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Hydropower development in Vietnam: Involuntary resettlement and factors enabling rehabilitation

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ABSTRACT

This paper examines the livelihood outcomes and adaptation strategies of households who have been involuntarily resettled from the project area of the Son La Hydropower Project in Vietnam to a remote mountain location with an intense scarcity of resources. We collected household data using a double recall, referring to the situation before and after resettlement, and for both the resettled and host households. The results show that resettled households lost income mainly because of a loss in crop output. In response, they tried to intensify crop production by using more fertilizers. The distribution of their farm output and income became less equal after resettlement although land had been distributed equally to all households. The host households had a greater number of opportunities to adapt and increased the cropping frequency of rice, intensified mineral fertilizer use and intensified livestock production, and as a result, their farm output and incomes increased. The livelihood adaptation of both the host and resettled households was strongly conditioned by a lack of available livelihood assets in this remote mountain location; it is therefore questionable whether households will be able to maintain their livelihood outcomes in the long run.

Introduction

Large dam projects are unrivalled by any other type of physical infrastructure project in terms of the scale of population resettlement they bring about (WCD, 2000). About 12 million people have been displaced due to reservoir construction projects in China since 1949 (Webber and McDonald, 2004) and 16–38 million people have been displaced in India for the same reason (WCD, 2000). Although large dams are controversial because of their disruptive effects on local communities and ecosystems, rapidly increasing energy demands have led to a new wave of large hydropower projects being planned and implemented, especially in Southeast Asia. In total 58 large dams are currently under construction in Cambodia, Laos, Myanmar and Vietnam, with a further 52 dams in the planning phase (Bui and Schreinemachers, 2011). Particularly controversial has been the plan to build 15 dams on the Mekong River in China, Laos and Vietnam.

A few studies have shown that resettled people can regain or even improve their living conditions after being resettled (Agnes et al., 2009; Nakayama et al., 1999), but the majority of studies have shown that resettlement can lead to a sharp deterioration in income and production levels, a reduction in living standards and an increase in poverty, especially in poorly managed relocation projects (Bartolome et al., 2000; Cernea, 2003; Scudder, 1997). In 2011 for instance, the government of China admitted that the Three Gorges Dam, which involved a carefully planned relocation of 1.4 million residents, had failed to raise the living standards of the relocated residents (Martina, 2011). Previous studies have shown that the adverse economic and social impacts of resettlement have been particularly severe for the more vulnerable groups such as the poor, women, children and ethnic minorities (Morvaridi, 2004; Tan et al., 2005).

The deterioration in living standards caused by these project results from a loss of productive assets, a lack of access to markets and employment opportunities, and a disruption of the social networks existing within communities (Cernea and Schmidt-Soltau, 2006; Webber and McDonald, 2004). These previous studies paid much attention to the observed impacts of resettlement projects in terms of land and other resources, food security, plus food production and income levels. Much less is known about how people, those whose livelihoods are affected by involuntary resettlement programs, adapt or try to adapt to their new location and what factors enable them to restore their livelihoods, or prevent them from doing so. This is important, as numerous studies have revealed the repeated failure of resettlement programs to focus on the economic and social development and rehabilitation of those people affected, instead focusing only on the physical relocation process (WCD, 2000). Therefore, one objective of this study is to explore the process of change and adaptation after resettlement, with a particular

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focus on livelihood assets, strategies and outcomes, whilst another objective is to shed light on the general impact of resettlement programs in the late-socialist countries of East and Southeast Asia (Cambodia, China, Laos, Myanmar and Vietnam). These countries have been particularly active in developing their hydropower potential, but have given-out little information on the planning and implementation aspects of these projects or their impact on local communities, as this topic is sensitive and local authorities are reluctant to allow outside research projects in to investigate.

For this study, we collected interview-based survey data from the resettled and host households in a community near the Son La Hydropower Project in northwestern Vietnam. Using the Sustainable Livelihood Framework (DFID, 2001) as an analytical framework, we used an econometric approach to identify those changes in livelihood assets and strategies that helped households to rehabilitate their livelihoods after resettlement. The identification of these factors is important for the better planning of resettlement projects in the future and for identifying policy interventions that may help to reduce the adverse impacts of involuntary resettlement. The study builds on previous work in which we used a descriptive approach to compare the livelihood impacts of such projects on host and resettled households (Bui and Schreinemachers, 2011).

This paper is organized as follows. We begin by providing some background information about the study area and describe the analytical approach and methods used. We then describe how livelihood outcomes have been changed and what strategies the resettled and host households have applied in order to rehabilitate their livelihoods. Next, we discuss the implications of the results, after which we draw conclusions.

Materials and methods

Son La Hydropower Project

Son La is a province in the Northwest region of Vietnam – the poorest region of the country. Per capita income in the Northwest is only about 55% of the Vietnamese average, and although the poverty rate decreased from 46% in 2004 to 33% in 2010, it is still relatively high when compared to the country average of 11% (GSO, 2010).

