrigated lowland paddy cultivation since they settled the area.

The hillside/valley zone is located in the areas surrounding the lowland zone. Its topography is a complex of narrow valley and slope land originally covered with evergreen or

Table1 Agro-ecological Landscape of Agricluture-forestry Conplex in the Study Area

Zone	Altitude (m)	Geographical Features	Agricultural Landscape	Natural Vegetation	Main Tribes
Lowland	560–600	Intermountain basin with gentle slope	Irrigated and rainfed paddy field	Grass land	Black Tai
		Meandering rivers with many tributaries	Shifting cultivation with 1 to 2 years fallow	Evergreen forest (cemetery forest)	Tai Lue
		Marsh/ponds	Vegetable garden along river/ tributary garden of bamboo and banana	Secondary evergreen forest Mixed deciduos forest	Tai Nguan
		Near markets (30 minutes to 1 hour by walk)	Plantation of mulberry and teak Fish pond	Bamboo stands	
Hillside/valley	550–700	Gentle/moderate slopeland	Shifting cultivation with 3 to 5 years fallow	Secondary evergreen forest	Khmu Rok
		Stream/river with many tributaries	Paddy field and vegetable garden in valley	*imperata* grass	Khmu Nguan
		Narrow valley	Plantation of teak, rubber, *nyaka*, bamboo and banana	Mixed deciduous forest	Khabit
		Moderate distance to markets (One hour by bicycle)		Bamboo stands Primary evergreen forest	Lanten White Hmong
Mountain	700–1,500	Gentle/steep slopeland	Shifting cultivation with 6 to 20 years fallow	Primary evergreen forest	Akha
		Mountain torrents	Upland fields of maize, cotton, vegetables, opium and banana	Mosaic of secondary forest	White Hmong
		Very far to markets (3–8 hours by walk)		*imperata* grass	Yao Sila

mixed deciduous forests. Valley is reclaimed as fields and vegetable gardens, and slope land is partly occupied by shifting cultivation and tree plantations including teak and rubber. Major inhabitants are Lao Theung, represented by a majority of Khmu. They were formerly shifting cultivators, but introduced lowland paddy cultivation several decades ago.

The mountain zone occupies the rest of the area. Most of mountain slope is, even now, covered with primary evergreen forest, which is rich in non-timber forest products. Major inhabitants are Lao Sung including Yao, Hmong and Akha, and the predominant mode of agriculture is shifting cultivation.

III–2 *The Study Villages*

We selected six villages, two from each agro-ecological zone, for intensive survey.

The two lowland villages are Black Tai. The total population is 634 people, and the number of households is 98. Of this number, 85 are farmer households, in the sense that their major income source is agriculture. Others are engaged in trading, wage labor, or getting pension or remittance. Both villages were settled more than 100 years ago. They have good access to the market, and are located 30 minutes to one hour by foot from these villages to the provincial town.

The two hillside villages have, in total, 778 persons and 138 households, of which 97 are farmer household. The residents are Khabit and Khmu who settled down the area more than 100 years ago and 25 years ago, respectively. They can access the market in approximately one hour by bicycle.

The two mountain villages have, in total, 854 persons and 119 households, of which 114 are farmer households. They are Akha villages, one of which settled down at the present location 62 years ago, and the other 9 years ago. It takes eight and three hours to walk to the market from the old and new village, respectively.

