Published in final edited form as:

Environ Manage. 2018 September ; 62(3): 489–499. doi:10.1007/s00267-018-1047-0.

Impacts of China's Grain for Green Program on Migration and Household Income

Paul Treacy¹, Pamela Jagger¹, Conghe Song², Qi Zhang², Richard E. Bilsborrow³

¹Department of Public Policy, University of North Carolina, Abernethy Hall, CB #3435, Chapel Hill, NC 27599-3435, USA

²Department of Geography, University of North Carolina, 205 Saunders Hall, CB #3220, Chapel Hill, NC 27599-3220, USA

³Gillings School of Global Public Health, University of North Carolina, 206W Franklin Street, CB #8120, Chapel Hill, NC 27516, USA

Abstract

In the late 1990's, China's Yangtze and Yellow River Basins suffered devastating natural disasters widely attributed to the degradation of soil and water resources. The Government of China responded with a number of major environmental programs, the most expensive and influential of which, the Conversion of Cropland to Forest Program (CCFP), was implemented widely in 2001. Under the CCFP, the central government compensates farmers to convert cropland on steep slopes or otherwise ecological sensitive areas to forest or grassland. Its long-term success depends on households' ability to make sustainable changes to their household income streams and income diversification strategies.

In this paper, we use a difference-in-difference estimation approach to examine the role of migration as a household-level response to CCFP, testing the extent to which individuals migrate following a reduction in land available for farming. Importantly, we exploit 15 years of data on migration decisions and establish that participating and non-participating households were on parallel migration paths before the program, thus refuting a key threat to causality in a difference-in-difference model. We find that participating families do, in fact, choose migration as an income diversification strategy more frequently than non-participants. The program effects varied over time, but peaked post-Great Recession in 2011 when migration rates in CCFP households exceeded those of non-CCFP households by 5.9 percentage points ($p=0.003$) or about 26%. Our findings should encourage policy makers that families are making long-term adjustments to their livelihood strategies to avoid poverty in anticipation of the eventual withdrawal of government supports.

Keywords

Conversion of Cropland to Forest Program; Grain for Green Program; China; migration; income diversification; payment for ecosystem services

Introduction

Payment for ecosystem services (PES) schemes are an approach taken by many governments and organizations around the world to address natural resource degradation. Through market mechanisms, PES programs put a price on the ecosystem services that, theoretically, would otherwise be consumed and/or generated for free, mitigating the potential problem of overuse. The Conversion of Cropland to Forest Program (CCFP) in China (also known as the Grain for Green Program or the Sloping Land Conversion Program) is the largest land reforestation scheme in the world in terms of investment and public participation (Delang and Yuan 2015). The primary goal of CCFP is to incentivize farmers to convert croplands on steep slopes and otherwise ecologically sensitive areas into forests by paying them an amount equivalent to the lost crop revenue. Begun in 1999 and expanded in 2001, CCFP covers the largest area and engages the most participants of any ecological program in Chinese history (Song and Zhang 2010; Yin and Yin 2009). By increasing forest cover, the program is expected to provide ecological services, including reducing soil erosion, conserving water resources, and increasing carbon storage. Further, CCFP is expected to have positive socioeconomic effects such as poverty alleviation and greater diversification of labor within families. In particular, the withdrawal of land from crops was expected to increase household income by freeing up labor, allowing individuals to migrate to employment opportunities elsewhere. These socio-demographic outcomes are the subject of our research.¹

While government payments help compensate families for the loss of income from reduced agricultural production, they are not intended to continue forever. For the program to sustain forest cover in the long run, participants must pursue other sustainable sources of income so they neither revert to farming CCFP-designated land when the payments cease, nor fall into poverty. Participating households, therefore, must make durable changes to their livelihood strategies that can overcome the cessation of CCFP payments, increasing their income streams from sources such as off-farm employment, business ventures, livestock, forest products, and remittances from labor migration.

The link between forests and rural labor migration is an increasingly important subject for researchers of environmental outcomes and management, particularly in China where the migrant population increased by 90 million between 2000 to 2010 (Liang et al. 2014). Rural areas contain most of the world's natural resources, and while future population growth will occur predominantly in cities, virtually all forest cover changes will occur in rural environments (Carr 2009). Researchers have found statistically significant and positive correlations between remittances and reforestation in El Salvador (Hecht 2010), and between rates of off-farm labor and changes in forest and scrub cover under CCFP in China's Yunnan Province (Zhang et al. 2017). Other studies have focused on the processes through which increased rural labor migration positively affects forest cover. Rural households with fewer family members due to migration have lower demand for fuelwood, reduced supply of labor

¹Ultimately, ours is partial equilibrium analysis focusing on changes in migration and household income and assets brought on by CCFP. A general equilibrium analysis considering downstream consequences of migrants' decisions (for instance, working in a resource- or carbon-intensive industry in a polluted city) would provide a more comprehensive evaluation of sustainable resource management and be a source for future research with different data, but is not our objective here.

for fuelwood collection, and upgraded household assets away from wood-burning power to electric stoves and other modern appliances (Qin 2010; Chen et al. 2012).

