

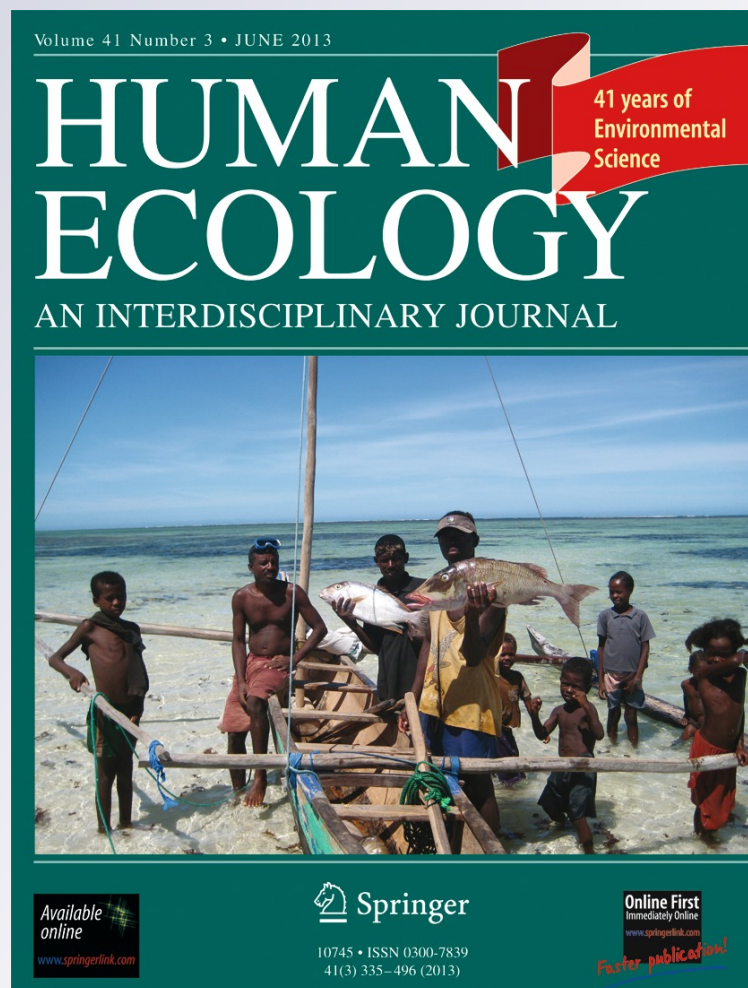
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# Dam-Induced Displacement and Agricultural Livelihoods in China's Mekong Basin

Brendan A. Galipeau · Mark Ingman · Bryan Tilt

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**Abstract** Households in China's Yunnan Province were surveyed to understand the impacts of hydropower development and resettlement on the agricultural livelihoods of rural villagers. Household-level data from this survey are analyzed to test whether income and landholdings vary by resettlement status. Independent sample t-tests and one-way ANOVAs are used to examine how resettlement status relates to income, land allotments, agricultural crops, and government subsidies. Results showed that, contrary to predictions, resettlement corresponds to higher household incomes, while differences in landholdings were mixed. Results indicate that while productive landholdings are less for resettled households, new wage labor, government subsidies, and intensified agriculture may contribute to a higher annual mean income at the household level. However, the tradeoff of receiving wage income for reduced landholdings may be a significant vulnerability for the affected households of the Mekong River Basin, since this loss in productive land corresponds to a long-term loss in social security.

**Keywords** Mekong · China · Hydropower · Resettlement · Agriculture

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## Introduction

The Upper Mekong River, called the “Lancang” in Chinese, plunges from its glacial sources high upon the Tibetan Plateau into the deep and dissected gorges of China's Yunnan Province. It is from these gorges flanked by mountains 6,000 m high in Northwest Yunnan that the Lancang River flows into the central canyons and valleys of the province before exiting China and flowing through mainland Southeast Asia. From this point the Mekong River serves as the lifeblood of many downstream agricultural and industrial communities of Myanmar, Laos, Thailand, Cambodia, and Vietnam. As one of the world's most important river basins, the Mekong River is home to over 60 million people, many of whom rely directly on the river for their daily livelihoods through agriculture and fisheries harvests (Magee 2006). Within China, the basin is home to several partially subsistence-based agricultural communities, many of which are ethnic minorities. However the river also houses a vast capacity of hydropower, which China's government is actively exploiting through the planned construction of seven dams along stretches of the Mekong River in central Yunnan Province, to include some of the world's largest arch dam structures (Dore *et al.* 2007; Magee 2006, 2011). These projects have come under attack due to the potentially adverse ecological impacts they may pose not only to downstream countries, but also to the local agricultural communities that are directly affected at the dam sites. Ultimately, hydropower is considered a favorable energy alternative to fossil fuels for the Chinese government vis-à-vis its ever burgeoning economy.

