Land Inequality and Rice Security in Northern Laos

Phaythoune PHOMVIXAY*
Souksavanh VIXATHEP**
Phanhpakit ONPHANHDALA***

Abstract

Backward agriculture, inadequate farm income and absolute poverty have long characterized the economy of developing countries. Unequal distribution of agricultural land is often cited as a source of poverty and inefficiency in agriculture. However, much of literature on smallholders tends to address income inequality and (total) land size, while land inequality has been overlooked in those discourses. In view of filling the research gap, this paper provides a micro-level foundation for discussions on land inequality and food security in Laos as a case study for least developed countries.

Using detailed primary data of farm households from Phongsaly, one of the poorest provinces in northern Laos, the study decomposes agricultural land into three types, namely irrigated lowland, rain-fed lowland and upland, and evaluates the effect of uneven distribution and quality of land on food security. A significant contribution of the paper to food security literature in Laos is that land inequality is controlled for in the analysis and that access to agricultural infrastructure is measured by irrigated area. The study reveals that landholdings – regardless of types of land – improve rice self-sufficiency, and that superior land quality – irrigated or rain-fed lowland – enhances food security of farm households. The findings pertain to impact of land policy (allocation, utilization and management of agricultural land) on food security and poverty alleviation.

* National Project Manager of Northern Rural Infrastructure Development Project, Ministry of Agriculture and Forestry, Lao PDR (corresponding author),
** Assistant Professor, Graduate School of International Cooperation Studies, Kobe University,
*** Visiting Associate Professor at GSICS, Kobe University and Faculty of Economics and Business Management, National University of Laos.

Key words
food security, land inequality, Laos

JEL Classification
Q15, Q24

1. Introduction

Land plays a crucial role in agricultural development for developing countries. It has direct impact on the livelihoods of farmers, income generation and poverty situations in rural economies. For an agriculture-based economy land also plays a central role in the formulation of development policies that aim at increasing the nation's income and improving people's living standard. There exists an observation that in many (economic) theories, which attempt to address the success of nations in raising their incomes over time, the dichotomy of 'landlessness' and 'having-access-to-land' is treated comprehensively, while the distribution of land among economic agents with access-to-land has received less attention (Erickson and Vollrath, 2004).

For Laos (also known as Lao PDR), a country located in the center of the Indochinese peninsula with an overwhelmingly agriculture-dependent economy, land is a major resource that is vital for socio-economic development and poverty reduction. While the role of agriculture in the economy has long been prioritized and emphasized, the sector is characterized by multiple land tenure and farming practices, traditional production systems and widespread use of household labor. A means of modernizing this crucial sector is a land reform that is supposed to consolidate land security and give farmers more responsibility in managing natural resources (Ducourtieux et al., 2005).

Published studies on Lao agriculture address a number of issues related to land reform, farmers' response to government policies and farm practices (Ducourtieux et al., 2005; Takai and Sibounheauang, 2010), land use planning for agricultural production, changes in land use and livelihoods (Thongmanivong and Fujita, 2006; Thongmanivong et al., 2009; Phachomphon et al., 2010), commercialization of farm products and market information dissemination in rural communities (Foppes and Phommasane, 2006; Yokoyama, 2010) and the like. Apart from some empirical works on farming output and land productivity (Onphanhdala, 2009, 2010), foreign investment in agriculture and rural

development (Onphanhdala and Suruga, 2011, 2013) and technical efficiency in farming systems (Vixathep and Onphanhdala, 2013), most of the research papers addressing land distribution and land use tend to focus on qualitative analysis based on project work.

Moreover, although land inequality has been examined in cross-country studies (Erickson and Vollrath, 2004; Vollrath, 2007), the impact of land distribution on rice sufficiency (livelihood) and poverty in Laos has virtually not been studied. Against this background, the present paper provides a micro-level foundation for discussions on land inequality and food security in Laos. By applying primary data of farm households from Phongsaly province in northern Laos, the paper decomposes the inequality measure with respect to three types of agricultural land, namely irrigated lowland, rain-fed lowland and upland, and evaluates the effect of uneven land distribution on land holding and estimates the impact of land quality on food security. This study could well be considered as a pioneer work for Laos and a case study for least developed countries.

2. Land Reform and Land Use Transformation

Farming practices: One of the most important economic sectors of Laos is agriculture, including forestry and fishery, which contributes roughly one-third to the GDP in 2010 and engages about three-quarters of the workforce in 2011. The sector is dominated by subsistence rice production, followed by fresh vegetables and some industrial crops (FAO, 2012). The farming system consists of two major practices: the rain-fed and/or irrigated farming along the Mekong River and its tributaries (lowland farming), and the slash-and-burn cultivation in the northern and eastern regions (upland farming). About 60% of rice farmers practice lowland cultivation and some 10% do both lowland and upland farming. Rotational shifting cultivation is the most common agricultural practice, while slash-and-burn practices are more frequent in the northern region (Vixathep and Onphanhdala, 2013).