IV　Farmer Household Economy

IV–1 *Farming Activities*

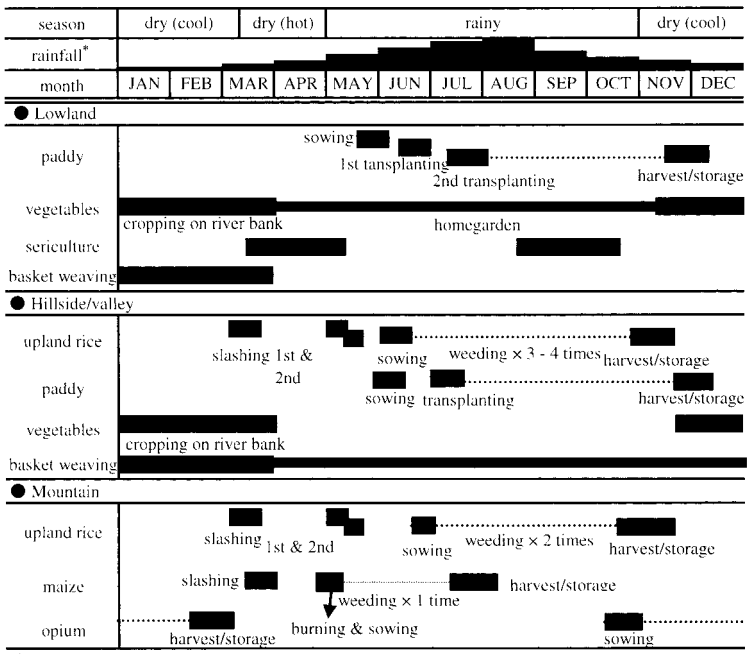
The major mode of food production is lowland paddy cultivation in the lowland villages, shifting cultivation of upland rice in the mountain villages, and a mixture of the two in the hillside villages. We can see this tendency at the selected villages (Table 2; Fig. 3).

In the lowland villages, almost all farmer households are engaged in lowland paddy cultivation. Their average farm size is nearly 1 ha and a household produces, on average, 2 tons of paddy in a normal year. Rice production is supplemented by small-scale shifting cultivation that about the half farmer households are engaged in.

The lowland villages grow abundant vegetable crops, and are active in sericulture, raising of water buffalo and cattle, and fish culture. Dry season vegetables and spices, silk, cattle and other animals are important sources of cash income. In comparison to the hillside

Table 2 Farming Activities in the Study Villages

Zone	Lowland	Hillside/Valley	Mountain
Farming structure (% of household)			
Lowland paddy	41	4	0
Lowland paddy + shifting cultivation	54	25	3
Shifting cultivation	5	71	97
Lowland paddy cultivation			
Average farm size (ha)	0.92	0.46	0.78
Average rice yield (t/ha)	2.2	1.3	1.7
Shifting cultivation			
Fallow period (year)	1 to 2	3 to 5	6 to 20
Average number of livestock (head/household)			
Water buffalo	1.0	0.5	0.8
Cattle	2.0	0.4	0.4
Pig	1.8	2.9	2.7
Goat	no	0.1	0.6
Horse	no	no	0.1
Duck	7.6	1.3	0.2
Chicken	9.5	4.9	11.7
Turkey	0.6	no	no
Dog	no	no	1.2
Holding of machinery (% of household)			
Tractor	4	1	no
Power tiller	49	7	no
Motorbike	3	1	no
Bicycle	88	64	no
Rice mill	7	4	2



*Shows the general trend of rainfall

Fig. 3 Major Cropping Calendar at the Study Villages

and mountain villages, they also have a greater number of agricultural and transportation machinery, such as power tillers and tractors. These reflect year-round access to water sources and good road conditions.

In the hillside villages, almost all farmer households are engaged in shifting cultivation, with one fourth also cultivating lowland paddy. The fallow period of shifting cultivation is three to five years, which is much shorter than in the mountain villages. The average farm size of lowland paddy field is about half of that of the lowland villages. These indicate less advantageous land conditions of the hillside villages, when compared to the mountain and lowland villages.

Among the three agro-ecological zones, farming systems in the hillside villages may be the most diverse because they have both lowland and upland environments. They grow vegetables in fields along streams in the dry season, as it is done in the lowland villages, and by mixed-cropping with upland rice, as in the mountain villages. But both are limited due to smaller farm size and less fertile soil.

In the mountain villages, rice production depends on shifting cultivation. The fallow period of shifting cultivation is as long as 6 to 20 years, reflecting sufficient available land resources, and results in high land and labor productivity.

They are also rich in non-rice upland farming owing to abundant and fertile land. They grow maize and cotton in separate fields. Pumpkin, cassava, chili, maize, cucumber and ginger are inter-cropped with upland rice. They grow banana after the harvest of upland rice. Animal husbandry such as pigs, goats and poultry is popular. These products are mostly consumed at home due to difficult access to the market.

IV–2 *Cash Income* [1)]

Cash income of all farmer households of the study villages in the year 1999/2000 was obtained from the questionnaire survey. The average cash income was the highest in the lowland villages, US$43/person/year, followed by the mountain villages, US$38/person/year, and the hillside villages, US$30/person/year. Villagers reported that the year of 1999/2000 was a normal year in terms of natural disaster and economy. Thus, this tendency should be general in recent years.