It is well documented that dams can have significant socioeconomic impacts on people, rural populations in particular (Cernea 2003; World Commission on Dams 2000). While there has been a fair amount of scholarship that has tried to characterize and describe these impacts—particularly

in the case of China's Three Gorges Dam—there is no good standard for doing so. Furthermore, there is very little research that specifically compares different populations in terms of their socioeconomic status before and after resettlement from dams. We use cross-sectional data from recent household surveys to understand the socioeconomic impacts on people displaced by Mekong River dams, focusing specifically on household income, land holdings, crop selection and outputs, and government compensation.

We provide relevant background information and policy context related to China's current hydropower development program, review previous research on the social impacts of dam-related displacement and resettlement, and outline our research questions and methods. We then describe the data used; present the results of our several analyses; and conclude with a discussion of our findings and recommendations for further research.

### Hydropower Development in Contemporary China

The construction of large dams<sup>1</sup> is a major component of China's economic development strategy, and the Chinese government is building these projects at a rapid pace (Magee 2006). Hydropower currently supplies China with 16 % of its total electricity; with a rapidly growing economy that is highly reliant on coal-fired power plants, China's government sees hydropower as a valuable source of clean energy (Rosen and Houser 2007). Hydropower in China's western regions such as Yunnan (where the vast amount of the hydropower potential is located) is also a large part of two national development policies. The first is the "Great Western Opening" policy, which has several objectives. The first is to develop western China's remote, rural, and generally poor and marginalized regions through large scale infrastructural development to reduce the sizable economic gap between China's western and eastern provinces. The second objective is to solve what is known as the nationalities<sup>2</sup> problem (Tilt 2010). In general, China's minority nationalities, which primarily inhabit the western regions, suffer from lower economic prosperity and more marginalization than the (majority) Han people. The "Great Western Opening" is intended to promote and fund large-scale infrastructure development and to harness the vast natural resources of the west to both alleviate economic disparities between the east and the west and bring greater prosperity to minority peoples. The second key national policy related to

hydropower development is the "Send Western Electricity East policy," which is an attempt to harness western China's rivers to continue to meet the large demand for power in eastern China's large cities (Magee 2006; Tilt *et al.* 2009).

The Mekong River has become a major focal point in the implementation of these policies. Within China's Mekong Basin, on which this paper focuses, the government originally planned a cascade of eight dams, which has since been scaled down to seven (Dore *et al.* 2007; Magee 2011). Within this cascade, four dams are currently either complete or very near completion, with the other three expected to be completed within the next decade. Two of these dams, Xiaowan and Nuozhadu, are among the world's tallest arch dam structures<sup>3</sup> and will produce very large reservoirs, inundating vast tracts of land (Magee 2006).

### The Human Impacts of Dam Construction

In 2000, the World Commission on Dams produced a report specifically highlighting many of the positive and negative effects of building large dams. The major contributions of this report were that while large dams have traditionally provided great benefits to society including hydropower, flood control, irrigation abilities etc., the environmental and social costs of such projects have also been great:

Dams have made an important and significant contribution to human development, and benefits derived from them have been considerable... In too many cases an unacceptable and often unnecessary price has been paid to secure those benefits, especially in social and environmental terms, by people displaced, by communities downstream, by taxpayers, and by the natural environment (World Commission on Dams 2000).

In China alone, where the construction of large dams is moving forward at a rapid pace, the social costs of these projects are on a huge scale, with over 12 million people being displaced by dams according to the commission's report (2000), and over 1 million displaced by the Three Gorges project alone. Overall, research around the world on the social impacts of dam-induced resettlement have suggested that very rarely do living conditions improve when communities are forced to resettle, and that typically their living conditions get worse (Cernea 2003). While vast amounts of research have explored the social impacts of resettlement at Three Gorges, the amount of research conducted on the Mekong is limited to a few studies. The Mekong River is a unique situation because it includes multiple dam projects,

<sup>1</sup> Large dams are defined by the World Commission on Dams (2000) as any dam over 15 m in height or any dam with 3 million cubic meters of storage capacity.

<sup>2</sup> A nationality (*minzu*) in China refers to ethnicity. China includes 56 officially recognized nationalities including the majority Han nationality. Yunnan province alone contains 25 of these 56 nationality groups.

<sup>3</sup> The well known Three Gorges Dam on China's Yangtze River is the world's largest overall dam structure. However Xiaowan and Nuozhadu will actually be even taller.

making the socioeconomic impacts spatially significant with villages in various stages of resettlement spread throughout the basin. Additionally, many of the villages spread along the river consist of minority nationality groups which make the region culturally heterogeneous. This contrasts considerably with the Three Gorges region of the Yangtze River, where nearly all residents are Han Chinese.