Land reform: Laos has a mountainous landscape with limited land area for agriculture, mainly on the three major plains. With a resource-based economy, land reform has significant impact on natural resources (forests, water) and agricultural development. In the previous regime, the Kingdom of Laos, land was considered ultimately owned by the King and managed based on customary rules. After the Lao PDR was founded in 1975, land ownership was transferred to the people represented

by the state. The collectivization was initiated in the mid-1970s aimed at redistributing access to agricultural land and harvests, and over the following decade nearly 4,000 cooperatives were established. However, the collectivization was never made mandatory and faced passive resistance by farmers. Many cooperatives existed merely in name. The collectivization was in part responsible for a drop in rice output and the cooperatives were dissolved by the late 1980s and land ownership was returned to original owners (Vandergeest, 2003; Ducourtieux et al., 2005).

In the mid-1990s the government of Laos adopted a participatory approach to land reform. The Land and Forest Allocation Program and the land titling program received widespread support from grassroots development organizations, community forestry advocates, international organizations and many farmers. The main objectives of the program are to clarify property rights, reduce poverty through extension services, promoting community-based forest management and conservation, and stabilizing swidden agriculture. The concept is to provide clear land rights and encourage farmers to make productive investment in their land. The land allocation program was initially implemented in urban areas and then extended throughout the country (Vandergeest, 2003).

In literature on Laos, the land reform has been found to have limited success, while negative consequences are more common. Slash-and-burn practices have declined in some areas, but the true cause is said to be the spread of new mechanical means that has enhanced farmers' productivity. It is even stated that land titling might not be significant at all for enhancing agricultural productivity and food security. The land reform has induced changes in farming practices and caused a decline in rice production in some provinces. It has seriously affected farmers who do not have access to wet land and/or irrigation services, or those with limited access to other means of production (Ducourtieux et al., 2005; Vandergeest, 2003).

Land use transformation: Overall, the chronic changes of land use in Laos have been summarized into four major periods: (1) the civil war era (1963-1975) saw forest destruction due to bombing and reallocation; (2) the early socialist period (1975-1985) witnessed an expansion of paddy land and forest degradation; (3) the market transition period (1985-1995) experienced cash crop production resulting from trade and market liberalization; and (4) the post-socialist era (1990-present) has been experiencing an

increase in commercial production and land reform as a consequence of development process (Fujita, 2006).

Over the last decade land use for agricultural production has expanded from about 4.1% of the total land (one million hectares) in 1999 to 6.1% (1.5 million hectares) in 2009, in which rice farming accounts for 40% of cultivated land. Rice output, harvested areas and paddy yield have also increased. The country has shown relatively good progress in agricultural infrastructure development and provided irrigation to about one-fourth of cultivated land over the same period (Table 1).

Rapid expansion and transformation of agricultural land, mainly for commercial production, occurs at the expense of forests and outweighs the capacity of local authorities in the north. In particular, swidden land and fallow forests have been transformed into permanent land for contract farming, such as plantation of rubber trees, sugar cane and other cash crops (Thongmanivong et al., 2009). However, the land utilization ratio is still very low compared to many other developing countries in Asia. For example, over the period 1999-2009 the land use ratio for agricultural production in Cambodia was 22-23%, Vietnam 24-31%, Myanmar 16-19%, Thailand 37-38%, Indonesia 18-24%, Philippines 34-35%, Sri Lanka 30-35%, and heavily populated Bangladesh 64-68% (FAO, 2012).

The distribution of agricultural land is relatively equitable across provinces, with average land size of 1.62 hectares. Most of farmers hold agricultural land. Overall, 36% of farmers own less than one hectare, another 36% have 1-2 hectares, and 27% own 2

Table 1 Selected indicators of agricultural development in Laos

	1999	2005	2006	2007	2008	2009
Agricultural land (1000 ha) (% of total)	955 (4.1)	1,081 (4.7)	1,182 (5.1)	1,215 (5.3)	1,399 (6.1)	1,468 (6.4)
Agricultural population (% of total)	76.7	79.1	75.7	75.5	75.3	75.1
Agricultural land/agricultural population	0.24	0.24	0.26	0.26	0.31	0.32
Irrigated land (% of agricultural land)	26.2	16.5[a)]	27.8	27.4	26.2	21.1
Rice paddy output (1000 metric tons)	2,103	2,568	2,664	2,710	2,927	3,145
Rice paddy yield (kg/ha)	2,930	3,489	3,348	3,469	3,547	3,603
Rice paddy harvested area (1000 ha)	736	736	796	781	825	873

Note: [a)] denotes value of 2003

Source: *Selected indicators of food and agricultural development in the Asia-Pacific Region (various issues)*, Rome: Food and Agriculture Organization.

hectares or more (Onphanhdala, 2009). On the other hand, a decrease in agricultural population and a steady ratio of agricultural land to agricultural population of 0.24-0.32 could suggest a slight upward trend in land holding (Table 1).