The wealth ranking exercise classified all households into wealthy, middle and poor classes. The results of the questionnaire survey and wealth ranking coincided well, and significant differences in cash income can be observed between economic classes (Table 3). The number of households classified as wealthy, middle and poor class is nearly one third each in the lowland and mountain villages, while the wealthy class is 11 percent and the middle and poor classes are 44 percent each in the hillside villages. The average per capita

1） In this paper, the amount of cash income is estimated from sale and barter of agricultural products and natural biological resources. One US dollar is equal to 8,000 kip, and one kilogram of unhusked rice is estimated at 1,000 kip. The amount of self-consumption is not included in cash income.

Table 3 Cash Income and Income Sources

Wealth Rank	Number of Household	Total Income (US$/person)*	Source of Income(%)			
			Farm Products	Livestock	Wage Labor	Natural Biological Resources
Lowland						
wealthy	30	65.2±13.5	49	27	10	14
middle	21	33.0± 6.6	36	23	27	14
poor	24	24.1± 3.7	22	19	25	34
Hillside/valley						
wealthy	11	40.6±12.0	26	47	18	11
middle	43	31.0± 4.0	13	28	33	26
poor	43	27.1± 2.3	2	10	55	33
Mountain						
wealthy	43	57.3± 4.5	3	48	2	47
middle	39	28.0± 2.5	2	34	4	61
poor	32	24.4± 2.0	2	30	7	61

* Shows the average and standard deviation. People less than 16 years old and more than 64 years old are equivalent to 0.5 person in estimation.

annual cash income of the middle and poor classes are almost the same in all villages, US $30 and US$25 respectively, while that of the wealthy class is higher in the lowland and mountain villages at about US$60, than the US$40 in hillside villages. Thus, compared to the lowland and mountain villages, the hillside villages are economically more homogeneous due to lack of wealthy households.

The lowland and hillside villages show a similar pattern with regard to the composition of income sources. About 75 percent of cash income of the wealthy class comes from farm products such as rice, vegetables, silk and bananas, and livestock such as pigs, water buffalo, cattle and poultry, while more than half of the cash income of the poor class is derived from wage labor such as construction work and agricultural labor, and natural biological resources. The poor class in the hillside villages is heavily dependent on income from wage labor, particularly construction work. On the other hand, in the mountain villages, income sources do not differ by economic class, and more than 90 percent of cash income of all classes is derived from sale of livestock of pigs and cattle, and natural biological resources.

V Natural Biological Resources Use

V–1 *Hunting and Gathering Activities*

Evenson [1991] reported that he found more than 250 varieties of fruits and vegetables in Lao markets, of which 140 varieties are natural biological resources. We also surveyed Luang Namtha Central Market and found 106 varieties of fruits and vegetables, of which 37 were wild. This indicates that natural biological resources are widely used in the daily life of the rural population.

Major hunting and gathering activities of natural biological resources observed at the