Previous research on the potential impacts of future resettlement at the Nuozhadu Dam on the Mekong River has been especially useful in understanding the importance of agricultural lifestyles and also the local perceptions and opinions of communities regarding the future dam and impending resettlement (Zhang *et al.* 2008). The authors of this study conducted social surveys with several residents of different ethnicities who will be resettled by the construction of Nuozhadu Dam. Almost all of the study participants said that they did believe in the importance of hydropower in improving the economy of the country; however, there was almost unanimous agreement that resettlement was bad for their households and that they did not want to be moved. One of the main assertions made by the authors is that there will inevitably be social and cultural impacts on the local minority communities and that resettlement will end up fragmenting ethnic cultures from the social and ecological roots in agriculture to which they are closely tied. This in turn causes great losses in what the researchers consider to be the current eco-human system (Zhang *et al.* 2008).

In general, the entities that control the hydropower project also control the distribution of its benefits and costs. As a result, compensation for displacement and resettlement is not in the hands of the villagers but rather rests with the government. In fact, while villagers said that they expected to be compensated for losses in farmland, all of the compensation money will be given to the township government because land is collectively owned. Furthermore, while the local township officials indicated they want to do right by the people they represent, how resettlement compensation is distributed depends on higher level officials who control all of the funds. Along with this, current plans described for reallocation of land would distribute significantly smaller portions of agricultural and forest land to villagers in return for what they lost, worsening the livelihoods of already significantly marginalized groups. Scholars have suggested that these communities may become dependent on other forms of income such as wage labor and out-migration (Zhang *et al.* 2008).

A second set of studies on the social and economic impacts of resettlement for hydropower has been conducted in villages near the Manwan Dam (Tilt *et al.* 2009), as well as the Dachaoshan, and Xiaowan Dam sites (Chen 2008). In 1996, Manwan was the first dam to be completed on the Mekong. Survey data in these studies produced many interesting findings about economic and cultural changes

brought on by resettlement in the case of the Mekong. Both Chen and Tilt *et al.*'s studies concluded that all types of land holdings, especially land used for paddy rice agriculture and forest land orchards were significantly reduced after resettlement (Chen 2008; Tilt *et al.* 2009). Orchards in fact were reduced by 71.6 %, and the ratio of paddy to dry agriculture fields dropped from 6:4 to 4:6, greatly altering the agricultural crops and preferences of villagers (Tilt *et al.* 2009). Furthermore, on average, household income was significantly lowered across the surveyed villages (Tilt *et al.* 2009), and villagers became dependent on purchased rice and grains as they no longer possessed enough paddy land to grow what they needed for subsistence (Chen 2008). Cultural identity and commonly held values of minority groups were lost as they were assimilated with (majority) Han Chinese villages (Chen 2008), and traditional ecological knowledge was also negatively affected (Tilt *et al.* 2009). One major difference in these case studies is that the majority of the resettled communities were said to have been highly reliant on lowland rice agriculture, whereas those described in the study by Zhang *et al.* (2008) were primarily of the Lahu minority group, a hill and mountain culture that practiced more dry land and sloping agriculture. This had deleterious consequences for rice cultivating communities, because they were forced to move rice cultivation to marginal and sloping lands that in turn increased the occurrence of landslides and accelerated degradation of the natural environment (Chen 2008).

China's policy framework for dealing with the social impacts of development-induced displacement has been steadily improving in recent years. In 2006, the central government established a law that grants certain rights of fairness to people displaced by dams and requires the government to be absolutely certain the standards of living of displaced people are not decreased but remain the same, or even be raised through subsidies and post resettlement payments (PRC 2006). The law, known as "Regulations on Land Acquisition Compensation and Resettlement of Migrants for Construction of Large and Medium Scale Water Conservancy and Hydropower Projects," stated that communities reliant on agriculture must be moved to areas where they can continue to practice agriculture and must be given amounts of land equal to what they previously possessed. All trees and seedlings inundated must be compensated for, and if subsidy and compensation payments cannot offset these losses they must be increased until they do. Additionally, the law indicated that displaced people must be allowed to play a role in the decision-making process regarding their resettlement through public meetings or other activities (PRC 2006). Much of the literature however, suggests that enforcement of this resettlement law is sporadic and uneven (Brown and Xu 2010; Foster-Moore 2010; Tilt *et al.* 2009).

