

Pathway for Improving Livelihood of Relocated Villagers through Livestock Production in Lao People's Democratic Republic: A Case Study in Houakhoa Village, Long District, Luang Namtha Province

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Livestock production plays important roles in food production and income generation for relocated rural villagers. These farmers were relocated from mountainous regions in an effort to reduce the practice of shifting cultivation as part of the government policy to conserve its natural forests and increase food security through improved rice production in the lowlands. Improvement of livestock production in relocated rural villages, which are generally small, traditional, and subsistence-level, has been given the highest priority in the Lao government's rural development strategy (Gleeson and Colling, 2006). To investigate the effect of livestock production on livelihood improvement in relocated villages, I performed a case study in Houakhoa village, in Long District of Luang Namtha Province, Laos. Data on socioeconomic factors affecting farmers' livelihoods after relocation were collected; these data covered 58 households that had been relocated from different districts and provinces in the period 1985 to 2009. Farmers were allocated to five groups according to the time of their relocation: group 1 (1985–1989), group 2 (1990–1994), group 3 (1995–1999), group 4 (2000–2004), and group 5 (2005–2009). The total agricultural land areas owned by group 1 and 4 farmers were significantly larger than those owned by group 5 farmers. The total household income increased in all groups after relocation. The reason for the income increase could have been improved access to various social services and information, including agricultural technologies. No significant differences in total average numbers of pigs or poultry were observed among the five groups. Income from livestock production tended to be more important and stable than that from crop production in all groups. Reorientation of livestock production from semi-subsistence or subsistence systems toward sustainable commercial production, together with exploration of the potential of livestock intensification, could therefore be among the potential alternatives for improving the livelihoods of relocated rural villagers in Laos.

Key words: Resettlement, household income, livestock, sustainable pig production

Introduction

1. Background

Strengthening of food security and reduction of poverty in rural areas are the major priorities of the government of the Lao People's Democratic Republic (Lao PDR), and improvement of livestock production systems has been given the highest priority of the government's rural development strategy

(Gleeson and Colling, 2006). Livestock production is an important component of smallholder farming systems in the Lao PDR. Livestock are often vital sources of family savings and economic security, a means of accumulating assets, and a means of averting risk in case of crop failure or natural hazards such as flood or drought (Poku, 2009). However, livestock are still produced in smallholder systems, which are traditional and operate at sub-

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sistence level (Ingxay *et al.*, 2009). These systems are used for the production of all indigenous animals, which make up more than 90% of all meat consumed in the country (Keonouchanh, 2004). Most farmers keep a combination of a few local pigs, local poultry, native goats, and occasionally cattle; small livestock (notably pigs and poultry) contribute substantially to household income of small-scale farmers in Luang Namtha Province (PAFO, 2008).

To discourage shifting cultivation practices and reduce poverty in upland areas, resettlement from upland to lowland areas has been conducted by local governments with the aim of helping the poor to increase their food production and gain access to various social services. However, new settlers have often faced problems, such as limited availability of agricultural land and lack of experience in lowland agriculture and livestock production, which differ from the systems used in upland areas.

The livestock sector plays an important role in the socioeconomic development of rural households in terms of food security and the generation of farmers' incomes, as well as complementing crop production. Therefore, livestock development has been identified as an alternative to shifting cultivation that will help to alleviate some of the problems faced by resettled farmers (National Socio-Economic Development Plan, 2005). Increasing livestock production can play an important role in providing increased cash flow and reducing labor requirements (Stur *et al.*, 2002). However, productivity is low because of the use of indigenous breeds and because of poor management practices. It is clear that improvement of livestock production systems is important for enhanced productivity. However, there have been limited studies of the challenges faced by livestock smallholders in relocated villages. Moreover, there is a need to adopt indigenous livestock production technologies that will increase productivity by reorienting livestock production from semi-subsistence and subsistence systems toward sustainable commercial production at the village level.

2. Challenges and Potential of Smallholder Livestock Production in Houakhoa Village

Houakhoa village is a poor village in the Chaleunesay cluster in Long District. All the farmers

operate on a small scale and practice mixed farming. Livestock production is a key component in village and family well-being (Varney, 2006) and account for more than 50 percent of cash income in households in the upland areas (Wilson, 2007). Pig production is a major source of household income for most families, whereas poultry production is the main source of the meat consumed daily. Because there is limited availability of grasses and fallow land, non-ruminants are raised in the village. The major constraints to efficient and sustainable small livestock production by smallholders in this village are low productivity (slow weight gain), which is attributed to poor breed fertility and poor nutrition (or feed shortages), and poor management (PLFO, 2009), which is not only labor intensive but also contributes to poor infection resistance and exacerbates disease problems, as reflected in the high rates of parasitism and of diseases such as classical swine fever (CSF), fowl cholera, and Newcastle disease. Because the identification of CSF outbreaks is based on a system of passive surveillance, the incidence of CSF is probably underreported (Khounsy and Conlan, 2007), as farmers have limited knowledge of effective general animal health and management skills. Vaccination and deworming are not done regularly, even though treatment of internal and external parasites is a cheap and effective way to increase productivity and minimize disease and mortality (Phimphachanhvongsod *et al.*, 2004). Farmers are also faced with declining livestock productivity because of inadequacy of animal feeds. Nutrient intakes are not well balanced for protein, carbohydrate, minerals, and vitamins. Crop by-products (rice bran and broken rice) are the main animal feeds used, and farmers rely on common property feed resources, which occur naturally in fallow fields, near cropping areas, and in the forest (Phengsavanh, 2008). Inbreeding or poor livestock quality with low growth rates is another problem faced by farmers, because animals for fattening are often purchased from local markets, neighboring villages, or passing traders without quarantine or realization of the consequences (Varney, 2006). Most breeding pigs are brought from rural upland areas, where free-scavenging systems are used, with supplementary cooked feed being supplied in the morning and late afternoon.