Construction of Son La dam started in 2005 and when completed, as is planned for 2013, it will be the largest hydropower plant in Southeast Asia. The project is set to dam the Da River, creating a 224 km^2 reservoir which has already led to the largest involuntary resettlement in the history of Vietnam, with around 91,100 people from 248 villages across three provinces (Son La, Lai Chau and Dien Bien) relocated between 2005 and 2010. Son La has been the province most seriously affected, with 62,394 people displaced in 2004, accounting for around 6.3% of the province's population at that time. Of the area to be submerged, 7670 hectares (ha) is agricultural land and 3170 ha is forest land. The total estimated loss of assets and infrastructure was expected to be around 1788 billion Vietnamese dong (VND) (equivalent to 116 million USD in 2004), of which 59% was household and personal property (Decision No. 196/QD-TTg, 2004). Different to previous dam projects, displacement costs were included into the project balance sheet, a resettlement plan had been prepared before the construction of dam started, and the government adopted specific policies for the Son La dam project, covered by Decision No. 459/QD-TTg, Decision No. 196/2004/QD-TTg and Decision No. 02/2007/QD-TTg (Dao, 2010). Furthermore, the implementation process came under the supervision of the provincial people's committees and resettlement project management boards at the provincial, district and commune levels (Dao, 2010). Although the resettlement program

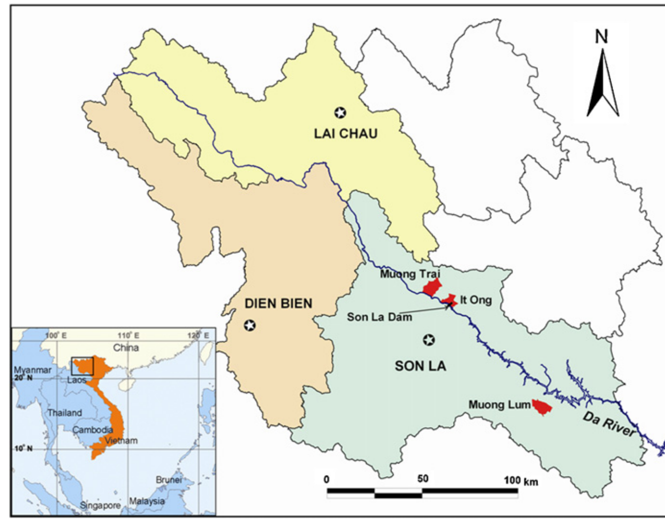

Fig. 1. Location of Son La Hydropower Project and the study villages.

was planned and implemented with considerable effort made to avoid the severe and adverse impacts of previous dam projects, it faced numerous challenges in rehabilitating the people it displaced (Bui and Schreinemachers, 2011; VUSTA, 2006). According to the resettlement plan, each resettled household should have received at least 1 ha of farmland at the resettlement site (Decision No. 02/2007/QD-TTg). Although a 'land for land' compensation policy was applied to both the resettled and the host communities, the host households only received cash compensation as there was just not enough land to distribute. The majority of the resettled people were therefore not provided with arable land or with sufficient production support required to restore their livelihoods. According to a 2006 study by the Vietnam Union of Science and Technology Association (VUSTA) on the impacts of the Son La resettlement project, the resettlement in Lai Chau province was delayed due to conflicts about land prices and a lack of infrastructure at the resettlement sites. In total, 500 households from the town of Lai Chau and from Chan Nua commune were supposed to move to the Pa So resettlement site in 2005, but only 27 households had been relocated to Pa So by 2006 (VUSTA, 2006). The same study showed that around 50% of the resettled people stated that their income had declined, while only 10% said it had increased; and around 29% had lost their jobs and became unemployed. The host communities were also affected by the resettlement, with 42% reporting that their income had reduced and only 5% that it had increased (VUSTA, 2006). In 2008, a follow-up study was carried out by VUSTA, its aim being to assess the impacts in terms of livelihoods, culture, health and the environment two years after the first survey (VUSTA, 2008). The study showed that several problems remained unsolved and that new problems had emerged. For example, the resettled people had not received adequate support in order to re-establish their livelihoods at their new location, land scarcity in the resettlement areas made it difficult for households to restore their income and livelihood, and this had induced some resettled households to return to their original homes to farm the land there, as it had not yet been inundated.

Study site and data collected

For this study we collected data from Muong Lum Commune, a remote mountainous community in Son La Province shown in Fig. 1. As a result of the dam's construction, 67 households belonging to the Black Thai ethnic group and living in Muong Trai Commune along the Da River, were relocated to ethnic Black Thai villages in

Muong Lum Commune between April 2008 and January 2009. The resettlement increased the population of Muong Lum Commune from 2212 to 2496 people. The community was selected for this study because of its existing links to an ongoing research program, a fact which was important when carrying out the research.[1]

The commune covers 5000 ha of land, of which 83% is used for agriculture. About 96% of the available labor force works in agriculture, with crop cultivation and animal husbandry being the dominant livelihood activities (Thai, 2010). In the Black Thai villages, the main crops grown are rice grown in paddies, and maize cultivated on mountain slopes, while fruit and vegetables are grown in home gardens. The farmers raise buffalos, cows, goats, pigs, chickens and ducks, with smaller income contributions coming from aquaculture and forestry. Markets for goods and services have not yet developed in and around the commune due to its remoteness and isolation, and the low purchasing power of the people who live there.

The data for this study came from an interview-based survey held in the ethnic Black Thai villages of the Muong Lum Commune among the 56 resettled households and a random selection of 52 existing host households. Using a structured questionnaire, we conducted the interviews between August and November 2009 employing a double recall method to collect data from both before (2007) and after the resettlement (2009). We should note that as the survey took place one year after resettlement, it could only capture the immediate adaptation strategies of the households, not the long-term effects. All monetary values from 2007 were converted to 2009 values using the Consumer Price Index (CPI) for rural areas of Vietnam (GSO, 2009, 2010).