In this paper, we examine the role of migration in household responses to CCFP, estimating the extent to which individuals move away from home for long periods of time in response to a reduction in land available for farming. Policy makers should interpret an increase in migration among participating households as an encouraging sign that they will be able to make long-term adjustments to their income streams. The successful pursuit of migration income should also help preserve the gains in forested land and sustain any ecological benefits.

This paper distinguishes itself in a few ways from previous studies of the effects of CCFP. First, we use 15 years of data on migration activity, including a pre-treatment period from which we can establish baseline migration behavior. Second, we rigorously test the typical assumption in CCFP literature that participation is free of selection bias. Finally, our dataset is both newer (results of a 2014 survey) and generally larger (1,887 individuals, 465 households) than previous studies.

Background and conceptual framework

In 1997, China suffered severe drought along the Yellow River and, in the following year, disastrous flooding along the Yangtze River. The flooding alone cost 250 billion yuan (\$31 billion in 1998 U.S. dollars) in damages and led to the loss of more than 4,000 lives (Sun et al. 2002). Both events were attributed in large part to widespread soil erosion and the accompanying loss of water retention capacity resulting from extreme deforestation in the upper and middle reaches of the river basins. CCFP was one of the main government responses to rescue the land from degradation, its primary goal being to reduce soil erosion and increase China's forest cover by retiring less productive croplands on sloping terrain and converting them into forest or grassland. A pilot program was launched in 1999 in three ecologically sensitive provinces (Sichuan, Shaanxi, and Gansu) and subsequently rolled out to 22 additional provinces starting in 2002 in pursuit of a goal of converting 14.67 million hectares of cropland to forest or grassland by 2010. However, the government scaled back those plans in 2004 due to concerns about food security after the conversion of 9 million hectares (Yin and Yin 2010). More recent studies report that by the end of 2013, CCFP land had reached only 9.26 million hectares (China State Forestry Administration 2014), falling short of the original goal though contributing significantly to ecological restoration and poverty alleviation (Liu and Lan 2015).

The government incentivizes farmers under CCFP using a variety of mechanisms, including cash, in-kind payments, and tax breaks, along with the option of planting economic forest (trees bearing fruits, nuts, timber, medicinal goods, etc.) from which they could draw income, or ecological forest that primarily protects the soil but may also provide some fuelwood and salable timber. Originally, households were given 150 kg of grain annually for every mu (about 1/15th of a hectare) of cropland converted to forest in the Yangtze River Basin, or 100 kg/mu/year in the Yellow River Basin (Song et al. 2014). In addition to the grain, participating households receive a cash subsidy of 20 yuan/mu/year (\$1 US equaled 8.2 yuan at the time). To reduce transportation costs, the grain subsidy was replaced starting

in the second year with increased cash compensation: a total of 230 yuan/mu/year and 160 yuan/mu/year for the Yangtze and Yellow River Basins, respectively. Croplands converted to forests were also exempt from agricultural taxes. The cash subsidy was intended to continue for 8 years for ecological forests, 5 years for economic forests, and 2 years for grasslands. In 2007, however, the Chinese government renewed the CCFP cash compensation, at half the initial rate, for another contract period (up to 8 years) following the end of the initial contract. The total national investment in CCFP is estimated to reach 431.1 billion yuan by 2021 (Yin and Yin 2009, citing paper presentation by Tang 2007).

Like many PES projects, the objectives of CCFP were not only to reduce environmental degradation but also to alleviate rural poverty (Grosjean and Kontoleon 2009). Families were assisted in the transition from over-reliance on agriculture to a more sustainable mix of income from crops and other sources such as off-farm employment, business pursuits, livestock, forest products, and remittances. The long-term success of CCFP relies on households making changes to their livelihood strategies so that when subsidies are withdrawn, the threat of poverty does not compel participants to harvest the new trees and revert to low-productivity agriculture. Early on, most households did not have a plan for a sustainable income after withdrawal of subsidies (Wang et al. 2003). In a survey of two provinces, about 30% of farmers predicted they would convert forests back to croplands whenever government supports ended, making this a potential barrier to the long-term success of the program (Uchida et al. 2005).