Agriculture in Phongsaly province: Phongsaly, the most-northern province in Laos, has a very mountainous landscape. The major farming practice is slash-and-burn agriculture by farmers belonging to non-Lao ethnic groups (mainly Lao-Tai and Sino-Tibetan ethno-linguistic groups). Rice is by far the most important agricultural product of the province, followed by maize, starchy roots, vegetables, beans and nuts (Table 2). Since the beginning of the 2000s the plantation of sugar cane and some other cash crops (vegetables, beans, and nuts) has seen an upward trend, which most likely results from increased demand for agricultural products in neighboring countries and from increased investment in the agricultural sector largely by investors from China and Thailand (Onphanhdala and Suruga, 2013).

With respect to land reform, the program was launched in the province in 1997 and accelerated in 2000. With the allocation program, the average family land holding has declined (from 17 ha to 13 ha per family), whereas the area of slash-and-burn agriculture (roughly 3 ha per family) has not changed. The reform does not

Table 2 Agricultural production in Phongsaly province (unit: Tons)

Output (Tons)	1976	1980	1985	1990	1995	2000	2005	2009	96-00	01-05	06-09
Rice	20,055	26,093	38,310	39,720	40,946	37,430	44,725	51,155	39,800	38,067	46,123
Rice (% of Lao)	*3.03*	*2.48*	*2.74*	*2.63*	*2.89*	*1.68*	*1.74*	*1.63*	–	–	–
Maize	2,710	1,488	4,148	4,210	4,000	7,376	9,170	16,629	9,047	9,033	13,170
Starchy roots	2,122	2,460	2,185	9,720	6,000	1,204	20,810	25,133	9,280	19,796	20,798
Vegetables & beans	937	1,120	1,219	2,408	783	1,106	13,190	6,586	1,350	7,257	11,972
Peanuts	251	380	126	800	1,029	334	500	488	202	202	583
Soybeans	8	207	521	1,060	630	139	290	210	183	84	218
Mungbeans	11	85	140	280	217	52	210	105	32	119	131
Tobacco	147	245	360	1,600	1,139	–	–	–	563	–	–
Cotton	120	120	258	373	74	–	190	46	53	75	130
Sugar cane	–	–	1,250	1,225	630	43,200	21,100	83,109	31,330	27,041	63,975
Coffee	–	12	7	36	–	–	–	3	–	–	–
Tea	–	–	–	56	175	70	240	597	–	149	734

Note: '96-00' implies that the figure in the column is the average value for 1996-2000, '01-05' for 2001-2005, and '06-09' for 2006-2009.

Source: Northern rural infrastructure development sector project in (Ministry of Agriculture- and Forestry)

have immediate impact on reduction of shifting cultivation, but it has caused drastic reduction of fallow areas (from 21 ha to 7 ha per family) and accelerated rotations of swidden land (Ducourtieux et al., 2005).

3. Analytical Framework and Data

3.1 Analytical approach and empirical model

Following the theoretical work by Shorrocks (1982), which introduces alternative decompositions of income of households or individuals into different factor components, studies on inequality have drawn great attention in economic literature. In the 1980s and 1990s, a large number of research works on inequality topics were conducted for developed countries owing to availability of detailed household data (Lerman and Yitzhaki, 1984; Silber, 1989; Garner, 1993; Lambert and Aroson, 1993).

In a significant work, Lerman and Yitzhaki (1985) offer an alternative interpretation[1] of the 'natural decompositions' by Shorrocks and propose the marginal effect interpretation of an increase in income source on the overall inequality measure.

Derived from a formula for half of Gini's mean difference (A):

$$A = \int_a^b F(y)\,[1 - F(y)]dy = 2\sum_{k=1}^{K} cov(y_k, F) \qquad (1)$$

where y denotes income (a the lowest income, b the highest income), F the cumulative distribution of income (uniform distribution between [0, 1]), $y_k(k = 1, \ldots, K)$ the components of family income, and $cov\ (y_k, F)$ the covariance of the y_k component and F.

The decomposition of the Gini coefficient (G) is expressed as (Lerman and Yitzhaki, 1985; Lopez-Feldman, 2006):

$$G = \sum_{k=1}^{K}[cov(y_k, F)/cov(y_k, F_k)] \times [2cov(y_k, F_k)/m_k][m_k/m] \qquad (2)$$

$$G = \sum_{k=1}^{K} S_k\, G_k R_k \qquad (3)$$

where S_k represents share of component k in total income (importance of income component k to total income), G_k is the relative Gini of component k (how equally or unequally distributed income component k is), and R_k is the Gini correlation between

income component k and total income (how component k and the distribution of total income are correlated).