An earlier analysis of the same data set showed that the resettled households experienced a significant decline in the land available to them for growing paddy rice (−33%; from 0.18 ha to 0.12 ha per household) and upland maize (−78%; from 1.38 ha to 0.29 ha per household) and a significant 53% reduction in the number of animals kept (Bui and Schreinemachers, 2011). In addition, the resettled households lost all access to rivers for fishing and to common pastures for grazing cattle. The study also found that the net household incomes of the resettled households declined by 66%, but that this decline was offset by one-off compensation payments made in the year after resettlement. The study did not find significant changes in livelihood outcomes for the host households, in spite of the fact that the host households had to give up some of their paddy land.

Conceptual and analytical framework

We used the livelihoods approach (DFID, 2001; Ellis, 2000; Scoones, 1998) as the conceptual framework, in order to understand the complex relationships that exist between resources, adaptation strategies and household well-being in the socio-economic context of changing institutions and policies. This approach assumes that livelihood outcomes are a function of livelihood assets and their allocation across economic activities (Barrett et al., 2005; Brown et al., 2006).

Households that lack the ability to choose between livelihood strategies have little adaptive capacity, something which Vincent (2007, p. 13) has defined as ‘a vector of resources and assets that represents the asset base from which adaptation actions and investments can be made’. A lack of adaptive capacity leaves households defenseless and vulnerable to external shocks that impact upon their livelihoods (Luers et al., 2003; Smit et al., 2000). Involuntary resettlement can be viewed as one such type of external shock.

Here, we studied how changes in livelihood assets and strategies affected changes in livelihood outcomes by quantifying livelihood outcomes in three ways: (a) farm output from crops, animals and aquaculture, which are the most important sources of household revenues and directly related to the availability of land, labor, farm animals and cash – the main resources of the households; (b) net household income, which is a more comprehensive indicator including the income generated from crops and livestock, and also from aquaculture, forest products and off-farm work; and (c) food security as an indicator of the consumption of the household.

The analytical approach relates changes in livelihood outcomes to adaptation strategies and changes in five livelihood asset types, which for this study included:

(i) Human capital, incorporating household size, the dependency ratio (persons under 15 or over 65 as a percentage of the total household size), the farm labor supply and the household head’s level of participation in training programs and number of years spent in education, as education is expected to improve a household’s ability to adjust production decisions during periods of change. Household size was expressed in terms of male adult equivalents, based on energy requirements following James and Schofield (1990), to account for age and sex differences.
(ii) Natural capital, including the quantity and quality of farmland available, as measured on a five-point scale (very bad, bad, medium, good, very good) and the amount of livestock available, as expressed in Tropical Livestock Units (TLUs) adjusted for East and Southeast Asia (Chilonda and Otte, 2006).
(iii) Financial capital, which included the amount of government compensation and support provided, the level of household savings and the number of sources from which a household could potentially borrow money.
(iv) Social capital, roughly calculated as the number of groups or organizations to which the adults in the household belonged, and the number of peers the household could turn to when in need of help.
(v) Physical capital, referring to the commune’s infrastructure, including irrigation, roads, electricity and water supplies; though as these aspects did not vary between households, we could not include this category in the household-level analysis.

Some of the variables were dropped from the analysis because they were highly correlated (correlation coefficient above 0.5).

A loss of livelihood assets does not necessarily diminish livelihood outcomes if households are able to adapt, so we considered two adaptation strategies, both of which are subject to the physical constraints of the system. First, households can switch between income generating activities; for instance, when unable to fish in the river, households could extract more resources from the forest. Second, households can try to intensify certain activities, such as working the land more intensively.

Relationships between livelihood outcomes and the explanatory variables were assumed linear, so that Ordinary Least Square (OLS) regression could be employed to quantify the strength of the relationships. Using the Shapiro–Wilk test for normality, we confirmed that all variables had a normal distribution. Following Fields (2003) and Fields et al. (2003), we used a decomposition analysis to estimate the relative contribution of each determinant of livelihood outcomes. The inequality of the dependent variable was decomposed using so-called factor inequality weights, whereby the more positive the weight for a given explanatory variable, the more it contributed to the inequality of the dependent

[1] The Uplands Program is an international research project involving cooperation between universities in Germany, Vietnam and Thailand with a focus on sustainable land use and rural development in the mountainous areas of Southeast Asia. See http://sfb564.uni-hohenheim.de/.