## Research Questions, Methods, and Data

Researchers seeking to understand the effects of dam-induced resettlement on communities face some serious methodological challenges (see Bartolome *et al.* 2000; Tilt *et al.* 2009). The preferred method would be to collect longitudinal data from communities before and after resettlement, but the effects of resettlement typically unfold over a long time horizon, making this approach impractical. We have opted instead for a cross-sectional study approach that compares resettled communities with nearby communities that have similar demographic characteristics but have not been resettled. Our research questions are as follows:

1. How does household income differ between resettled and non-resettled households?
2. How do land holdings differ between resettled and non-resettled households?
3. How do crop selection and output differ between resettled and non-resettled households?
4. What effects do government compensation programs have on rural household incomes?

This cross-sectional approach does not allow us to directly measure changes in agricultural livelihood for any given household, but it does allow for a systematic examination of differences between households based on resettlement status.

The data for this study were collected in 2010 from the Mekong River valley in central and southern Yunnan, China. In total, 843 households were surveyed. Enumerators surveyed either the household head or the household head's spouse. Detailed information was collected about each member of every household and thus information was collected on several thousand individuals. A wide range of demographic, social, and economic information was recorded. Specific topics of inquiry ranged from age, gender, health, ethnicity, education level, many aspects of agricultural production, participation in village activities, and many other variables. Especially useful in this analysis were figures relating to total household income, land allocation, agricultural production, wage labor, and government subsidies.

Sample sites were stratified both by dam location, administrative regions, and resettlement status: the three states of resettlement being households resettled, planned for resettlement, and those with no resettlement planned. In China, provinces are divided into prefectures and counties. Within each county there are several townships, each of which administers multiple villages, which are then further divided into historical natural villages that have typically existed over very long periods of time. We sampled

households within four counties, three of these associated with specific dam sites. In Yun County, households were surveyed under the resettlement implemented and resettlement planned categories at both the Manwan and Dachaoshan Dam sites. In Fengqing County, households in these same two categories were surveyed at the Xiaowan Dam site, which was completed in 2010. In Lancang County, at the Nuozhadu Dam construction site, households under all three categories of resettlement were surveyed. Lastly, in Jingdong County, only households with resettlement planned and households with no planned resettlement were surveyed. In total, households were sampled from 42 natural villages across all four counties, with an average number of households per village of 23; however this number ranged from 3 to 60 households depending on village size and other factors (see Table 1). Within the total basin, households represented a mix of 10 ethnicities including Han Chinese, who made up the majority of the survey with 562 households. After Han, the major ethnic groups represented were Yi (142 households), Lahu (105 households), and Bulang (17 households). Of the Lahu households surveyed, 104 of 105 lived in Lancang County, a Lahu autonomously administered county (Fig. 1).

As described, the households surveyed in this study are distributed across three hydropower project resettlement categories—resettlement not planned, resettlement planned, and resettlement implemented. For the majority of our analysis, we combined households into two groups— not resettled, and resettled—to allow for inter-group comparisons using independent-samples t-tests, since households in the “resettlement planned” category had not yet been displaced. However, at the end of our analysis we examine all three categories and use one-way analysis of variance (ANOVA) tests to better understand the effects of government compensation on household income.

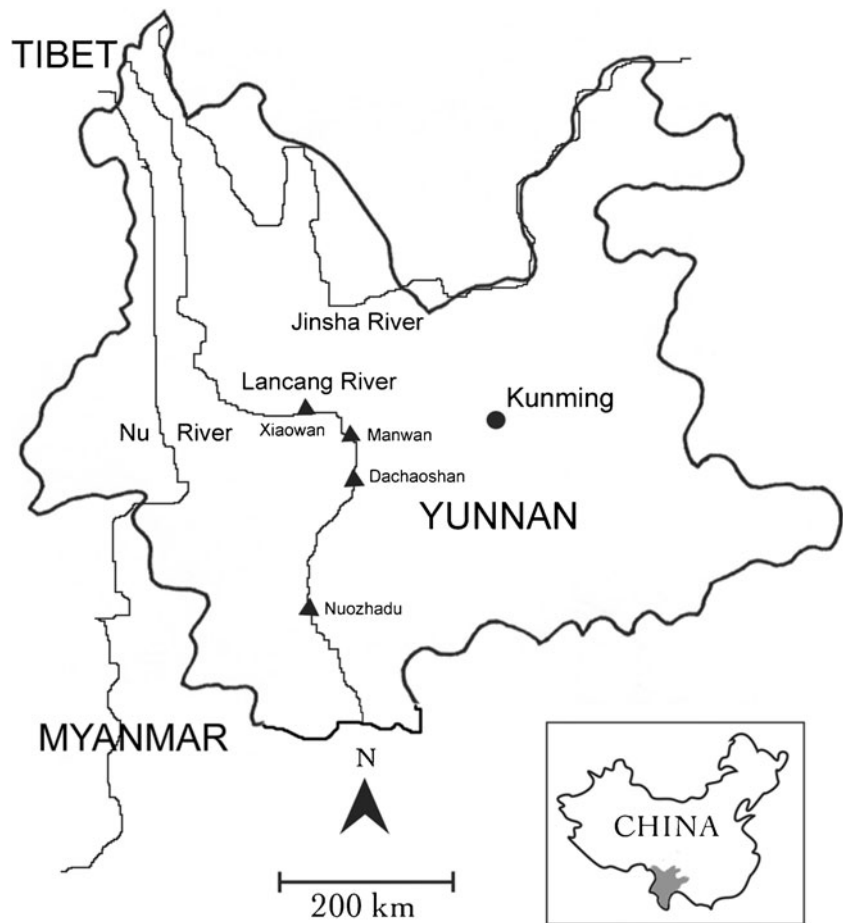
**Table 1** Households interviewed in each county sampling site by resettlement category