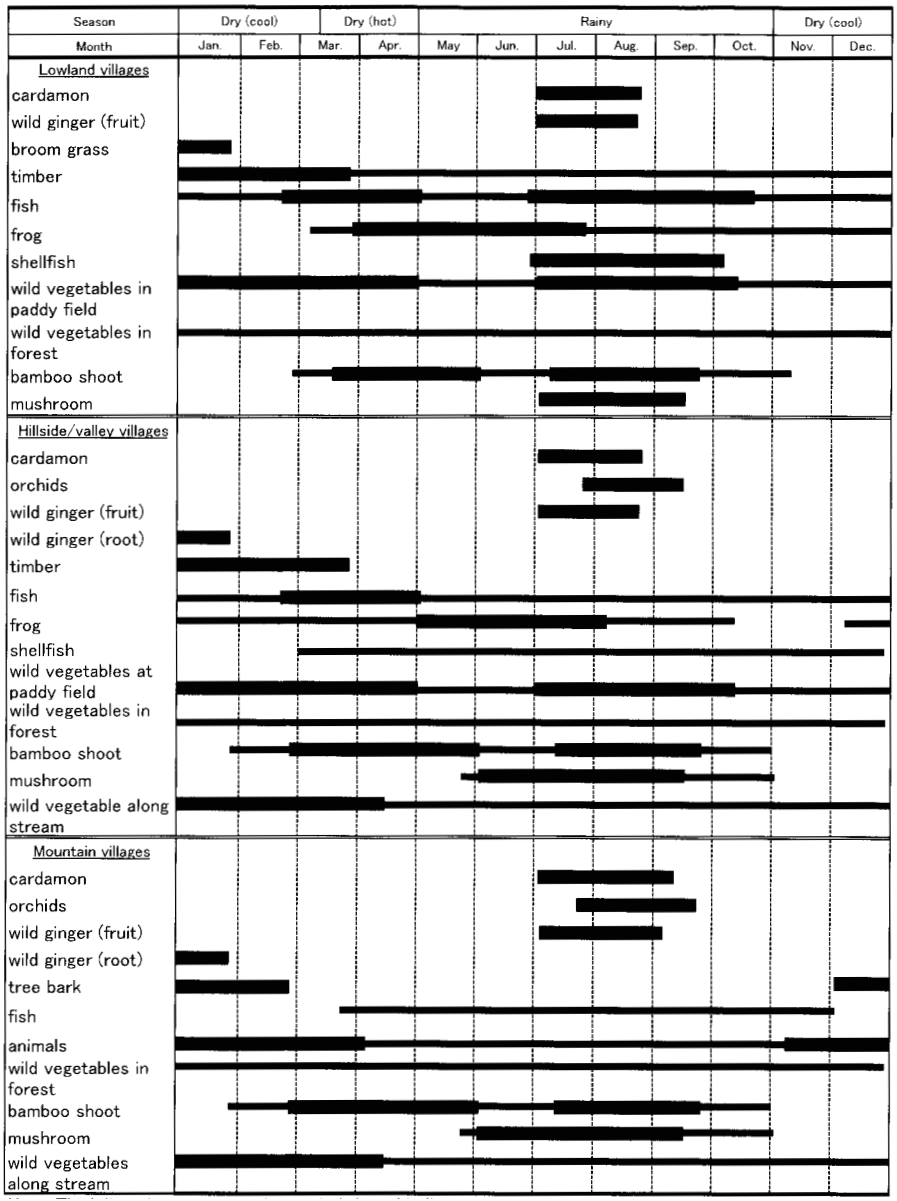


Fig. 4　Major Hunting and Gathering Activities

Note: Thick line shows more active period than thin line.

study villages are summarized in Fig. 4.

In the lowland villages, paddy fields and their surrounding area provide various kinds of flora and fauna. Weeds in paddy field such as *phak ween (Marsilea quadrifolia)* and *phak nok (Cantalla asiatica)* are important vegetables for local people year-round. People also catch aquatic animals including fish, frogs, shellfish, crabs and insects by means of rod, net and various sizes of trap. They catch fish in the paddy fields, particularly in the latter half of the rainy season, and in the river in the dry season when the water level is low. People also collect bamboo shoots and banana flowers in nearby hilly areas, and fern (*Pteridium aquilinum*, *Lygodium conforme* and *Gleichenia linearis*) along streams.

In the hillside villages, people collect rattan, banana flowers and bamboo shoots in surrounding degraded forest. Rattan handicrafts are quite popular. Mushrooms and fern can be found on fallow land after shifting cultivation at the beginning of the rainy season. Hunting of small animals such as rats, deer and birds in shifting cultivation fields and surrounding forests is also practiced by means of various types of trap. For example, a *heu* is a trap set on the ground to catch small animals. A *long* is a trap set on trees to catch birds, and a *kup* is a baited cage to catch birds. They also walk into deep forest to collect cardamom, orchids and wild ginger.

In the mountain villages, various types of forest including primary forest, secondary forest and bush after shifting cultivation accessible to the people. These forests provide a wide range of non-timber forest products. In addition to cardamom, orchids and wild ginger, wild fruits such as *mak ngeo* (*Xerospermum laoticum*), *mak wa* (*Eugenia* sp.) and *mak ko* (*Diospyios hayatae*), wild insect such as bee and moth larva, and honey are collected in the primary forest. Hunting of wild animals such as bear, deer, squirrels, monkeys and wild boar is also practiced, particularly in the dry season. Hunters use homemade matchlock guns for hunting.