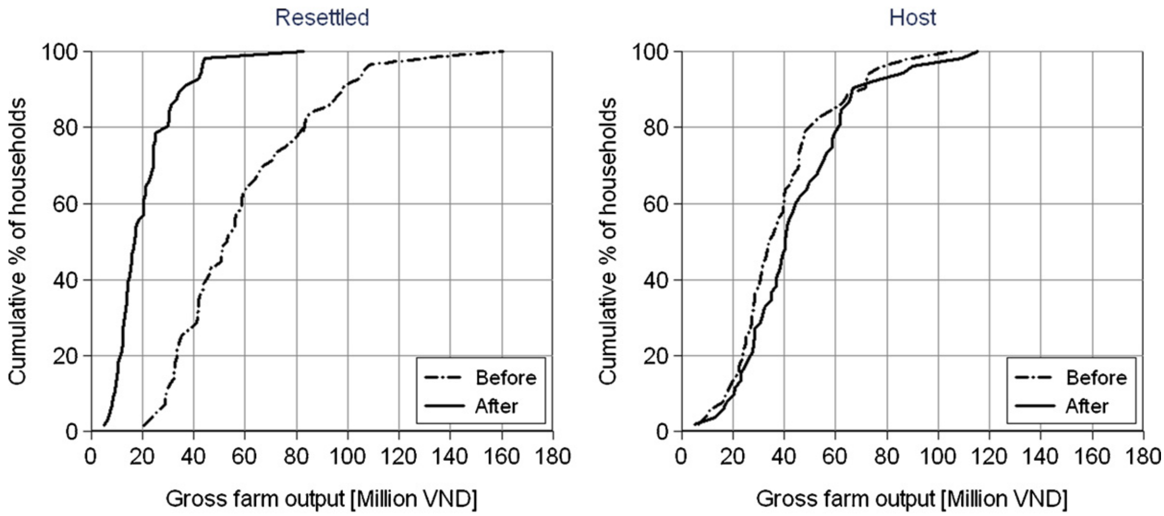

Fig. 2. Distribution of gross farm output for the resettled and host households, before and after resettlement.

variable, while negative weights implied that the factor caused the dependent variable to be more equally distributed (Fields et al., 2003). Decomposition was based on observed rather than predicted values for the dependent variable, so that the factor shares added up to the explained variance of the model.

Eq. (1) explores the determinants of change in terms of gross farm output, calculated as the sum of gross revenues from crops, livestock and aquaculture.

$$\Delta \text{ Farm output} = f(\Delta \text{ Labor}, \Delta \text{ Arable land}, \Delta \text{ Farm animals}, \Delta \text{ Crop inputs}, \Delta \text{ Livestock inputs}, \Delta \text{ Percentage of cultivated paddy land}) \quad (1)$$

Households in the study area derive their incomes from five major sources, including crop production, livestock rearing, aquaculture, forest product collection and other income sources, including off-farm work and business activities, retirement pensions, remittances, gifts and petty trade. We used decomposition analysis to quantify the relative contribution of each source in relation to the changes in household income levels, and employed the method proposed by Fields et al. (2003), who calculated relative factor inequality weights, denoted by $S_k(Y)$, based on Shorrocks (1982) study about the determinants of income inequality:

$$S_k(Y) = \frac{\text{cov}(\Delta Y_k, \Delta Y)}{\sigma^2(\Delta Y)} * 100\%, \quad \sum_k S_k = 100\% \quad (2)$$

in which k denotes the income source and Y is the net household income.

Eq. (3) examines the restoration of income after resettlement and is based on the work of Fields et al. (2003). We expressed the dependent variable as the absolute income change (income after minus income before) rather than taking the logarithmic approach, as has been done in some other studies (Fields et al., 2003). Application of the absolute approach did not show considerable difference from the application of the logarithmic approach but the explained variance of the model was much higher for the resettled households. Government compensation payments given to the resettled households were not included as income, because these were one-off payments unrelated to the adaptive capacity of the households. Independent variables included time-invariant household characteristics as well as changes in assets.

$$\Delta \text{ Net household income} = f(\text{Income in the base year}, \text{Education level of household head}, \text{Dependency ratio in the base year}, \text{Participation in training programs}, \Delta \text{ Human capital}, \Delta \text{ Social capital}, \Delta \text{Land quantity}, \Delta \text{ Land quality}, \Delta \text{ Farm animals}, \Delta \text{ Agricultural inputs}) \quad (3)$$

Household income before resettlement was included as an independent variable, and as this variable might have been partly determined by the other independent variables in the model, we used the Durbin–Wu–Hausman test to check for endogeneity. The asset variables in the year before resettlement were used as instruments (paddy land area, household size and number of farm animals available), assuming that these variables were not affected by measurement error. The results showed a high p-value (0.91 for the resettled population and 0.16 for the host population), indicating that endogeneity might not have been an issue and that the OLS estimator is consistent.

The last part of the analysis examines the rehabilitation of food security after resettlement. For this variable we could not collect data prior to the resettlement, only after. We used two indicators: (i) Per capita daily calorie intake, based upon a seven-day recall of food consumption obtained from the person in the household preparing the food, was calculated by dividing the average daily calorie intake for the household by the household size. (ii) Dietary diversity, which was calculated in line with Hoddinott (1999) as the weighted sum of the number of different food items consumed by the household over a 30-day period, with weights reflecting the frequency of consumption of each type of food (24 = 16–30 days, 10 = 4–15 days, 3 = 1–3 days, 0 = 0 days). The determinants of per capita calorie intake after resettlement are as follows:

$$\text{Per capita calorie intake} = f(\text{Household demography}, \text{Human capital}, \text{Arable land}, \text{Farm animals}, \text{Per capita income}) \quad (4)$$

We initially included compensation payments in the regression analysis for the resettled households; however, we dropped this variable from the analysis as it was highly correlated with the dependency ratio and paddy land per capita.

Table 1
Comparison of fertilizer use before and after resettlement (kg/ha).