In September 2008, a Livestock Farmer Support

Project (LFSP), which was ran by department of livestock and fisheries, granted aid to village farmers via a livestock revolving fund. The purpose of the project is to sustainably increase profits for livestock farmers from improved management and sales, as provided by effective livestock services. The project activities are as follows: (1) training in techniques of livestock production, including livestock management, animal nutrition, and animal health (e.g. diseases, vaccination, and treatment); (2) supporting livestock farmers with a revolving fund; (3) formation of a livestock production group and village committee for fund management; and (4) introduction and promotion of the establishment of forage legumes, such as *Stylosanthes guianensis* 'CIAT 184' (Stylo 184), on local farms.

With the support of the LFSP, farmers are moving toward more intensive and market-oriented livestock production systems, such as fattening pigs. Farmers usually fatten pigs aged from about 4 months and at a weight of about 14 to 15 kg, and they sell them at an estimated weight of 65 kg. To reach this weight in the traditional way, it takes about 18 months, but by using Stylo 184 as a supplementary feed the fattening period is reduced to less than 9 months (Phengsavanh, 2008). Livestock production has changed from a free-scavenging system to a semi-intensive system (confining pigs in enclosures or penning). Farmers have planted and utilized fresh Stylo 184 as a supplementary feed by mixing it with the main feeds such as rice bran and banana stem and green feed collected from fallow fields and the forforest. Some farmers who brew alcohol from sticky rice utilize the brewing waste to feed their pigs by mixing it with the main feeds; this could help to increase the overall digestibility of the feed. Because of high prices, no commercial feeds are provided or used.

However, even though the livestock raising system has become more manageable, the change remains limited. Some farmers still raise pigs predominantly by the traditional methods, with low input. Growth rates of both young pigs and breeding stock are low because of poor nutrition and inadequate watering. Farmers still seem to depend more on rice bran, banana stem, and other available green feeds occurring naturally than on Stylo 184.

The purpose of this study was to explore the potential of livestock intensification, which could

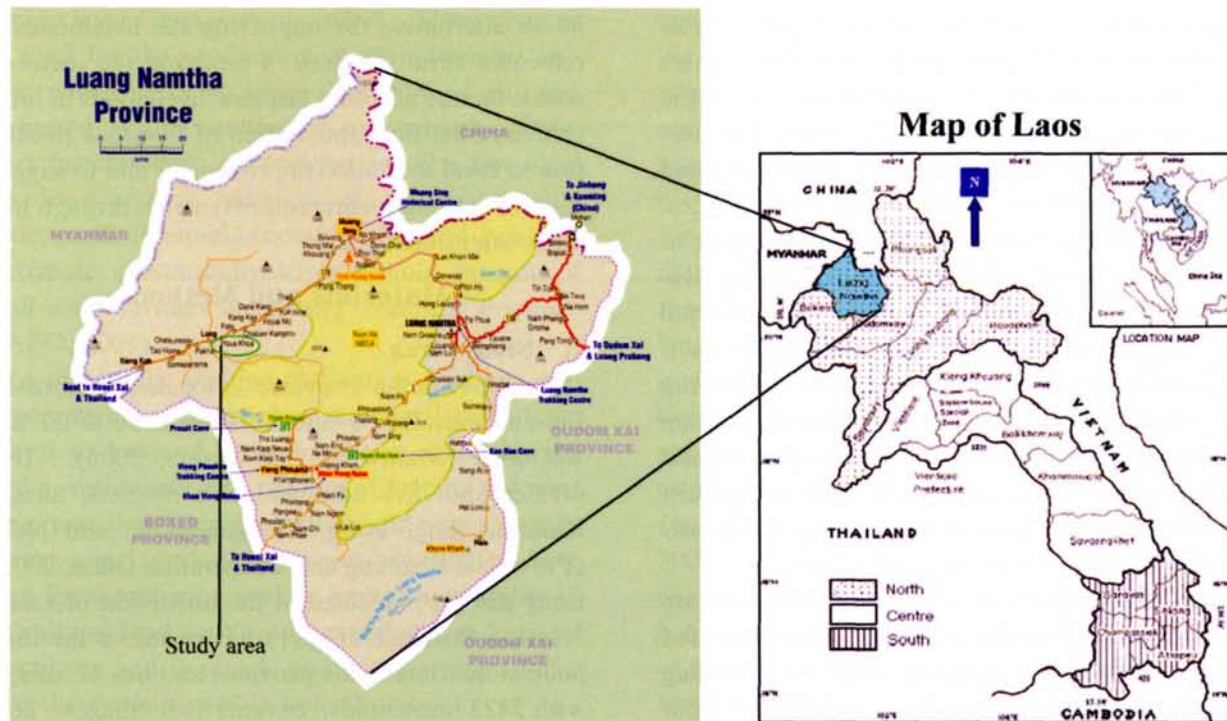
be an alternative for improving the livelihoods of relocated rural villagers. I analyzed the socioeconomic factors affecting farmers' livelihoods in order to determine the contribution of livestock production to rural livelihood improvement and to suggest ways of making further improvements through livestock intensification.