V–2 *Sale of Natural Biological Resources*

Local people sell natural biological resources directly in local markets and also through middlemen. Some precious non-timber forest products are traded to Chinese middlemen. These are mostly materials for Chinese medicinals and incense, which are exported to China, Taiwan, Korea, Japan and Thailand.

The results of the questionnaire survey on the sale of natural biological resources by all farmer households of the study villages are summarized in Table 4.

The average amount sold is the highest in the mountain villages, US$85/year/household, followed by the hillside villages at US$41/year/household, and lowland villages at US $23 /year/household. These amounts represent 53 percent, 27 percent and 18 percent of total household cash income, respectively. The composition of natural biological resources also shows a big difference among the villages. Cardamom, orchid and wild animals, which are expensive and for export, are the most important cash sources in the mountain villages. This clearly indicates that people in the mountain villages enjoy rich forest resources. More

Table 4 Sale of Natural Biological Resources

Kinds of Natural Biologial Resources			Purposes	Place Collected	Sales* (US$/household)		
English Name	Lao Name	Scientific Name			Lowland	Hillside/Valley	Mountain
Export							
cardamon	mak neen	*Amomum ovoideum, Amomum villosum*	medicine	primary forest	0.99	1.65	58.89
orchid	nya bai lai	*Ludisia discolor*	medicine	primary forest	0.00	0.05	7.17
wild ginger	kha	*Alpinia* spp.	medicine	primary forest	0.00	0.00	2.24
tree bark	puak muak	*Debregaesia hypoleuca*	glue	primary forest	0.11	0.82	3.56
rattan fruit	mak wai	*Calamus* spp.	medicine	primary forest	0.08	2.62	1.18
suger palm	mak tao	*Arenga saccharifera, Arenga awesterhoutii*	medicine	primary forest	0.00	0.18	0.00
eagle wood	mai kesana	*Aquilaria crassna*	perfume	primary forest	0.78	0.00	0.00
Sub-total					1.96	5.32	73.04
Local market							
wild pepper	mak keen	*Zanthoxylum rhetsa*	spice	primary forest	0.00	0.00	0.07
not available	sakhan	*Piper* spp.	spice	secondary forest	0.00	0.00	0.00
rattan shoot	nyot wai	*Calamus* spp.	food	fallow forest/ primary forest	0.00	0.49	0.00
bamboo shoot	no mai	*Indosasa sinica,Thyrostachys siamensis, Bambusa tulda, Bambusa spinosa*	food	fallow forest/ primary forest	2.77	7.71	3.15
banana flower	mak pi	*Musa* spp.	food	fallow forest	0.65	2.19	0.00
wild litchi	mak ngeo	*Xerospermum laoticum*	fruit	primary forest	0.00	0.00	0.44
honey	nam pung	not available	food	primary forest	0.00	0.04	0.86
not available	mak ko	*Livistona saribus*	food	primary forest	0.00	0.00	0.28
wild vegetables in forest	phak pa	*Pteridium aquilinum, Lygodium conforme, Piper lilot,Eugenia* spp., *Diplazium esculentum, Oroxylum indicum, Diospyros mollis*	food	fallow forest/ primary forest	0.83	2.81	0.00
wild vegetable in paddy field	phak na	*Marsilea quadrifolia, Cantalla asiatica, Eichornia crassipes, Ipomoea aquatica*	food	paddy/wetland	0.48	0.44	0.00
not available	mak fai	*Clausena lansium, Baccauvea sapida*	fruit	primary forest	0.13	0.25	0.00
not available	mak vai	*Calamus (godefroyi)*	fruit	primary forest	0.00	0.00	0.85
mushrooms	hed	*Agaricus integer, Auricularia* spp.	food	fallow forest/swedden field	0.04	0.03	0.47
fish	pa	*Mastacembelus armatus, M. nemurus, Monotreta* spp. *Puntius brevis, Macrognathus siamensis, Pristolepis fasciata, Oreochromis niloticus, Tilapia niloticus, Tilapia niloticus, Cyprinus carpio, Monotreta* spp. *Leiocassis siamensis*	food	river/paddy/wetland	15.65	1.19	0.00