Crops/fertilizers	Resettled households		Host households	
	Before	After	Before	After
Maize				
NPK	0.00	60.74 (204.37)**	193.96 (227.78)	342.26 (254.58)***
Urea	0.00	1.75 (9.02)	17.34 (32.57)	52.17 (92.62)***
Paddy rice				
NPK	68.50 (231.99)	1065.10 (529.04)***	764.80 (653.48)	1088.61 (648.36)***
Urea	125.85 (170.89)	362.45 (183.58)***	167.14 (198.98)	265.39 (261.16)***

Notes: Average figures per household given; standard deviations shown in parentheses.
Significance tests refer to a two-sample *t*-test of the difference in means: $^{*}P<0.10$, $^{**}P<0.05$, $^{***}P<0.01$.

Table 2
Comparison of maize and rice yields before and after resettlement (kg/ha).

Crops	Resettled households		Host households	
	Before	After	Before	After
Maize	6550 (1822)	7169 (2677)	8414 (3792)	8102 (3126)
Rice – first season	5182 (1341)	5033 (1274)	5225 (1371)	5448 (1760)
Rice – second season	4364 (1288)	4696 (1534)	4282 (1280)	4490 (1217)

Notes: Average figures per household given; standard deviations shown in parentheses.
Significance tests refer to a two-sample *t*-test of the difference in means: $^{*}P<0.10$, $^{**}P<0.05$, $^{***}P<0.01$.

Results

Strategies to rehabilitate farm output

Fig. 2 shows the distribution of gross farm output among the host and resettled households before and after resettlement. The resettled households (left-hand diagram) saw their average farm output decline by 65%, from 59.5 to 20.9 million Vietnamese Dong (VND) (1 million VND was 58.9 USD at the time). After resettlement, gross farm output was more unequally distributed among the resettled households (the Gini coefficient for farm output rose from 0.26 to 0.30). The host households (right-hand diagram) managed to significantly ($p<0.05$) increase their farm output from 39.4 to 45.1 million VND partly due to a significant increase in their crop output from 25.4 to 29.0 million VND, which happened in spite of their loss of paddy land.

Intensifying the use of inputs, chiefly mineral fertilizers, was the main strategy employed by host and resettled households in order to deal with increased land scarcity, while the host households also increased the number of cropping cycles carried out. As can be seen from Table 1, the average amount of mineral fertilizer used per hectare of paddy land increased significantly after resettlement; for example, for NPK it rose from 68 kg to 1065 kg for the resettled households and from 765 kg to 1089 kg for the host households. It should be noted that the resettled households had not applied mineral fertilizers to maize in their previous location. For the resettled households, the overall cost of the inputs used for crop production purposes increased from 2.1 to 3 million VND, while livestock input use declined dramatically, from a cost of 6.5 to one of 3.5 million VND. The host households on the other hand increased their crop input use (from 4.5 to 5.9 million VND) as well as livestock input use (from 3.8 to 4.8 million VND).

The amounts of fertilizer applied for rice production by both populations and for maize production by the hosts after resettlement, were substantially higher than what has been reported for other communes in the same province (*e.g.* Dang et al., 2008; Lippe et al., 2011). The increase in fertilizer use among the hosts resulted from a significant decrease in the area of rice paddies available to them. Furthermore, not all of the host households were able to keep their old plots of land after the redistribution, as some of them were allocated new plots of land of an area equal to their land holding before the resettlement, minus the area given to the resettled households. Some host households reported that their new

Table 3
OLS regression results explaining the changes in farm output.

Explanatory variables	Resettled households		Host households	
	Coefficient	% contribution	Coefficient	% contribution
Change in working adults (number)	6.020**	5.94	1.407	1.72
Change in arable area (ha)	0.259	0.12	11.310	0.94
Change in farm animals (TLUs)	2.207*	10.17	0.296	0.82
Change in crop inputs (million VND)	4.339***	21.26	1.242*	6.17
Change in livestock inputs (million VND)	2.766***	33.77	3.324***	35.70
Change in % of paddy land cultivated (%)	–	–	0.132**	8.22
Constant	−28.720***	–	−1.114	–
Number of observations	56		52	
F-Statistics	24.80***		8.65***	
Total explained (%)	71.27		53.57	

Notes: The dependent variable is Δ farm output (million VND).
* $P<0.10$.
** $P<0.05$.
*** $P<0.01$.