The effect of a marginal change in component k, denoted as e_k (a percentage change in component k), is derived in Lerman and Yitzhaki (1985) as:

$$\frac{\partial G}{\partial e_k} = S_k(G_k R_k - G) \quad (4) \text{ or}$$

$$\frac{\partial G/\partial e_k}{G} = \frac{S_k G_k R_k}{G} - S_k \quad (5)$$

Equation (5) means that the percentage change in inequality as a consequence of a marginal change in component k equals the original contribution of component k net of the component k's share of total income. In this paper we use an algorithm[2] developed by Lopez-Feldman (2006) to evaluate the effect of land inequality (types of agricultural land) on total land holding.

In addition, a regression analysis is applied to evaluate the impact of different types of paddy land and some farm characteristics (number of adults in the household, ethnicity of farm household) on rice sufficiency of farm households. An ordered probit model presents the best possible estimation for our case, because the dependent variable is ordinal and classified into three levels (Wood, 2006; Ogurtsov et al., 2009). The standard ordered probit model is expressed as:

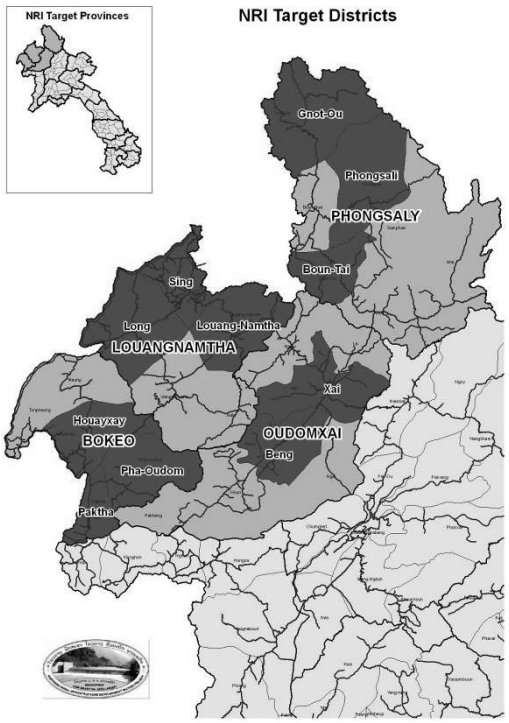
$$y_i^* = \boldsymbol{\beta}_i' \boldsymbol{x}_i + \varepsilon_i \quad (6)$$

where y_i^* is an unobservable variable, $\boldsymbol{x}_i$ is a vector of independent variables, $\boldsymbol{\beta}_i'$ is an array of parameters to be estimated, ε_i is a random error term assumed to follow a normal distribution, and the index denotes the *i-th* household. Instead of y_i^* we observe y classified into three categories (rice shortage, rice sufficiency, rice surplus) (Table 3).

3.2 Data and variables

The empirical analysis applies primary household data of 2011 and 2012, collected within scope of the socioeconomic analysis for the Northern Rural Infrastructure

Figure 1 Site of projects for data collection (Phongsaly province)



Source: Feasibility study for NRI Project in Phongsaly Province (MAF, 2012, 2013)

Development Sector Project (hereafter NRI Project). The NRI Project covers four provinces in northern Laos (Phongsaly, Luang Nam, Oudomxay and Bokeo province) and is implemented over several phases. The data used for this paper are obtained from the household surveys from five subprojects: (1) 2011 Survey (2 subprojects, 1,005 samples): Nam Ou Irrigation Subproject covers six villages (844 households), and Nam Lan Irrigation Subproject contains one village (161 households); and (2) 2012 Survey (3 subprojects, 1,296 samples): Nam Ngaen Subproject covers four villages (751 households), Nam Thae Subproject contains five villages (415 households), and Komaen-Phongsat Subproject includes two villages (130 households). Upon clearing data with incomplete information, 2,301 observations from the two surveys are applied for the investigation. All the variables used in the empirical analysis are non-monetary terms and invariant over the course of one year. This enables the use of combined data from the two surveys (pooled data) and thereby increasing the sample size and enhancing

the inference power of the analysis.

The surveys use a stratified random sampling method based on a master list of households (Masterlist) in a village (Ban) provided by the village authority. Each village is classified into sub-village (Nouay). The number of households (HHs) to be drawn from a Nouay is determined based on its size (a larger sub-village is allocated more sample HHs). In a village with more than ten Nouay's, a random sampling of ten sub-villages shall be done first, and sample HHs are randomly selected from each Nouay (MAF, 2012).