Survey sample site	Resettlement category			Dam status <sup>a</sup>
	Resettlement not planned	Resettlement planned	Resettlement implemented	
Fengqing	0	137	62	Completed
Jingdong	39	45	0	In progress
Lancang	30	113	60	In progress
Yun	0	233	124	Completed
Total	69	528	246	Sample Total = 843

Total sample size is 843 households

<sup>a</sup> Dam construction status at the time of sampling

**Fig. 1** Map of China's Yunnan Province showing the study dam sites



**Results**

**Total Annual Household Income**

How does household income differ between resettled and non-resettled households?

We calculated total household income in a way that goes beyond typical government accounting measures. The Yunnan Statistical Yearbook (2011) estimates average annual household income in these counties to be approximately 19,000 *yuan*. The figures reported here are notably higher for two reasons. First, agricultural income is much more comprehensively calculated and includes: agricultural sales minus input costs; the estimated value of agricultural and livestock production for household consumption; income from wage labor; bank investments; and self-employment income. Second, these figures also include government subsidies—both poverty alleviation subsidies and, for many households, displacement compensation—which will be addressed in detail later. In addition to cash income, we also asked study participants to provide values for in-kind sources such as medical services, gifting, labor sharing, and the receipt of agricultural tools and products.

There is a consistent trend for mean incomes evident across all counties. Income is highest for resettled households (Table 2). Yun, Lancang, and Fengqing Counties all show higher income in the resettled category than in households not resettled (from 23834.91 to 37183.50 *yuan*, 29920.46 to 52523.11 *yuan*, and 28585.08 to 40185.39 *yuan* respectively). Jingdong County, with only non-resettled households, had an average household income of 25966.29 *yuan*.

**Annual Income, Wage, and Subsidy Income**

How does household income differ between resettled and non-resettled households? Independent samples t-

**Table 2** Annual income by county and resettlement status

County	Not resettled	Resettled
Yun	23834.91	37183.50
Lancang	29920.46	52523.11
Fengqing	28585.08	40185.39
Jingdong	25966.29	N/A

Means are in Chinese *yuan*. (1 U.S. dollar = ~6.3 *yuan*)

tests were conducted to test for differences in average income across resettlement categories. The results reveal a difference in annual income between resettled households (41415.53 *yuan*) and households not resettled (26618.84 *yuan*) (Table 3). This difference was significant ( $p < .001$ ), and the effect size of this relationship between variables was typical to substantial ( $r_{pb} = .32$ ) (Cohen 1988; Vaske 2008). Contrary to expectations, the mean annual income for all counties combined was higher in resettled households than in non-resettled households. The mean wage incomes were also found to be considerably higher in resettled households, at 6187.28 *yuan*, as compared to 2257.40 *yuan* in households not resettled (Table 3). This difference was statistically significant ( $p < .001$ ) and the effect size of  $r_{pb} = .29$  indicates this relationship is of medium or typical strength.

The total mean government subsidy income from resettled households (2201.18 *yuan*) to non-resettled households (2468.87 *yuan*) did not show a statistical difference ( $p = .701$ ) and had an effect size of very minimal strength ( $r_{pb} = .01$ ). Descriptively, households that have not been resettled received more government compensation than those already resettled. These results are somewhat unclear because households in the transitory category of being planned for resettlement have been combined with those that will not be resettled at all and who have not received any subsidies. We take a further look at the differences in government subsidies across all three categories of resettlement utilizing one-way ANOVA statistics below.<sup>4</sup>

#### Land Allotments and Resettlement

How do land holdings differ between resettled and non-resettled households?