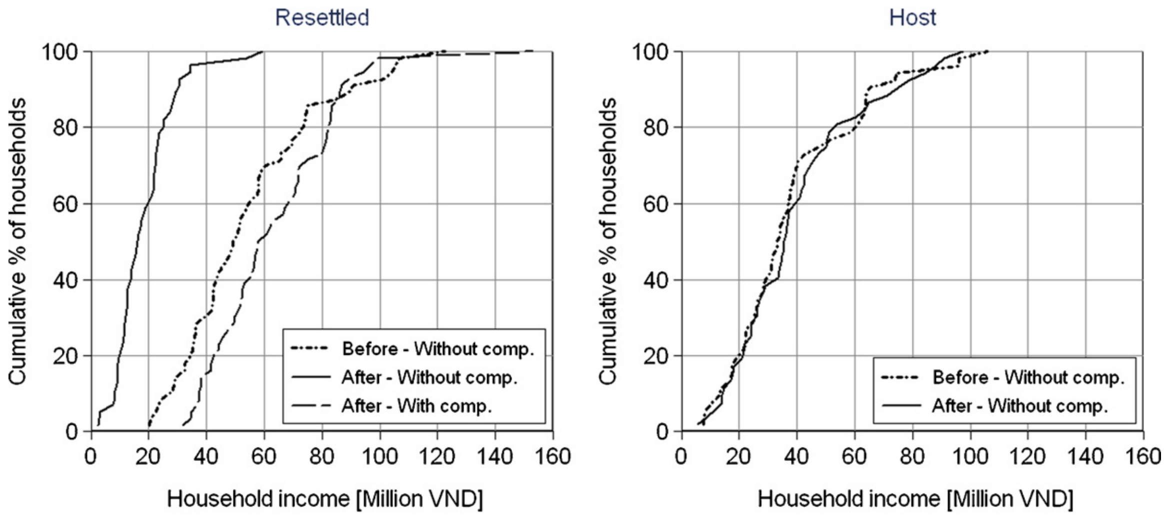

Fig. 3. Distribution of household incomes for the resettled and host households, before and after resettlement.

land was less fertile. The resettled households explained their high levels of fertilizer use by saying that the land was less fertile in the new location and that they lacked experience with the new land; therefore, they took over the input use patterns of the host households.

As can be seen from Table 2, the increase in mineral fertilizer use did not translate into significantly higher maize and rice yields. The increase in crop output levels for the host households was achieved by growing more crops per year rather than obtaining a higher yield per cropping cycle, while the drop in crop output levels for the resettled households was chiefly due to a reduction in the cultivation area available.

Table 3 shows the regression results from Eq. (1), confirming the importance of crop and livestock input use in helping to recover farm output after resettlement. For the resettled households, the changes in input use for livestock and crop production were significant ($p < 0.01$), contributing to a 34% and 21% change in output, respectively. For the resettled households, a one million VND increase in crop input use after resettlement was, all other variables being constant, associated with a change in gross farm output of 4.3 million VND. For the host group, 36% of the variation in farm output change could be attributed to the change in livestock input use, while changes in the percentage of paddy land cultivated were the second most important factor, accounting for 8% of the variation.

Changes in labor supply and the number of farm animals were both significant determinants of the change in gross farm output for the resettled households, but not for the host households. Changes in the area of arable land did not significantly explain the variation in gross farm output, even though both the resettled and host households lost substantial amounts of land. It is likely this is because all the resettled and host households were more or less equally affected by the land redistribution. Before resettlement, the resettled households fallowed a large amount of arable land, especially sloping land. After resettlement, land was equally distributed to them. In addition, it should be noted that the resettled households left some of their sloping land fallow as they had to spend time clearing the previously uncultivated land that was not taken from the host households. As the clearing of land is labor intensive, they chose to cultivate a smaller area, but more intensively, and so any impact on the total arable land area might therefore have disappeared. As a result, access to arable land was not a significant determinant of gross farm output for the resettled households both before and after resettlement. Meanwhile, the

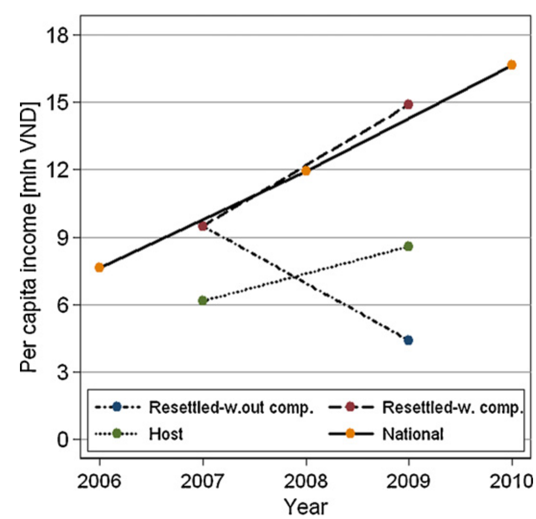

Fig. 4. Net per capita income changes for the host and resettled households, as compared to the national average (current prices).

host households were able to maintain rice output by intensifying their land use; cultivating more crops per year.

Strategies to rehabilitate household incomes

Fig. 3 shows the distribution of net household incomes before and after resettlement. While the resettled households (left-hand diagram) lost substantial income – without compensation payments – after the move, the host households (right-hand diagram) were just about able to maintain their incomes. For the resettled households, per capita income significantly ($p < 0.01$) declined by 65%, from 12.4 to 4.4 million VND. However, these households also received average government support and compensation payments of 45.1 million VND in 2009, and when including these payments, a significant ($p < 0.01$) increase in per capita income of 20% to 14.9 million VND was actually experienced. The resettlement increased per capita income inequality for the resettled households as the Gini coefficient increased from 0.20 to 0.30; yet, if including compensation payments in the income, then it reduced inequality as the Gini coefficient decreased from 0.20 to 0.16.

Fig. 4 compares the changes in per capita income in Muong Lum with the national average, showing an increase in the per capita

Table 4
Income changes by source for both the resettled and host households.