Materials and Methods

1. Study Area

Luang Namtha Province is located in northern Laos between 20°30' and 21°30'N and 100°30' and 102°00'E (Manivong and Cramb, 2006). It is divided into five administrative districts, namely Namtha, Sing, Long, Viengphoukha, and Nalae (Provincial Planning and Cooperation Office, 2005). Long district is located in the northwest of Luang Namtha Province (Fig. 1). It is one of the three poorest districts in the province and has 82 villages with 5423 households. Seventy-two villages—88% of the total—are poor (lack basic human needs such as adequate food, clothing and permanent housing). The total population is 29,273, of which 14,164 are women. More than 70% of farmers in the district are smallholders, living in rural uplands and remote areas with poor infrastructure, poor social services, and low living standards (District Agriculture and Forestry Office, 2008). Their livelihoods depend on natural resources: to survive, they hunt wildlife, fish, forage for forest products, and practice slash-and-burn crop cultivation with a low profit margin (Gender Resource Information and Development Center, 2006). Most farm incomes in the uplands are derived from sale of livestock, small amounts of leafy vegetables and non-timber forest products, as well as from non-farm and off-farm activities that finance the purchase of additional rice and other everyday needs (Pravongviengkham, 1998).

Initially, Houakhoa village was established in 1985 with 15 households when families migrated from other provinces in search of productive agricultural land. Thereafter, other groups of rural families arrived as the government began to encourage the relocation of upland farmers. Currently, there are 58 households (65 families) living in Houakhoa village, and the total population is 324. The rate of relocation of villagers varied among periods: 15 households moved during the period



Source: http://www.ecotourismlaos.com/images/map/namtha/namtha_bg.jpg

Fig. 1. Laos and the study area.

1985–1989; 8 moved between 1990 and 1994; 13 between 1995 and 1999; 11 between 2000 and 2004, and 11 between 2005 and 2009. The village population moved predominantly from Houaphan, Louang Prabang, and Oudomxai provinces. Before relocation, many of the villagers lived in remote and mountainous areas where agricultural land was limited. They experienced poor living conditions because of limited access to electricity, telecommunications, and clean water. Generally, these people tended to have poor physical access to public financial resources.

2. Data Collection and Analysis

To investigate the effects of livestock production on the livelihoods of relocated villagers, I performed a case study in Houakhoa village in October 2009. Data on the socioeconomic factors affecting farmers' livelihoods after relocation were collected, and two district livestock officers, each of whom had more than 3 years' service and experience, were selected to administer the questionnaire to the 58 households that had been relocated from the different districts and provinces during the period 1985 to

2009. The questionnaire was divided into four main sections: (1) general household information, including educational level, number of family members, age, sex, marital status, and relationship of family members to household head; (2) household economics, including income sources, annual income before and after translocation, annual expenditures, income-generating activities, and area of farmland owned; (3) livestock production status, including animal breeds, animal health, and animal nutrition and management; and (4) reasons for relocation, place from which they had moved, their expectations in moving to a new place, and their attitudes toward livelihood improvement and poverty reduction.

The primary data collection method was individual household interview in the presence of village leaders and a village veterinary worker; every family in the village was interviewed to ensure that no information was missed. Respondents were identified as household heads or their wives. The data collection also included reviewing related secondary data such as reports, statistical data, maps, and documents.

After careful examination of the nature of collected data, 58 farmers were grouped according to the time of their relocations: Group 1 (1985–1989), Group 2 (1990–1994), Group 3 (1995–1999), Group 4 (2000–2004), and Group 5 (2005–2009). Consequently, the number of farmers allocated into Group 1 through Group 5 were 15, 8, 13, 11 and 11, respectively.

The one-way analysis of variance was conducted by using the SAS/STAT statistical package software (SAS/STAT Ver 8.02, SAS Institute, Cary, NC, USA). The results were reviewed and discussed so that final conclusions and recommendations could be made.