The initial dataset contains information on three major types of agricultural land (paddy land) and some information on land for home garden, fishpond, fruit trees, and wood. However, partly due to land scarcity in the mountainous landscape of the regions under study, very few households in the samples own or use land for other purposes than subsistence rice farming. This fact paves the way for the analysis to concentrate on paddy land. Moreover, information on household characteristics includes number of

Table 3 Definition of variables

Variable	Definition/description
Land types	
irr_lland	Irrigated lowland (Lao language: "napee sonlapathan") in hectare
rainf_lland	Rain-fed lowland (Lao language: "napee hap namphon") in hectare
upland	Upland (Lao language: "neun soung, na hai, na peut") in hectare
paddyland	Sum of the three types of agricultural land in hectare
Rice sufficiency	
ricesuffice	Ordinal variable defined as follows:
	"1" denotes rice shortage (for less than a month to more than 4 months)
	"2" denotes rice sufficiency
	"3" denotes rice surplus
Household characteristics	
adult	Number of adult members in the household
laotai	Ethno-linguistic dummy for Lao-Tai group (*reference*)
monekhmer	Ethno-linguistic dummy for Mone-Khmer group
hmonglu	Ethno-linguistic dummy for Hmong-Lumien group
tibechn	Ethno-linguistic dummy for Tibeto-Chinese group

Notes: 1) The vast majority of households do not own or use land for home gardens, fishponds, fruit trees, and wood. Hence, they are negligible and excluded from the analysis.

2) The original definition of rice insufficiency distinguishes five levels of rice shortage (shortage of less than one month, above 1 month to 2 months, above 2 months to 3 months, above 3 months to 4 months, and more than 4 months. However, in the analysis they are summarized to one situation of "rice shortage" regardless of the length of the event, i.e. the variable '*ricesuffice*' equals 1.

Table 4 Summary of variables

Description	Variable	Obs.	Mean	Std. Dev.	Min	Max
Irrigated lowland (ha)	*irr_lland*	2301	0.27	0.58	0.0	9.9
Rain-fed lowland (ha)	*rainf_lland*	2301	0.33	0.53	0.0	5.5
Upland (ha)	*upland*	2301	0.53	0.73	0.0	9.3
Paddy land (ha)	*paddyland*	2301	1.14	1.08	0.0	10.4
Rice sufficiency level (1, 2, 3)	*ricesuffice*	2301	1.90	0.53	1	3
Number of adults in the household (persons)	*adult*	2301	2.00	1.48	0	9
Ethno-linguistic group of Lao-Tai	*laotai*	2301	0.65	0.48	0	1
Ethno-linguistic group of Mone-Khmer	*monekhmer*	2301	0.07	0.25	0	1
Ethno-linguistic group of Hmong-Lumien	*hmonglu*	2301	0.01	0.11	0	1
Ethno-linguistic group of Tibeto-Chinese	*tibetchn*	2301	0.28	0.45	0	1

Source: Authors' calculations (primary data from Northern Rural Infrastructure Development Sector Project).

adult HH members and dummy of ethno-linguistic group. The definition of variables for the empirical analysis is presented in Table 3.

The summary statistics of land distribution and farm characteristics are presented in Table 4. On average, a typical farm household in Phongsaly province (northern Laos) owns about 0.3 hectare of irrigated lowland, 0.3 hectare of rain-fed lowland and 0.5 hectare upland for rice farming. These figures reflect the fact that the landscape of northern Laos is mountainous and fertile agricultural land is rather scarce. With respect to rice output, an average household would produce just enough for self-consumption (*ricesuffice* = 2), a fact that would confirm the existence of widespread subsistence farming in the country. Finally, the table reveals that the Lao-Tai and Tibeto-Chinese ethnic groups are the major ethnic groups in Phongsaly province, as they comprise more than 90% of the sample households.

4. Results and Discussions

The empirical analysis consists of two parts, namely the decomposition of land inequality among the three types of agricultural land based on Equation (5) and the evaluation of land inequality impact on food security (rice sufficiency) by estimating Equation (6). The Gini decomposition of land inequality is conducted for all households and for the three subgroups classified by rice sufficiency levels (Table 5).

Agricultural crop production is the main source of income, and rice output strongly influences the livelihoods of farmers in Phongsaly province. Hence, owning or having

Table 5 Decomposition of land inequality by types of agricultural land

	Source	Land holding share S_k	Gini of source (land type) G_k	Correlation with rank of total land holdings R_k	Share of land inequality I	Relative marginal effect (% Change)
A	All households					
	irr_lland	0.236	0.772	0.644	0.247	0.011
	rainf_lland	0.295	0.703	0.570	0.249	-0.046
	upland	0.470	0.626	0.814	0.504	0.034
	Total agricultural land		0.475			
B	Households facing rice shortage					
	irr_lland	0.135	0.896	0.721	0.158	0.022
	rainf_lland	0.200	0.812	0.632	0.186	-0.015
	upland	0.665	0.617	0.888	0.657	-0.008
	Total agricultural land		0.554			
C	Households achieving rice sufficiency					
	irr_lland	0.218	0.741	0.551	0.203	-0.015
	rainf_lland	0.316	0.662	0.525	0.250	-0.066
	upland	0.466	0.620	0.830	0.547	0.081
	Total agricultural land		0.439			
D	Households achieving rice surplus					
	irr_lland	0.399	0.662	0.728	0.418	0.019
	rainf_lland	0.270	0.723	0.531	0.225	-0.045
	upland	0.330	0.664	0.749	0.357	0.026
	Total agricultural land		0.460			

Source: Authors' calculations.

access to good land and irrigation services would raise farmers' income, improve their livelihoods and reduce the poverty incidence in the province.