Resettled households on average receive more paddy land (+0.83 *mu*), less dry land (-8.63 *mu*), and considerably less forest land (-11 *mu*) than non-resettled households (Table 3). The relationships between land allotments and

resettlement status are all statistically significant ( $p < .001$ ). The effect size of these higher paddy land allotments in resettled households indicates a relationship of typical to substantial strength ( $r_{pb} = .28$ ). The effect size of lower dry land allotments in resettled households is also of typical strength ( $r_{pb} = .20$ ). The effect size for lower forest land allotments in resettled households was of large or substantial strength ( $r_{pb} = .40$ ). When considering the resettled and non-resettled categories across all land allocation types, the greatest difference is in forest land allocation, with resettled households showing remarkably less access to forest lands.<sup>5</sup>

#### Agricultural Outputs and Resettlement

How do crop selection and output differ between resettled and non-resettled households? Differences in crop patterns relate directly to the changes in land allocation described above. Resettled households sold less corn to the market than non-resettled households (3625.84 *jīn* as compared to 5071.98 *jīn*), probably because they had less access to dry agricultural land where corn is typically grown (Table 3). This difference was statistically significant ( $p < .001$ ), however the relationship strength was minimal ( $r_{pb} = .07$ ). In contrast, resettled households sold far more rice than non-resettled households (1038.74 *jīn* as compared to 427.68 *jīn*), probably because they typically had access to larger plots of paddy land. The difference was statistically significant ( $p < .001$ ) and had a relationship of typical to substantial strength ( $r_{pb} = .33$ ).

Walnut production, which is a major form of cash-cropping in the area, differed significantly between resettlement categories, with resettled households selling an annual average of only 4.35 *jīn* compared to 556.40 *jīn* for non-resettled households. This finding was statistically significant ( $p < .001$ ), and the relationship strength was typical ( $r_{pb} = .26$ ).<sup>6</sup>

<sup>4</sup> To understand the variability among responses, we used the standard deviation of household income as a measure of dispersion with respect to the mean (Vaske 2008). All resettlement categories showed a similar level of variability for total income: one standard deviation in each resettlement category varied from the mean by approximately half of the value of the mean. For specific income sources, the standard deviation of household responses was relatively high across each resettlement category; one standard deviation varied from the mean by as much as, or more than, the mean value. A high degree of variability for wage labor among households was common to all resettlement categories. It is unknown to what extent the overall high degree of variability may relate to uneven levels of education, infrastructure, and the sporadic nature of wage labor in the Chinese countryside; in the conclusion we discuss what impacts dam construction may have on wage labor opportunities.

<sup>5</sup> In terms of land allotments, paddy land allocation for resettled households showed the least amount of variability. In contrast, non-resettled households had a standard deviation value that exceeded the mean. Dry land allocation variability follows a similar pattern, where only the households that have been resettled have a standard deviation that is less than the value of the mean. It appears the government may be relatively consistent in how it allocates both paddy and dry land among resettled households. The allocation of forest land also indicates a high degree of variability, however no pattern is observed between the resettlement categories.

<sup>6</sup> Variability among resettlement categories for corn, rice, and walnut income was high; a single standard deviation exceeded the mean response values for all resettlement categories and all crop income sources. Again, the high degree of agricultural income variability was common across all resettlement categories.



**Table 3** Socioeconomic indicators by resettlement status

Research question	Not resettled	Resettled	t -value	p-value	$r_{pb}^a$
1 Annual income	26618.84	41415.53	9.01	<.001	.32
1 Wage income	2257.40	6187.28	7.25	<.001	.29
1, 4 Subsidy income	2468.87	2201.18	.38	.701	.01
2 Paddy land allocated	0.97	1.80	7.85	<.001	.28
2 Dry land allocated	15.63	7.00	8.72	<.001	.20
2 Forest Land Allocated	14.35	3.35	17.90	<.001	.40
3 Rice sold	427.68	1038.74	6.12	<.001	.33
3 Corn sold	5071.98	3625.84	2.66	<.001	.07
3 Walnuts sold	556.40	4.35	14.12	<.001	.26

Units are as follows: land area = Chinese *mu*~1/6 of an acre, rice/corn/walnut sold = weight in Chinese *jin* (500 g), income = Chinese *yuan* (1 U.S. dollar = ~6.3 *yuan*)

<sup>a</sup>Effect size determined by point biserial correlation (Pearson's) (Cohen 1988; Vaske 2008)

Government Subsidies

What effects do government compensation programs have on rural household incomes?