Table 4—Continued

Kinds of Natural Biologial Resources			Purposes	Place Collected	Sales* (US$/household)		
English Name	Lao Name	Scientific Name			Lowland	Hillside/Valley	Mountain
shellfish	hoi	not known	food	paddy/ wetland	0.55	0.00	0.00
animals	sat pa	*Sus scrofa, Muntiacus muntjak,Tragulus javanicus, Callosciurus* spp. *Gallus gallus, Lophura nycthemera*	food	fallow forest/ primary forest	0.00	0.00	6.12
wood (firewood and timer)	mai	*Sandricum Indicum, Schizostachyum zoilingen, Mansonia gagei, Livistona cochinchinensis, Michelia champala, Thyrostachys siamensis, Dendrocalamus strictus, Schizostachyum zoilingen*	wood	fallow forest/ primary forest	0.04	3.03	0.00
handicraft (baskets and broom grass)	hatakam	*Cephalostachvum virgatum, Calamus* spp., *Thysanolaema maxima*	handicraft	fallow forest/ primary forest	0.20	17.78	0.00
Sub-total					21.34	35.96	12.24
Total					23.30	41.28	85.28

* The average of all households at the study villages in the year 1999/2000.

than 70 percent of the income of the hillside villages comes from handicrafts, rattan fruit and bamboo shoots, which are collected in primary and degraded forests. The lowland villages, with paddy fields and perennial water flow of rivers, earn their major incomes from fish.

VI　Household Food Security

VI–1 *Rice Balance*

Farmers measure the sufficiency of their rice production in terms of how many months it can afford home consumption. After the harvest, which is November/December in case of lowland paddy and October/November in case of upland rice, farmers consume the rice they have harvested. If it exhausted before the next harvest, however, farmers face rice shortages and have to look for ways to cope in times of scarcity. The rainy season is the hardest time for them. If they have surplus even at the time of the next harvest, the surplus is stored to carry it over to the next year in case there is a poor harvest in the coming years.

Rice balance in the study villages reflects the situation of rice production of each village (Table 5).

Rice production is most sufficient in the mountain villages where almost two thirds of the farmer households do not face rice shortages and the reminder face shortages of one to three months. In the lowland villages, only two fifths of households are fully sufficient and about two fifths face shortages of one to three months. The reminder face shortages for more than four months. On the other hand, rice production is insufficient in the hillside villages. Production covers consumption for eight months or less for more than half of the households.

Overlaying wealth ranking with rice balance reveals a contrast among the villages. In the lowland villages, the wealthy class has sufficient rice production, while the most part of the middle and poor classes face rice shortage for one to three months and more than four months, respectively. In the hillside villages, the wealthy class has sufficient rice production, as observed in the lowland villages, the middle and poor classes face rice shortage for one to six months and more than four months, respectively. These findings suggest that rice balance is one of the outstanding indicators of the intra-village economic class in these villages, and producing sufficient amount of rice is a symbol of the wealthy class. In the mountain villages, on the other hand, most of the wealthy and middle class households produce suffi-

Table 5　Rice Balance in 1999/2000　(Unit: % of household)

Shortage Period*	Lowland	Hillside/Valley	Mountain
More than 7 months	8	27	0
4 to 6 months	17	39	6
1 to 3 months	36	25	33
Sufficient	39	10	62

* This refers to the period when home consumption can not be born by self-produced rice.

cient amount of rice, and some poor-class households face rice shortage. Considering that the sale of rice is negligible, as shown in Table 3, rice balance is not the determinant factor of the intra-village economic class in the mountain villages.

VI–2 *Contribution of Natural Biological Resources*

There are several ways that people in Laos cope with rice shortage. First, they borrow rice from relatives and neighbors, and return it after the next harvest. Second, they purchase rice or exchange goods for rice at the market or with neighbors. Third, they sometimes beg for rice from neighbors. Fourth, they substitute rice with other crops such as maize and wild tubers (*Dioscorea* spp.).

Table 6 summarizes the methods of supplemental rice acquisition in the study villages.

The total volume of acquired rice is the smallest in the mountain villages, followed by the lowland villages and then the hillside villages, which reflects the differences in rice balance among the study villages (Table 5). The poor class of the hillside villages shows the maximum average volume of 145 kg/person/year, which almost reaches half of their annual consumption.

In the hillside and mountain villages, the major method to acquire supplemental rice is by purchasing it, while borrowing also contributes substantial volume in the lowland villages, particularly for the middle class. This difference may reflect the difference in mode of rice production. In the case of shifting cultivation, the determinant factor of farm size is family labor, resulting in the limitation of surplus production, if any. On the other hand, in case of lowland paddy cultivation, rich farmers try to expand farm size. Paddy field is recognized not only as a tool for production but also as an investment. This creates large-scale farmers who produce sufficient amount of rice to lend.