For all households in the samples, the Gini decomposition reveals that upland has the largest share and eventually the strongest impact on land inequality across the samples and the three subgroups. Specifically, it accounts for 33-67% of total landholding (Table 5, column 1) and contributes 36-66% to land inequality (Table 5, column 4). In addition, with a relatively high Gini correlation between upland and total landholding of 0.749-0.888 (Table 5, column 3), upland favors the farm households at the top of the distribution, i.e. the comparably land-rich households. On the other hand, irrigated and rain-fed lowland are most unequally distributed among farm HHs (Table 5, column 2), but they have a relatively weaker impact on land inequality, i.e. smaller share of land

inequality, as compared to upland (Table 5, column 4). This result implies that most of farmers would have access to upland for farming and that relatively wealthy farmers could secure access to good land and irrigation services to enhance food security. This source accounts for more than half of land inequality among households under study in all but one case. Among the farmers with rice surplus (Part D), irrigated lowland would make the difference in land inequality (column 4).

A particular interest of the study is to look into the land distribution issue for the very poor households who face serious rice shortage (Part B). Within this subgroup, access to irrigation services and rain-fed lowland is highly unequal (Part B, row 2 and column 2), but these sources contribute only 14% and 20% to inequality (Part B, row 2 and column 1), respectively. Moreover, most of the households in this subgroup are upland farmers who hold little lowland and have little access to irrigation services. However, those who can secure access to good land and/or irrigation services are better off among themselves.

For all households (Part A) and relatively wealthy farmers (Part D), a 1% increase in irrigated lowland or upland would increase the Gini coefficient of landholding by 0.01-0.03%. However, such a change would have mixed effects on poorer households (Part B and C). On the other hand, an equivalent increase in rain-fed lowland would decrease land inequality by 0.02-0.07%. The results imply that the relative marginal effect of an increase in inequality sources varies across the subgroups in both sign and magnitude (Table 5, column 5).

The second part of the empirical analysis evaluates the contribution of different land types, access to agricultural services, household labor endowment, and farmer's ethnicity to food security. The results of the ordered probit estimation are presented in Table 6.

Overall, the estimation results are consistent with the Gini decomposition discussed above. First, owning or having access to lowland and/or having access to irrigation services would improve food security, while upland farmers tend to face rice shortage (or upland does not appear to contribute to rice sufficiency). As the Gini decomposition has revealed, the distribution of upland is more equal among farmers in northern Laos (in comparison to the other two types of agricultural land), hence, its contribution to rice sufficiency would be more equal and the coefficient estimate for upland is

Table 6 Impact of land types and farm characteristics on rice sufficiency

Description	*Dependent variable: Level of rice sufficiency*			
	Variable	Coefficient	Std. Err.	P>|z|
Irrigated lowland (ha)	*irr_lland*	0.648***	0.068	0.000
Rain-fed lowland (ha)	*rainf_lland*	0.476***	0.053	0.000
Upland (ha)	*upland*	-0.016	0.035	0.655
Number of adults in HHs (persons)	*adult*	0.037**	0.018	0.042
Ethnic group of Mone-Khmer	*monekhmer*	-0.419***	0.107	0.000
Ethnic group of Hmong-Lumien	*hmonglu*	0.209	0.253	0.408
Ethnic group of Tibeto-Chinese	*tibetchn*	-0.607***	0.065	0.000
	Observation	2301		
	Log likelihood	-1601.173		
	Pseudo-R2	0.115		

Notes: 1) Absence of collinearity problem is confirmed by using correlation matrix of independent variables. The maximum absolute value of pairwise correlation coefficients is less than 0.40. 2) The asterisks ** and *** denote significance at the 5% and 1% level, respectively.

Source: Authors' calculations.

understandably not significant. Second, it is plausible that households with more labor (greater number of adult members) available for farming activities are more likely to achieve a higher rice sufficiency level. Finally, the Lao-Tai ethno-linguistic group appears to have a higher probability of achieving greater rice sufficiency.

In sum, water resources for agricultural production – either by nature or through manmade facilities such as irrigation systems – would increase farm output and improve farmers' income and livelihoods. The analysis, however, does not take into account the impact of land quality due to lack of information. Similarly, the question of why and how the Lao-Tai ethnic farmers have achieved superior performance cannot be answered within the scope of the study due to the very reason of data unavailability. Finally, the results and findings from this study cannot be compared to other (developing) countries owing to absence of such analysis in published literature.

These are some interesting and relevant topics for further research that attempts to look into the issues of land inequality in other parts of the country or the world, and to address such issues related to ethnic diversity in agricultural development.