As previously described, we sought a more nuanced understanding of when government subsidies were influencing household income to include the resettlement planned category. Therefore we examined two forms of compensation separately: money paid to rural households for displacement and resettlement, and money paid to rural households to compensate for land requisition. Based upon the land subsidy means from Table 4, land requisition and displacement subsidies accounted for a portion of the total resettled household income. In most cases it would appear land was not compensated for until households were in fact resettled, as per the mean land requisition subsidy being 279.85 *yuan* in households planned for resettlement, and 1184.55 *yuan* in those resettled. Conversely, displacement subsidies were higher in households planned for resettlement versus those already resettled (2881.63 *yuan* and 1016.63 *yuan* respectively). Both subsidies had statistically significant differences between resettlement categories ( $p=.007$ ,  $p=.006$  respectively). However both subsidies had a minimal relationship strength with resettlement ( $\text{Eta}=.11$ ). Tamhane post-hoc tests indicated these subsidy differences were between the resettled and not resettled categories, as well as the resettled and resettlement planned categories.

To conduct the one-way ANOVA tests we have separated out all three categories of resettlement to analyze income from government subsidies. Our surveys included several households in the transitory category of being planned for resettlement. This category is difficult to quantify in terms of land holdings and crop production because it can be expected that for the time being, these communities continue to possess all of the land that they have historically possessed. However, one place we can look at how this category differs is with government subsidies, because many of these communities are already receiving money from the government to compensate them for their future displacement. This differs from communities that will not be resettled at all who are not receiving such funds.

Households that are planned for resettlement are in fact receiving more displacement income already than those who have already been moved (Table 4). This difference is also statistically significant between these two groups alone as shown by the Tamhane's T2 post hoc test. While difficult to interpret with certainty, these results seem to indicate that resettlement policies for compensation may indeed be improving, which would correlate with the new resettlement law passed in 2006 (PRC 2006). This law provides a framework for compensating more recently displaced populations at a level far above what existed when communities were displaced for the Manwan Dam in the 1990s.

**Table 4** Government subsidies by resettlement category

Subsidy <sup>1</sup>	Resettlement not planned	Resettlement planned	Resettlement implemented	F-value	p-value	Eta ( $\eta$ )
Displacement	0.00 <sup>a</sup>	2881.63 <sup>b</sup>	1016.63 <sup>c</sup>	4.94	.007	.11
Land requisition	0.00 <sup>a</sup>	279.85 <sup>a</sup>	1184.55 <sup>b</sup>	5.16	.006	.11

Means are in Chinese *yuan* (1 U.S. dollar = ~6.3 *yuan*)

<sup>1</sup> Means with different superscripts differ at  $p<.05$  using Tamhane's T2 post-hoc tests for equal variances

## Conclusion

It can be quite a complicated task to examine the effects of dam-induced resettlement on agricultural livelihoods. In this paper, we used a cross-sectional approach to compare resettled communities with non-resettled communities in order to understand differences in income, land allocation, agricultural outputs, and government compensation. Two limitations of the study warrant comment. First, as noted in the “Introduction”, the cross-sectional study design allows us to make meaningful comparisons between communities with different resettlement statuses, but it does not allow us to infer that any observed trends are caused by resettlement. Second, in relation to the study's sampling frame, Lancang County is the only study location that included participants from all three resettlement categories, and Jingdong County appears to have a lower average income than the other study counties. Considering these limitations, the findings advance our understanding of the socioeconomic challenges of agricultural communities facing resettlement.

With respect to the first research question, we found significant differences between the incomes of the different resettlement groups, with average income being higher among resettled households. This difference appears to be explained primarily by higher wage income in resettled communities, describing approximately 35 % of the difference. Beyond higher wage income, a small portion of the difference in income appears to be explained by government subsidies distributed to resettled households. Also, while the overall higher income for resettled households is inconsistent with previous literature (Zhang *et al.* 2008), our findings show a higher reliance upon wage labor for resettled households as compared to households not resettled. This higher reliance on wage income may have important implications for resettled households. In China, since the sweeping social and economic reforms of the 1980s there have been fewer social services made available to rural people and therefore land is seen as one of the few sources of social security (Tilt 2010). Thus, while a higher reliance upon wage-based income for economic livelihood is apparent in resettled villages in this study; such wage-based labor may be less stable as a source of long-term income than traditional agricultural livelihoods.

These findings, that resettled communities have higher cash incomes than their non-resettled counterparts contradicts much of what social scientists have learned about the consequences of development-induced displacement for local communities. For example, after a comprehensive review of the social impacts of dams around the world, Scudder (2005) argues that there is not a single case in which dam-induced displacement resulted in improved livelihoods for local people. One key point of the controversy

over the long-term socioeconomic effects of dams is whether dam construction and operation actually create jobs for local residents, an argument that government agencies and hydropower corporations routinely put forward in support of their agendas.