Table 6 Method of Supplemental Rice Acquisition

Wealth Rank	Supplemental Rice Acquisition[1] (kg/person/year)				Purchasing Value	
	Total	Borrow	Purchase	Beg	Price[2] (US$)	% to Total Cash Income
Lowland						
wealthy	0	–	–	–	0.0	–
middle	45	34 (75)	7 (16)	4 (9)	0.9	3
poor	80	30 (38)	49 (61)	1 (1)	6.1	25
Hillside/valley						
wealthy	0	–	–	–	0.0	–
middle	97	16 (16)	78 (81)	3 (3)	9.8	32
poor	145	19 (13)	122 (84)	4 (3)	15.3	56
Mountain						
wealthy	0	–	–	–	0.0	–
middle	25	4 (16)	18 (72)	3 (12)	2.3	8
poor	69	17 (25)	47 (68)	5 (7)	5.9	24

[1] Number in parenthesis shows the percentage of proportion of each method.
[2] Calculated by the unhusked rice price of US$ 0.125/kg.

The necessary expenditure to purchase the supplemental rice and the contribution of the sale of natural biological resources to the total cash income are 25 percent and 34 percent for the poor class in the lowland villages, 32 percent and 26 percent for the middle class of the hillside villages, 56 percent and 33 percent for the poor class of the hillside villages and 24 percent and 61 percent for the poor class of the mountain villages. These results strongly indicate that natural biological resources are indispensable as a source of cash income to achieve household food security for poor people.

Another important point is the seasonality of cash flow. Rice shortages hit people before the harvesting season. This is when people have to purchase rice. The rainy season, just before the harvesting season, is the high season for the collection of non-timber forest products such as cardamon, orchid and wild ginger, and aquatic animals such as fish, frog and shellfish at paddy field (Fig. 4). The timely sale of these biological resources helps to overcome the rice shortage of poor people who generally do not have savings.

VII　Conclusions

The present study focused agriculture-forestry-based livelihood system of Northwestern Lao people. Lowland, hillside and mountain villages have different farming systems harmonized with their agro-ecological setting. The major modes of agriculture are lowland paddy cultivation, short-fallow shifting cultivation supplemented with lowland paddy cultivation and long-fallow shifting cultivation, respectively. The farming system interacts with forest and water resources of each zone. The mountain zone is covered with deep primary forest, while most of the remaining forest is degraded in the hillside/valley zone. Water resources are rich and diverse in the lowland zone, but limited in the hillside/valley and mountain zones. These are again closely related with natural biological resources use. Major natural biological resources in terms of cash income are aquatic animals and wild vegetables found in rivers and paddy field in the lowland zone, rattan, banana and bamboo collected in degraded forest in the hillside/valley zone and cardamon, orchid and wild ginger collected in deep forest in the mountain zone. We can see multiple functions of the agriculture-forest complex under different settings. This suggests that the local people have detailed environmental knowledge supporting these area-specific uses of biological resources.

Natural biological resources play a crucial role in household food security in terms of not only providing a wide range of food and nutrition, but also providing an important source of cash income and securing year-round acquisition of staple food, particularly for poor people. This finding suggests the necessity of re-considering the role of forest resources in the development strategy of the mountainous areas. Thus, forestland is a treasure house of biological resources and its protection is undoubtedly important, but this does not always mean that people's access to forestland must be prohibited. Forestland is also a growing space of natural biological resources such as non-timber forest products. They are renewable

resources. Moreover, regular intervention by human beings may enrich their growth. In addition to bio-diversity conservation for the next generation, the production aspect of forestland should be more emphasized in forest resources evaluation.

It is highly possible that the economic value of natural biological resources in the study area will increase in the future because the degradation of natural environment has accelerated in every country and is causing scarcity of natural biological resources. Laos, particularly the study area, still has comparatively rich resources, which can be a great economic advantage to the area if managed in a sustainable manner. The development strategy of the mountainous areas should be shifted from agriculture-oriented one to the mixture of agriculture and forest use, particularly the mixture of shifting cultivation and productive fallow.

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