5. Concluding Remarks

Unequal distribution of agricultural land is often cited as a source of poverty

and inefficiency in agriculture in developing countries. However, much of literature on smallholders tends to address income inequality and (total) land size, while land inequality among landed farmers has been overlooked in those discourses. In contemporary Laos, where the land reform is progressing and land use transformation is occurring, land distribution is crucial for livelihoods of farmers and poverty reduction efforts of the government. In recognizing the importance of the issue, this paper decomposes the Gini index of land inequality with respect to three sources (irrigated lowland, rain-fed lowland, upland) by applying primary data from two household surveys in northern Laos (Phongsaly province).

It has been found that superior farming practices, particularly lowland farming, and access to good agricultural land (i.e. land with access to irrigation and other extension services) enhance food security of farmers, and thereby, improve their livelihoods. To date, the provision of agricultural services is still very unequal and does not reach most of the poor in remote areas. These services, however, are crucial for enhancing farmers' food security, especially for the lower segment of the land-poor farm households.

By nature, the mountainous landscape of the northern part of Laos provides very limited amount of good land (lowland) for agricultural production. However, land quality and agricultural productivity can be improved by means of productive investment in agricultural infrastructure, appropriate utilization and maintenance of the facilities, application of best practices in agricultural production, and appropriate land management and utilization. In this context, sound agricultural policy and land policy are essential for enhancing agricultural productivity and improving farmers' livelihoods. The Northern Rural Infrastructure Sector Project demonstrates the commitment of the government to agricultural development and poverty reduction and, if successfully implemented, could be replicated in other regions.

References

Adams, R. H. Jr. (2002). Nonfarm income, inequality and land in rural Egypt. *Economic Development and Cultural Change*, 50 (2), pp. 339–363.

Baird, I. G. and Shoemaker, B. (2007). Unsettling experiences: Internal resettlement and international aid agencies in Laos. *Development and Change*, 38 (5), pp. 865–888.

Bardhan, P., Luca, M., Mookherjee, D., and Pino, F. (2011). *Evolution of land distribution in West Bengal 1967-2004: Role of land reform*. United Nations University, Working Paper No. 2011/31, 40 pages.

Besley, T. and Burgess, R. (2000). Land reform, poverty reduction, and growth: Evidence from India. *Quarterly Journal of Economics*, 115 (2), pp. 389–430.

Binswanger, H. P. and Deininger, K. (1997). Explaining agricultural and agrarian policies in developing countries. *Journal of Economic Literature*, 35 (4), pp. 1958–2005.
Bourdet, Y. (1995). Rural reforms and agricultural growth in Laos. *Journal of Developing Areas*, 29 (2), pp. 161–182.
Clarke, D. G. (1975). Land inequality and income distribution in Rhodesia. *African Studies Review*, 18 (1), pp. 1–7.
Deininger, K., Jin, S., and Yadav, V. (2011). *Long-term effects of land reform on human capital accumulation: Evidence from West Bengal*. United Nations University, Working Paper No. 2011/82, 23 pages.
Ducourtieux, O., Laffort, J-R., and Sacklokham, S. (2005). Land policy and farming practices in Laos. *Development and Change*, 36 (3), pp. 499–526.
Erickson, L. and Vollrath, D. (2004). *Dimension of land inequality and economic development*. International Monetary Fund, Working Paper WP/04/158. Online Available: http://www.imf.org/external/pubs/ft/wp/2004/wp04158.pdf (26 June 2013).
Evrard, O. and Goudineau, Y. (2005). Planned resettlement, unexpected migration and cultural trauma in Laos. *Development and Change*, 35 (5), pp. 937–962.
Food and Agriculture Organization (FAO). (2012). *Selected indicators of food and agricultural development in the Asia-Pacific region 2001-2011*. Rome: Food and Agriculture Organization of the United Nations.
Fujita, Y. (2006). Understanding the history of change in Laos. *Mountain Research and Development*, 26 (3), pp. 197–199.
Fujita, Y. and Phanvilay, K. (2008). Land and Forest Allocation in Lao People's Democratic Republic: Comparison of Case Studies from Community-Based Natural Resource Management Research. *Society and Natural Resources*, 21 (2), pp. 120–133.
Garner, T. I. (1993). Consumer expenditures and inequality: An analysis based on decomposition of the Gini coefficient. *Review of Economics and Statistics*, 75 (1), pp. 134–138.
Haq, R. (2008). Land inequality by mode of irrigation in Pakistan, 1990-2000. *Pakistan Development Review*, 46 (4), pp. 1011–1022.
Jayne, T. S., Yamano, T., Weber, M. T., Tschirley, D., Benfica, R., Chapoto, and Zulu, B. (2003). Smallholder income and land distribution in Africa: Implications for poverty reduction. *Food Policy*, 28 (1), pp. 253–275.
Keswell, M. and Carter, M. (2011). *Poverty and land distribution: Evidence from natural experiment*. United Nations University, Working Paper No. 2011/46, 34 pages.
Lambert, P. J. and Aronson, J. R. (1993). Inequality decomposition analysis and the Gini coefficient revisited. *Economic Journal*, 103 (420), pp. 1221–1227.
Lerman, R. I. and Yitzhaki, S. (1984). A note on the calculation and interpretation of the Gini index. *Economic Letters*, 15 (3-4), pp. 363–368.
Lerman, R. I. and Yitzhaki, S. (1985). Income inequality effect by income source: A new approach and applications to the United States. *Review of Economics and Statistics*, 67 (1), pp. 151–156.
Lopez-Feldman, A. (2006). Decomposing inequality and obtaining marginal effects. *The Stata Journal*, 6 (1), pp. 106–111.
Ministry of Agriculture and Forestry (MAF) (2011). Report on the implementation of the 6th five-year agriculture and forestry development plan (2006-2010) and directions for the 7th five-year agriculture and forestry development plan (2011-2015). Phongsaly Provincial Department of Agriculture and Forestry, MAF, Government of Lao PDR.
Ministry of Agriculture and Forestry (MAF) (2012) Northern rural infrastructure development sector project: Feasibility study on Nam Ou Irrigation Subproject and Nam Lan Irrigation Project. Vientiane: MAF, Department of Planning (Two project reports).
Muller, E. N., Seligson, M. A., Fu, H-D., and Midlarsky, M. I. (1989). Land inequality and political violence. *American Political Science Review*, 83 (2), pp. 577-596.
Nippon Koei (2012). *Feasibility Study on Nam Ou Irrigation Subproject in Nhot Ou District of Phongsaly province*. Northern Rural Infrastructure Development Sector Project. Department of Planning, Ministry of Agriculture and Forestry, Government of Lao PDR.
Ogurtsov, V. A., M.A.P.M. van Asseldonk, and R.B.M. Huirne. (2009). Purchase of catastrophe insurance by Dutch dairy and arable farmers. *Review of Agricultural Economics*, 31 (1), pp. 143–162.
Olper, A. (2007). Land inequality, government ideology and agricultural protection. *Food Policy*, 32 (1), pp. 67–83.
Onphanhdala, P. and Suruga, T. (2011). Impacts of Chinese investments on agricultural transformation and