The picture in the Mekong Basin appears to be mixed. In Yun County (the site of Manwan and Dachaoshan dams), among households reporting some income from wage labor, fewer than 4 % reported that someone in the household held a job that was connected to a hydropower facility. In Fengqing County (the site of Xiaowan Dam), no households reported a member working in a job connected to hydropower. However, in Lancang County (the site of Nuozhadu Dam), 40 % of households with a member working in wage labor said that a member of the household worked in a job related to hydropower, likely because the Nuozhadu Dam was still under construction at the time the survey was administered, providing more opportunities for labor-intensive work. If Lancang County follows the typical pattern of other dam projects in China, low-level job opportunities will likely disappear as the dam begins operation.

With respect to the second and third research questions regarding land allocation and crop selection and output, our findings run contrary to much of the previous research. Surprisingly, paddy land allotments for resettled households were higher than for non-resettled households. As a result, resettled households receive more income from rice sold compared to non-resettled households. One interpretation of this finding is that low-producing communities, such as the Lahu of Lancang County, are being displaced at higher rates than communities with well-established rice production. Unlike wet-rice-cropping communities in other regions of the Mekong such as the Han Chinese, the Lahu have traditionally lived on less-fertile hilly land growing dry grains rather than rice (Zhang *et al.* 2008). Furthermore, many resettled households may be intensifying their rice production, as rice is a once or twice per year crop that could be used to replace losses of other perennial crops such as walnuts. In contrast to paddy land allocation, dry land allocation was lower in resettled households, as was the amount of corn sold, making the situation with dry land and corn more consistent with previous research of displacement impacts upon rural households.

Perhaps the most interesting trend in our data relates to forest land holdings and the amount of walnuts sold (the primary orchard crop); forest land allotments were significantly lower for resettled households. This is in line with the literature on dam-induced displacement (Scudder 2005; Tilt *et al.* 2009). Similarly, the amount of walnuts sold by resettled households was also significantly lower, thus adversely affecting household income. Only 23 respondents in the resettled category actually stated they sold walnuts, whereas over 200 respondents in the non-resettled category

stated they sold walnuts. Walnut trees are not native to the region; furthermore, once planted they are not easily transplanted to a new location. The variety of perennial crop types is likely to be much fewer for resettled villages, which may in turn present a degree of instability in relying solely upon a few varieties of annual crops. This lower diversity in crop production may make it difficult for resettled households to adapt to fluctuating prices and other market conditions. Furthermore, household income data suggest that requisition of forest lands does not seem to be compensated for at the level required by the 2006 law that outlines compensation for resettlement due to large development projects.

This opens up an important avenue for future research on how best to assist resettled communities in the transition to new economic activities. Given that the scale and pace of dam construction in China continues unabated, social scientists and policymakers will need to better understand the potential impacts on agricultural communities in order to minimize adverse impacts. While our findings indicate a shift toward wage-based income sources in resettled communities, careful thought should be given to the sustainability of such a shift. Although household incomes are shown to be higher in resettled populations, this does not necessarily indicate less susceptibility to vulnerability from dam-induced displacement.

Vulnerability itself in social situations such as dam resettlement has been defined as “the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt” (Adger 2006: 268). Based upon this definition, while dams themselves may bring unskilled forms of wage based labor, which appears to be the main driver of higher incomes, this source of income has disappeared in most cases once construction is complete, with no indication that communities have any form of replacement for these losses and thus a lack of adaptive capacity. A second case of more vulnerability and less adaptive capacity suggested by Jalan and Ravallion (2001) is that communities lacking diverse sources of income in China have been shown to be more vulnerable to many different socioeconomic changes and perturbations. Based upon our results this would indeed indicate more vulnerability among resettled communities in the Mekong Basin, who place more reliance on wage based income and appear to have less diversity in agricultural income sources and crops; a concern in and of itself shown to be an indicator of economic instability in rural households in China (Galipeau 2012; Li and Tilt 2007; Tilt 2008). Thus, while our results do indeed appear contrary to those found in the typical literature with respect to income and overall socioeconomic wellbeing, this is not to say that resettlement has not caused major changes or in any way been completely beneficial to the communities of the Mekong Basin in China.

Our goal in this paper is not to advocate a policy position on hydropower development, but rather to offer a close examination of some of its implications for rural households. As stated in the “Introduction”, even the World Commission on Dams acknowledged the positive benefits of such projects (2000). With a very high reliance on coal, China is in need of developing cleaner energy sources, including hydropower. However, there are various socioeconomic costs associated with large dams, which we have sought to highlight here in hopes of better informing policy decisions regarding such projects. Our data suggest that, in line with recent policy changes, compensation for resettled households in rural China appears to be improving over time. Overall, these findings paint a picture of resettled households moving away from traditional agricultural livelihoods to an economic strategy based on intensified agriculture and smaller landholdings, supplemented by a new and growing wage-based economy.

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