Income source	Resettled households			Host households		
	Before (mln VND)	After (mln VND)	% contribution[a]	Before (mln VND)	After (mln VND)	% contribution[a]
Crops	26.57 (13.05)	9.78*** (5.80)	40.35	20.40 (9.69)	22.41 (10.32)	46.95
Livestock	8.97 (6.79)	2.72*** (2.74)	19.39	6.67 (5.86)	6.42 (6.12)	18.06
Aquaculture	9.48 (6.83)	0.56*** (3.50)	16.18	1.66 (2.85)	2.40 (3.29)	9.95
Forest products	3.02 (3.35)	1.68*** (2.68)	3.98	1.17 (0.74)	1.59*** (1.16)	0.83
Off-farm activities	6.69 (10.34)	4.20* (5.13)	20.10	8.73 (13.14)	7.12 (10.50)	24.21

Notes: Average income changes per household; standard deviations shown in parentheses.
[a] Calculated using Eq. (2).
Significance tests refer to a two-sample t-test of the difference in means: $^{*}P<0.10$, $^{**}P<0.05$, $^{***}P<0.01$.

income for the host households in absolute terms, but also a widening gap when compared to the national average (i.e. an income decrease in relative terms). A comparison of the per capita income of host households with the average per capita income in the north-western region also showed a relative decrease in their income, but by a smaller amount than when compared to the national average. For the resettled households, the graph shows a sharp deterioration in per capita incomes, but when including the compensation payments that were made, the income change ended up being in line with the national average.

Table 4 shows the relative contribution of each income source to the change in net household incomes, based on Eq. (2). It shows that the income changes from crop production were the most important determinant of the change in terms of total household income, accounting for 40% of household income decline for the resettled households and 47% of the household income increase for the host households. For both the host and resettled households, the changes in income resulting from off-farm work were the next most important component.

The regression results for Eq. (3) are shown in Table 5, showing a negative relationship between income changes and household incomes in the base year for both household types, but a much stronger effect for resettled households. This suggests that households with higher incomes before the resettlement had greater difficulty recovering their income levels afterwards. For the resettled households, the decomposition results indicate that income levels before resettlement accounted for 56% of the variation in income change after the resettlement. Changes in agricultural inputs were the next most important variable, which confirms the findings shown in Table 3, and the results here suggest that changes in land quality had a significant ($p<0.05$) effect on changes in income. For the host households, the model has a much lower explained variance; 30% as compared to 80% for the resettled households. Changes in agricultural input use had the strongest impact on changes in income, accounting for 16% of the variation. The next most important variables were changes in the household size expressed in terms of male adult equivalents and the level of income received before resettlement. Changes in the family size of host households largely resulted from the entering or exiting of male or female adult members after marriage and had a significant effect on the household income through its effect on the household labor supply.

For both models, we found that the age and education level of the household head and the dependency ratio in the initial year did not have a significant impact on changes in the income levels. Like the regression results for gross farm output, the loss of arable land had no significant impact on changes in net household incomes.

Strategies to rehabilitate food security

Fig. 5 compares the per capita calorie intake of the host and resettled households after resettlement, while Fig. 6 compares their dietary diversity. The figures suggest that the sudden drop in crop production and household income levels for the resettled household did not translate into them experiencing a lower level of dietary diversity than the host households. Only 7.1% of the resettled households were found to be food insecure, as measured from their daily calorie intake, as compared to 11.5% for the host households. Calorie intake per capita was significantly higher for the resettled households than for the hosts (4294 kcal/person/day

Table 5
OLS regression results explaining the change in net household incomes.

Explanatory variables	Resettled households		Host households	
	Coefficient	% contribution	Coefficient	% contribution
Ln (household (hh) income in 2007)	−36.276***	55.55	−9.365***	11.50
Education level of the hh head (years)	0.245	0.16	0 .516	2.64
Dependency ratio in 2007	0.024	0.49	−0.002	0.02
Participation in training programs (dummy)	−6.642	1.93	6.732*	4.01
Change in hh size (male adult equivalent)	3.409	4.18	5.283**	12.06
Change in social reliance	0.413	1.48	−1.931	0.08
Change in livestock numbers (TLUs)	0.145	0.70	−0.489	−0.39
Change in land quality (dummy)	8.243**	3.40	−0.072	0.03
Change in land quantity (ha)	−2.583	−0.22	−26.775	−1.69
Change in agricultural inputs (million VND)	0.950***	15.91	1.474**	15.61
Constant	102.996***	–	23.703**	–
Number of observation	56		52	
F-Statistic	22.90***		3.20***	
Total explained (%)	83.58		43.87	

Notes: The dependent variable is the change in net household incomes (million VND).
* $P<0.10$.
** $P<0.05$.
*** $P<0.01$.

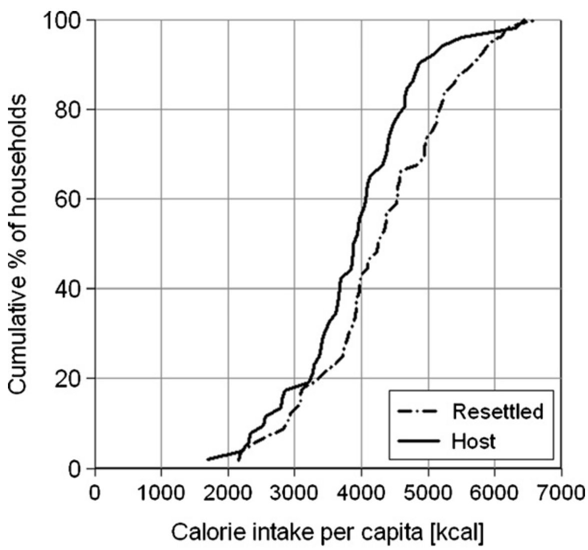

Fig. 5. Daily calorie intake of the resettled and host households after resettlement.