Results

There were no significant differences in the average ages of household heads or in family size among each resettlement group. The literacy rate of household heads in group 1 was significantly higher than those in the other groups ($P > 0.05$), and this group recorded the highest overall educational level. There was no significant difference in literacy rates between group 3 and group 4. The household heads of group 5 had reached only a primary level of education. The literacy rate of the household heads of group 2 was markedly lower than that in all the other groups (Table 1).

The total farmland areas owned by households in groups 1 and 4 were significantly ($P < 0.05$) larger than those owned by group 5 but not larger than those owned by groups 2 and 3; the paddy area owned by group 1 households was significantly larger than that of group 5, but not of groups 2, 3, and 4. The rubber tree plantation area of households in group 1 was significantly larger ($P < 0.05$) than those in all the other groups, and the upland rice plots of households in group 4 were significantly larger ($P < 0.05$) than those of groups 3 and 5, but not of groups 1 and 2 (Table 2).

There were no significant differences ($P > 0.05$) among farmer groups in the proportion of income derived from livestock production. The proportion of income derived from crops by group 1 was significantly higher ($P < 0.05$) than by all the other groups. The proportions of income derived from off-farm activities by groups 3 and 5 were significantly ($P < 0.05$) higher than by the other groups (Table 3).

There were no significant differences in annual income and expenditure among the five groups before relocation. Annual income and net income after relocation in group 1 were significantly higher ($P < 0.05$) than in group 5. There were no significant differences ($P > 0.05$) in annual income and net income among groups 2, 3, and 4 after relocation (Table 4).

The average total numbers of pigs and poultry did not differ significantly among the five groups ($P > 0.05$). The number of boars owned by group 1 was significantly greater than that owned by group 5. There were no significant differences in the mean numbers of roosters owned by the five groups (Table 5).

The mean overall rate of vaccination of pigs against CSF was high (92.5%), but no farmers vaccinated their poultry (Table 6).

Discussion

Household income was analyzed to establish correlations among the farm size, family size, age, and educational attainment of household heads and income-generating activities. The literacy rate of household heads in group 2 was much lower ($P < 0.05$) than those in the other groups (Table 1). Clearly, these farmers had had poor educational support before resettlement. Settlement in remote areas before the resettlement process had given them poor access to education, because educational support from the government has been very limited in remote areas in the past three decades. The educational level of household heads was not related with annual household earnings.

I examined the proportions of the population of the village in its current location that had attended, or were attending, school (Figs. 2 and 3). Primary school and secondary school attendance and literacy rates were high for young people (both male and female) under 20 years old. It was not surprising that students of all ages had access to education in the villagers' current location, because the Ministry of Education had recently conducted the Education for All program, which is the main vehicle for expanding access to primary and lower secondary education. Moreover, adult literacy and education are recognized by the National Social Economic Development Plan as of crucial priority and one of the four pillars of the poverty reduction strategy,

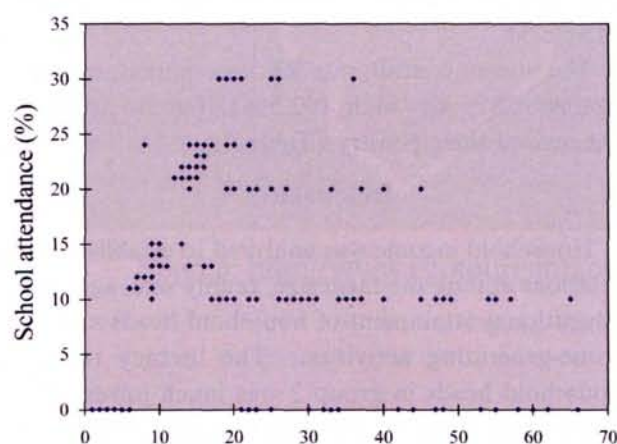
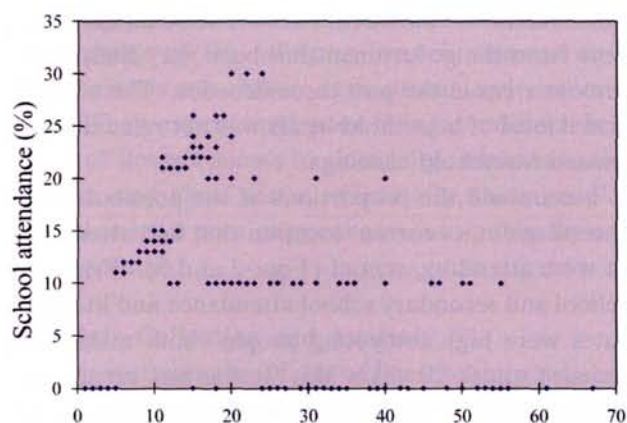
Table 1. Family size, age distribution, and educational level among farmer groups

Group no.	No. of HH	Average age of HH	Average family size	High school	Lower secondary school	Primary school	Illiterate	Literacy rate
Group 1	15	40.9±2.4 ^A	5.7±0.4 ^A	1	3	9	2	86.0 ^A
Group 2	8	43.3±4.1 ^A	4.9±1.0 ^A	0	0	1	7	12.5 ^D
Group 3	13	44.8±4.0 ^A	5.7±0.4 ^A	0	2	6	5	61.6 ^B
Group 4	11	43.5±2.4 ^A	5.5±0.5 ^A	0	1	7	3	72.7 ^B
Group 5	11	36.9±3.4 ^A	5.8±0.8 ^A	0	0	8	3	72.7 ^C

A, B, C, D Different letters in the same column indicate that the values differ significantly ($P < 0.05$).