rural development: Evidence from Oudomxay, northern Laos. *Scientific Journal of National University of Laos*, 5, pp. 179–188.
Onphanhdala, P. and Suruga, T. (2013). Chinese outward FDI in agriculture and rural development: Evidence from northern Laos. Kobe University, Graduate School of International Cooperation Studies, Working Paper No. 25. Online Available: http://www.research.kobe-u.ac.jp/gsics-publication/gwps/2013-25.pdf (4 July 2013).
Phachomphone, K., Sengxua, P., Phouthavong, K., and Phenvichith, V. (2012). Agricultural and forestry land use planning at cluster village level: In case Xiengdao cluster village, Meung district, Bokeo province. *Lao Journal of Agriculture and Forestry, 26(Special Issue)*, pp. 1–10 [Lao language].
Phongsaly Provincial Department of Planning and Investment (PDPI) (2011). The 7th five-year socio-economic development plan of Phongsaly Province (2011-2015). PDPI, Phongsaly Province.
Shorrocks, A. F. (1982). Inequality decomposition by factor components. *Econometrica*, 50 (1), pp. 193–212.
Silber, J. (1989). Factor components, population subgroups and the computation of the Gini index of inequality. *Review of Economics and Statistics*, 71 (1), pp. 107–115.
Thongmanivong, S., Fujita, Y., and Phanvilay, K. (2009). Agrarian land use transformation in northern Laos: From swidden to rubber, *Southeast Asian Studies*, 47 (3), pp. 330–347.
Thongmanivong, S. and Fujita, Y. (2006). Recent land use and livelihood transitions in northern Laos. *Mountain Research and Development*, 26 (3), pp. 237–244.
Vandergeest, P. (2003). Land to some tillers: Development-induced displacement in Laos. *International Social Science Journal*, 175, pp. 47–56.
Vixathep, S. and Onphanhdala, P. (2013). Efficiency of upland and lowland farming in Lao PDR. *Lao Journal of Economics and Management*, 4 (1), pp. 18–37.
Vollrath, D. (2007). Land distribution and international agricultural productivity. *American Journal of Agricultural Economics*, 89 (1), pp. 202–216.
Wood, E. H. (2006). The internal predictors of business performance in small firms: A logistic regression analysis. *Journal of Small Business and Enterprise Development*, 13 (3), pp. 441–453.

Notes

1 Lerman and Yitzhaki (1985) maintain that explaining the contribution of each factor component as the product of its own inequality, its share of total income, and its correlation with the rank of total income yields a more intuitive and compelling interpretation than the original 'natural decompositions' (the source contribution is viewed as the product of income share and the pseudo-Gini) by Shorrocks (1985).

2 Lopez-Feldman (2006) developed an algorithm for estimating equation (5) that reports all the components: S_k, G_k, R_k, G, and the marginal effect ($\frac{\partial G/\partial e_k}{G}$).