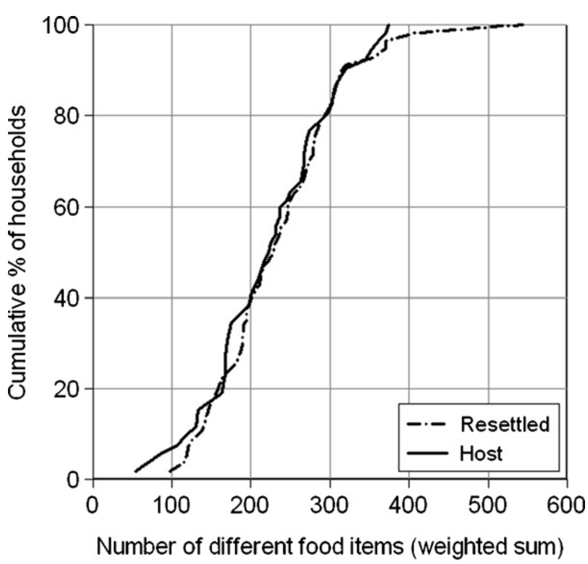

Fig. 6. Dietary diversity of the resettled and host households after resettlement.

compared to 3901 kcal/person/day). This effect is likely to have been caused by the cash compensation payments made to the resettled households, 17% of which were spent on purchasing food, accounting for 19% of their total food consumption, while the host households purchased only 13% of the food they consumed.

Table 6 shows the regression estimation from Eq. (4), whereby per capita income had a significant ($p < 0.05$) and positive effect on the daily calorie intake of the host households, accounting for 12% of the variation. A 1% increase in per capita income was, all other things being equal, associated with a 0.16% increase in per capita calorie intake for the host households; however, the impact of per capita income on calorie intake was insignificant for the resettled households.

Both models show that a higher dependency ratio – that is more children and elderly persons relative to the number of adults in a household, reduced per capita calorie intake. For the resettled households, the dependency ratio and the area of paddy land were the two most important variables explaining the variations in per capita calorie intake, while income levels and the education level of the household head had the strongest effect on the dietary intake of the host households.

Discussion and policy recommendations

The results of our analysis point to the importance of intensifying crop and livestock production after resettlement. In the study area, those resettled households who intensified crop input use were better able to restore their farm output and household income levels after resettlement. Crop input use was, however, the only strategy available, as livestock intensification was not an option due to a loss of farm animals and the scarcity of areas suitable for grazing. Fishing was also not an option because households were relocated to a remote mountain commune and so lost access to any rivers, and off-farm work was not an option because of the remoteness of the commune and the lack of a local cash economy. The host households, on the other hand, were able to intensify both their crop production through increased input use and multiple cropping, and also their livestock production. In spite of the loss of paddy land, they managed to slightly increase their income in absolute terms (although not in relative terms as compared to the national average), which shows a remarkable adaptive capacity in spite of the enormous resource scarcity they faced.

Although it is questionable whether the relocation of people to a poor and remote mountainous community with significant resource scarcity is a suitable strategy, when it does occur, project planners need to focus on helping resettled households to intensify crop and livestock production. In particular, small livestock rearing might help improve the welfare of affected communities where the amount of arable land area is limited. Livestock development could therefore be one of the solutions introduced to deal with the challenges posed by resettlement.

Table 6
OLS regression results explaining per capita daily calorie intake (kcal).

Explanatory variables	Resettled households		Host households	
	Elasticity	% contribution	Elasticity	% contribution
Income per capita	0.052	1.59	0.163**	12.14
Dependency ratio (%)	−0.002***	14.74	−0.001**	9.10
HH head can read and write (dummy)	0.045	−0.25	0.213**	10.96
Ln (farm animals)	−0.037	2.62	−0.047	−1.73
Ln (paddy land area per capita)	0.496**	14.04	0.095	4.16
Number of observations	56		52	
F-Statistic	4.93***		4.87***	
Total explained (%)	32.74		34.63	

*$P < 0.10$.
** $P < 0.05$.
*** $P < 0.01$.

The results also show that the resettlement project had an unequalizing effect in terms of the gross farm output and net household incomes of the resettled households. The increase in Gini coefficient was observed in spite of the fact that resettled households with a relatively high income prior to resettlement experienced the strongest decline in incomes afterwards, suggesting they were unable to transfer assets and strategies from one location to another.

The chief limitation of our study is that by comparing two points in time, it only gives a snapshot of the changes and adaptation processes that took place immediately after the resettlement. As a result, follow-up studies should be carried out to observe how the households have continued to adapt, and how livelihood outcomes will change when government support and compensation payments end.

Conclusion

The ability of resettled households to rehabilitate their livelihoods after involuntary resettlement is strongly conditioned on their livelihood assets and available livelihood strategies. The resettled households in this study experienced a substantial decline in the amount of farmland and number of animals available, as well as their level of access to fishing and grazing areas. They were only able to partly compensate for this increased level of resource scarcity by intensifying crop production through the use of more fertilizers. The level of food security of the resettled households improved due to the large compensation payments made to them by the government, which allowed them to purchase food. The host households meanwhile had relatively more assets to choose from, and were able to intensify both their crop and livestock production activities and thereby slightly increase farm output and net household incomes. With a limited number of alternative livelihood strategies available to them, it is questionable whether the resettled households will be able to maintain their food consumption levels once the compensation payments are reduced, or removed entirely.

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