± Values represent mean ± SE.

HH, household heads.

**Fig. 2.** Age distribution of education in males.**Fig. 3.** Age distribution of education in females.

ensuring that all Laotians have to access to primary education by 2015 (Ministry of Education, 2008).

There were no significant differences in annual income among the five groups before relocation, but after relocation the total annual incomes dif-

fered significantly among farmers in group 1 and group 5 and each group had different ways of earning money. The incomes of farmers who owned less agricultural land were derived mainly from off-farm activities. After relocation, farmers in group 1 had significantly higher ($P < 0.05$) annual incomes than those in the group 5. Their income increased from 7.66 million kip to 10.42 million kip. The fact that these farmers had moved earliest and owned relatively large areas of farmland led us to infer that household income from agriculture was directly related to farmland area. At 2.27 ha, the total amount of agricultural land owned by this group was significantly larger ($P < 0.05$) than that owned by group 5 farmers; 0.75 ha of the 2.27 ha was paddy field, and this area, too, was significantly larger than that owned by group 5 farmers, who had resettled the most recently. It was not surprising that the farmers in group 1 owned more farmland than those in the other groups. Generally, they had access to fallow land that could be improved for agricultural use, including plains that could be developed into paddy fields. Farmers in group 1 also had early access to sloping land for the cultivation of upland rice, cash crops, and plantations of trees for industrial use, such as Para rubber trees. They could cultivate cash crops; therefore, the proportion of income derived from crops (31.59%) by this group was significantly higher than in all the other groups (Table 3). The Ministry of Agriculture and Forestry (2009) reported that rice is the dominant crop for small-scale farmers, as rice is the staple of the Lao people. Generally speaking, every family needs to produce sufficient rice for home consumption. Thus, group

Table 2. Farmland area ownership (ha)

Group no.	Paddy field	Upland field	Vegetable field	Rubber tree plantation	Other	Total
Group 1	0.75±0.1 ^A	0.60±0.2 ^{AB}	0.04±0.0 ^A	0.82±0.2 ^A	0.06±0.0 ^A	2.27±0.2 ^A
Group 2	0.36±0.1 ^{AB}	0.90±0.3 ^{AB}	0.05±0.0 ^A	0.26±0.1 ^B	0.06±0.1 ^A	1.64±0.4 ^{AB}
Group 3	0.45±0.1 ^{AB}	0.42±0.2 ^B	0.15±0.1 ^A	0.28±0.1 ^B	0.10±0.1 ^A	1.40±0.2 ^{AB}
Group 4	0.35±0.2 ^{AB}	1.27±0.5 ^A	0.05±0.0 ^A	0.34±0.1 ^B	0.00±0.0 ^A	2.02±0.5 ^A
Group 5	0.25±0.1 ^B	0.37±0.1 ^B	0.05±0.0 ^A	0.15±0.1 ^B	0.06±0.0 ^A	0.89±0.2 ^B

^{A, B} Different letters in the same column indicate that the values differ significantly ($P < 0.05$).

± Values represent mean±SE.

Table 3. Proportions of income from different sources, by group

Group no.	Percentage income from livestock	Percentage income from crops	Percentage income from off-farm activities
Group 1	34.85 ^A	31.59 ^A	33.57 ^B
Group 2	37.52 ^A	15.12 ^B	47.36 ^B
Group 3	28.68 ^A	10.17 ^B	61.16 ^A
Group 4	41.28 ^A	21.36 ^B	37.35 ^B
Group 5	28.81 ^A	8.78 ^B	62.40 ^A

Note: Income from off-farm activities includes principally employment for wages, but also sale of wild products (non-timber forest products) and handicrafts, and labor in non-agricultural enterprises.

^{A, B} Different letters in the same column indicate that the values differ significantly ($P < 0.05$).

± Values represent mean±SE.

1 farmers who had land appropriate for use as paddy fields could produce enough rice for home consumption all year round and had enough left over to sell as a cash crop. These farmers may have saved more money to pay for basic needs, such as electricity, clothing, schooling for their children, and health care.

The annual income and net income of farmers in group 5, who were the last to move, were significantly lower ($P < 0.05$) than those in group 1. In the new environment, these farmers could not increase their incomes to as great an extent as the farmers in group 1: their income increased only slightly, from 5.81 million kip to 5.90 million kip (Table 4). The limited farmland areas owned by this group included only small areas of paddy field, upland plots for growing upland crops, and rubber tree plantations; these farmers therefore had limited opportunity for successful agricultural production. The average farmland area owned by farmers

in group 5 was significantly smaller ($P < 0.05$) than those of groups 1 and 4 (Table 2). These farmers' traditional agricultural practices, with low inputs and poor management, together with their small areas of paddy (0.25 ha) and upland rice (0.37 ha) fields, contributed to low rice production throughout the year. Phimpachanhvongsod *et al.* (2008) reported that the low and variable yields from upland rice cultivation are largely due to declining soil fertility and increasing weed problems resulting from the trend toward short fallow periods. Slash-and-burn strategies could also encourage land degradation. The farmers of group 5 are likely to be under increased pressure in regard to food security and other basic needs, and they may need to spend large amounts of money purchasing rice from the markets. As a result, family members might work as temporary employees for construction companies and other employers in neighboring villages—for example, clearing weeds on Para rubber plan-

Table 4. Household income change (before and after relocation) (Units: ×million kip)

Group no.	Income before movement	Income after movement	Expenditure	Net income (income-expenditure)
Group 1	7.66±3.09 ^A	10.42±1.19 ^A	7.20±0.75 ^A	3.22±0.74 ^A
Group 2	3.56±0.92 ^A	6.86±1.33 ^{AB}	5.38±1.24 ^A	1.47±0.60 ^{BA}
Group 3	4.11±0.57 ^A	9.30±1.31 ^{AB}	7.26±0.93 ^A	2.03±0.53 ^{BA}
Group 4	2.98±0.46 ^A	6.93±1.08 ^{AB}	4.79±0.59 ^A	2.14±0.67 ^{BA}
Group 5	5.81±2.48 ^A	5.90±0.90 ^B	5.07±0.81 ^A	0.82±0.18 ^B

^{A, B} Different letters in the same column indicate that the values differ significantly ($P < 0.05$).

± Values represent mean ± SE.

tations, in rice transplantation and harvesting, and in sugar cane harvesting—to earn money. Therefore, the main household income of group 5 farmers (62.40%) was derived from off-farm activities, including the sale of handicrafts and small amounts of non-timber forest products, and from labor in non-agricultural enterprises (Table 4).

The total income from off-farm activities in group 3 (61.16%) was significantly higher ($P < 0.05$) than those in the other groups, except group 5; the contribution of off-farm activities to annual income in groups 1, 2, and 4 was less than 50%. The situation of farmer group 3 was therefore quite similar to that of the group 5 farmers. They held only a small area of upland fields (0.42 ha), but the area of paddy field owned was larger than that of all other groups except group 1. Group 3 farmers might have faced some obstacles in the process of upland field cultivation to paddy field cultivation, such as difficulties in managing the paddy water and the rice seedlings; they were also hampered by a lack of experience and technical expertise.

There were no significant differences ($P > 0.05$) in annual income and annual expenditure between groups 2, 3, and 4 either before or after relocation (Table 4). There were no significant differences ($P > 0.05$) in the contribution of livestock to total income by group (range, 28.68% to 41.28%) (Table 3). For all groups, livestock tended to be a more important source of household income than crops. Nevertheless, most of the farmers lacked advanced technologies and skills in livestock production; they used simple, traditional techniques with low input, and productivity was not high as reported in the 4th project progress report of the implementation of

livestock revolving fund (PLFO, 2009).

The results of the survey showed that there were two main raising systems used by smallholder farmers. Semi-free-range poultry raising was used by 54 households (93.10% of the total). The poultry were housed at night and released in the daytime to scavenge around and within the village. Broken rice and rice bran were fed in the early morning when the poultry were released and in the late evening before they were housed. A semi-intensive pig-raising system was used by 46 households (79.30% of the total). There were no significant differences ($P > 0.05$) in the average total numbers of either pigs or poultry kept by the five groups. The poultry population ranged from 20.4 to 39.6 and the pig population from 1.9 to 6.0 per household (Table 5). A close look at the figures revealed that the farmers of group 1 concentrated more on pig raising than farmers in the other groups. Group 1 also had significantly more boars ($P < 0.05$) than group 5 (Table 5). Group 1 farmers might have been able to afford better ways of both managing parent pigs and fattening pigs (e.g. the use of veterinary services). They might have recognized the potential of using additional feed resources to improve and intensify livestock production; it can be inferred that group 1 farmers attached importance to pig production to improve their livelihoods. This group of farmers might have had a better understanding of the technical information related to animal nutrition, health care, and management, because the project provided several technical training courses on pig production for target groups. Data from the project's progress report (PLFO, 2009) showed that 20 households were

Table 5. Average numbers of pigs and poultry, by group

Group no.	Pigs			Poultry		
	Boars	Sows	Total	Roosters	Hens	Total
Group 1	2.8±0.7 ^A	3.2±1.2 ^A	6.0±1.7 ^A	8.1±1.6 ^A	20.9±4.6 ^A	29.1±5.8 ^A
Group 2	1.8±0.7 ^{AB}	3.6±2.4 ^A	5.4±2.9 ^A	9.8±5.9 ^A	29.9±17.4 ^A	39.6±23.2 ^A
Group 3	2.5±0.6 ^{AB}	2.1±0.7 ^A	4.6±1.2 ^A	8.0±2.9 ^A	15.8±4.6 ^A	23.8±7.3 ^A
Group 4	1.9±0.7 ^{AB}	2.3±0.5 ^A	4.2±1.0 ^A	8.3±2.6 ^A	12.1±3.5 ^A	20.4±5.9 ^A
Group 5	0.5±0.2 ^B	1.4±0.3 ^A	1.9±0.5 ^A	7.6±1.8 ^A	16.8±3.4 ^A	24.5±4.7 ^A

^{A,B} Different letters in the same column indicate that the values differ significantly ($P < 0.05$).

± Values represent mean±SE.

Table 6. Livestock populations, average vaccination rates, and mortality rates

Livestock type	No. of livestock farmers	No. of livestock	Year-round vaccination rate (%)	Diseases vaccinated for	Mortality rate (%)
Breestock pigs	5	14	100	CSF	0
Fattening pigs	46	246	85	CSF	7
Poultry	54	1556	0	0	22

CSF: classical swine fever.

selected to be beneficiaries of the project in the first cycle (12 months) of the livestock revolving fund; most of the beneficiaries might have been farmers of group 1. The selection criteria gave priority to the original farmers or first-comers who were willing and had farm labor. These farmers seemed to have had more experience with livestock raising, and among the various relocated groups they may therefore be considered to have performed best in pig production. Farmers in group 5 kept the fewest pigs (average 1.9 per household). These newly arrived farmers may have lacked experience in animal husbandry. They based their feed more on rice bran, to which was added small amounts of green vegetables collected from fallow fields. Because of the limited land area that they owned, which was reflected in their low incomes from livestock and crops, they may not have used Stylo 184 as a supplementary feed. In contrast, most of the farmers in the other groups would probably have fed better quality feed in sufficient quantities by mixing a forage legume (i.e., Stylo 184) into the main diet to increase the overall digestibility of the ration, enabling them to raise more pigs for market and increase their household incomes. Phengsavanh (2008)

reported that Stylo 184 can be adapted to different areas and grows well in a wide range of soils, including poorly fertile, acidic soils. It produces large quantities of good-quality feed for cutting during the rainy season. It stays green into the dry season, and its leaves can be fed fresh or dried and stored as leaf meal.

The results in Table 6 revealed that almost every household vaccinated its pigs against CSF twice a year; this was done by district livestock officers and a village veterinary worker. The average vaccination rate of pigs was high (92.5%) compared with the national vaccination rate 23.2% for pigs (DLF, 2009). Khounsy *et al.* (2008) reported that CSF virus is endemic to the Lao PDR, with major outbreaks each year resulting in substantial production losses in all farming systems, including smallholdings and semi-intensive and intensive farms. Another reason for the high vaccination rate against CSF is that the District Agriculture and Forestry Office set up village regulations related to pig production as part of an agreement with the village. The villagers were strongly encouraged to vaccinate their pigs to ensure effective implementation of the livestock revolving fund, which is supported by

the LFSP. They understood that if their pigs were killed by disease, they would suffer losses: a pig costs a lot more than a chicken. Nevertheless, a few farmers were still vaccinating only their breeding stock and not their fattening pigs, and unfortunately no farmers were vaccinating their poultry. Farmers neglected vaccinating their poultry against fowl cholera and Newcastle disease during the yearly vaccination period, with the mistaken perception that their poultry were resistant to the disease. This problem is prominent among most smallholders in upland areas (DLF, 2009) and might have been one of the causes of the high mortality rate in poultry (22%). The lack of vaccination caused a decrease in livestock numbers at the beginning of the rainy season or when the weather changed dramatically. The reason often given by farmers for their neglect to vaccinate their poultry was a lack of money to pay for the government-subsidized vaccines. Another reason was that the vaccine remained effective for only a short time (3 months for fowl cholera and 6 months for Newcastle disease), so farmers found it difficult to vaccinate their livestock regularly in time.

Conclusion

As part of the Lao government's rural development and poverty alleviation strategy, resettlement or relocation of remote communities has been used by local governments to pursue multiple objectives, including discouraging shifting cultivation, eradicating opium poppy cultivation, providing social services, and enhancing cultural integration and nation-building. However, resettlement is generally costly and drastically reduces the household financial capital of new settlers because of the long transportation distances, the need to rebuild houses, and the agricultural transition from subsistence livelihood to a market economy. However, in the case of the villagers of Houakhoa village, who resettled along the road across the village. Most villagers seem to be happier than before resettlement, because they have increased physical accessibility to education and health care services and improved infrastructure through the support of the government and NGOs. They have better access to various services, including transportation (by road), health services, clean water, safe sanitation, and education (with better educational opportunities

for their children). Most farmers have access to more agricultural land, agricultural inputs, and agricultural techniques and to newly emerging marketing opportunities, giving them the initiative for transition from subsistence toward commercial production system. House hold incomes has increased since relocation in all groups, particularly in those who have been resettled the longest; these farmers are concentrating on intensifying their production methods to improve food security and commodity production. However, resettlement increases pressure and competition and favors land-use conflict between newcomers and first-comers or long-term established communities. The farmland area owned by first-comers was significantly larger than that owned by the most recent settlers (group 5). The availability of land suitable for paddy rice cultivation remains a crucial issue for these new settlers. Some of the recent arrivals have to choose less fertile agricultural land as the amount of agricultural land becomes more limited. They also face difficulties in adapting to such an abrupt change in their way of life, which differs from that in the upland villages. A lack of lowland agriculture experience, as well as the limited availability of agricultural land, results in insufficient crop production (both quantity and quality) to meet domestic demand. Therefore, most of the new settlers have to sell their labor cheaply as temporary employees to supplement their dwindling resources. These disadvantages give them poorer living standards than the first-comers.

Small livestock production—particularly of pigs for sale—contributes substantially to household incomes. Therefore, pig raising can be considered a potential alternative by which farmers can improve their livelihoods. However, the transition of pig production from a subsistence to a market-oriented system is, at this stage, just an initiative. Exploration of the potential for livestock intensification could be an option for improving the livelihoods of relocated rural villagers. Further social research is required for us to better understand the impacts on rural household livelihoods in this relocated village.

Recommendations

Resettlement aims not only to give access basic needs, but also to support people's transition and integration into their new livelihoods. Local gov-

ernment should create and give what is needed to ensure respect for the well-being of resettled villagers, both during and after their displacement.

Therefore, solutions for overcoming agricultural land shortages should be considered in advance. In the future, local authorities should consider villager strategies to ensure that adequate arable land is allocated equitably to both original residents or settlers and new settlers.

In the short term, pig production remains an important source of cash flow for villagers. However, because of pig genetic factors, animal diseases, and limited supplies of feed, in the longer term it is unlikely that smallholders will become a major force in pig production. Livestock production under traditional raising systems will not be an alternative for smallholders wishing to move to more market-oriented production systems. To move toward sustainable commercial production, I strongly recommend that livestock production be reoriented from semi-subsistence or subsistence to intensive commercial production to ensure food security and make sure that the increasing domestic requirements for meat consumption are met. Thus, there is a very urgent need to introduce a general package of improved and more intensive technologies to meet specific market requirements. Achieving this objective is a precondition for the introduction of typical interventions, such as improvements in management, animal nutrition, and selective breeding and increased vigilance in disease control, all of which may help to improve livestock productivity. This will eventually maximize productivity and reduce poverty among the villagers.

The following further improvements based on the results of this study are indispensable:

- a) A solution to animal feed shortages (in both quality and quantity) is urgently required. This can be done by increasing forage supplies, especially in the dry season, by establishing individual backyard forages such as Stylo 184 and sweet potato, and by integrated cropping of cassava, soybean, and maize in, for example, young rubber tree plantations. Supplying adequate feed throughout the year is an entry point to more intensive and profitable livestock production, as it gives farmers additional feed resources that they can use to supplement the available natural green vegetation to increase

total nutrient supplies. Application of animal manure as an organic fertilizer should be increased to improve the yields of forage legumes and feed crops. The highly productive Stylo 184 should be harvested during the rainy season for storage in dried form for supplementary feeding in the dry season.

- b) There is a need to emphasize the various initial activities related to animal health care services, including the provision of regular vaccinations to prevent seasonal outbreaks of disease; deworming treatments; and hygienic maintenance of animal pens. Vaccination is very important for sustainable disease prevention, and public awareness at the farmer level needs to be high for successful disease control. There is a need to establish group-based animal health service units instead of relying only on one village veterinary worker. The National Vaccine Production Center should consider improving vaccine quality. Effective CSF vaccination as a sustainable control strategy has the potential to provide benefits to smallholder pig farmers.
- c) Further efforts should be concentrated on genetic improvement in local breeds, because inbreeding can limit livestock productivity. To avoid inbreeding, castration of immature male pigs and the keeping of appropriate ratios of roosters to hens are required. Farmers should consider increasing their numbers of pigs to reduce time and labor input. Raising selective parent stock for reproduction is the initial stage of successful breeding.
- d) Dissemination of both modern and traditional technologies in animal husbandry through the development of participatory technology is an approach that can effectively enhance the knowledge and skills of small-livestock keepers. Cross-farm visits should be encouraged so that farmer groups can learn from each others' experience in lowland farming; this is especially useful for drawing lessons from management systems or technologies that have proven to be viable and trying to apply them to the farmers' own situations. Immediate transfer of technology takes place through the process of farmer interactions.
- e) The livestock revolving fund is an important

means of financial support from the government that provides good opportunities for farmers to improve their livelihoods by the commercialization of small livestock rearing. Thus, community leaders and village fund-management committees must pay special attention to effective management of these funds and must follow up and encourage every beneficiary to strictly conform to the village regulations, which are created by the farmer groups themselves. It is essential to recognize pig commercialization as a major income-generating activity that will improve livelihoods.

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