The theory underlying PES schemes relies on using market-like mechanisms (in the case of CCFP, cash and in-kind transfers, tax breaks, and revenue from forest product) to influence suppliers (landholders) to internalize the social benefits and costs of their decisions (afforestation on certain croplands) so that they provide the socially efficient level of ecological services (watershed management and reduced soil erosion). In reality, empirical results have not always been consistent with theory, nor have PES schemes always achieved policy goals. They have yielded a range of ecological outcomes depending on variation in the social, macro-policy, political-economic, and cultural environments in which programs are implemented and the unpredictable ways the factors interact (Pfaff et al. 2013). For instance, in rural China, community-level vegetation cover was found to be influenced by elevation and household density but not by CCFP incentives (Zhang et al. 2017). A number of studies found a prominent Costa Rican PES scheme had little or no impact on deforestation (with a small increase in net forest cover due to reforestation), but cautioned against extrapolating those findings due to unique conditions in the country (Pattanayak et al. 2010). Another meta-analysis of Costa Rica found that effects vary by scale: PES schemes made no incremental reductions at the national-level, but they reduced deforestation in sub-national cases (Daniels et al. 2010). A program in Mexico resulted in a 3–4% reduction in deforestation, but the effects varied considerably depending on property type and region, and some of the positive effects were mitigated by spillovers, that is, new deforestation in nearby, non-enrolled plots (Alix-Garcia et al. 2013). The heterogeneous results of these studies illustrate that the success of a single PES does not necessarily translate to other programs. Community-level social, economic, and biophysical features are important mediating factors and play a role in influencing the relationship between population dynamics and other rural restructuring processes (Qin and Liao 2016).

Research into the social and economic effects of CCFP has similarly shown heterogeneous results, with greater consistency among studies that consider longer time frames. Studies undertaken only a few years after implementation showed no effect on household income (Xu et al. 2004) and migration rates (Uchida et al. 2007) and virtually no effect on off-farm employment (Uchida et al. 2007). But subsequent research, after the program had a number of years to take hold, found program effects on a number of different outcomes. Researchers studying program impacts on off-farm labor in different provinces have found the association to be positive and significant (as was the association between off-farm labor and program intensity, as measured by number of years as a participant and proportion of land reforested) (Uchida et al. 2009); positive and significant, but only in ‘constrained’ households that had been compelled by local government and markets to meet a pre-program minimum level of agricultural production (Groom et al. 2010); positive and significant, though not large (Yao et al. 2010); and positive and significant (Kelly and Huo 2013). Regarding the association between CCFP and household income, researchers concluded that the relationship was positive and significant, especially for low-income households (Li et al. 2011). And a significant, positive association between CCFP and income diversification—especially among poorer households and only once the program had been in effect for three years—was found (Liu and Lan 2015). While most research has been conducted on outcomes other than migration, one study did look at migration in three poor areas and found it significantly, positively affected by CCFP (Démurger and Wan 2012).

Particularly salient to CCFP households, families in poorer, rural regions are uniquely vulnerable to income shocks due to extreme market fluctuations, disastrous weather events, crop raiding, death or illness of family members, and government fiat, among other factors. But since their agricultural land is largely fixed, and effective credit and insurance markets do not exist, attempts to respond to shocks are more difficult compared to those of rural households in developed nations or regions with strong local institutions. Yet the need to smooth income persists since households have limited capacity to reduce consumption in response to collapses in purchasing power. A key way of reducing the risk of a shock to agricultural income is for households to engage in multiple income-generating activities. Empirical studies have demonstrated that rural families smooth household income, accumulate wealth, and reduce the risk of poverty by pursuing a diverse set of income-generating activities (Nielsen et al. 2013). A well-diversified income stream can serve as an effective hedge against extreme volatility of any single source (Zhao and Barry 2014). And the larger a family’s size, the more effectively it can make household-level decisions that take advantage of specialization among members, allocating individuals to the activities where their marginal contributions to income and well-being are greatest (Reardon et al. 2006).

The CCFP has the potential not just to enhance the supply of environmental goods and services in rural Chinese provinces, but also to help families achieve smoother, more reliable—perhaps even higher—income streams. To the extent that the program’s cash and grain subsidies relieve capital constraints and free up household labor to pursue other activities such as migration, off-farm employment, or harvesting forest products, the new sources of income can reduce the risk of poverty by acting as effective forms of insurance against income fluctuations. On the other hand, participant households that fail to make durable

improvements to their income-generating activities are essentially relying heavily on subsidies to diversify their incomes, a strategy that is likely to fail after the government eventually withdraws its support (and may be insufficient even in subsidized years, given the small size of the payments). Our research explores whether CCFP households have turned to migration as an alternate income stream, and whether and how overall income levels, income diversification, and asset levels are affected.

Methods and data

Survey

Our data source is a household survey conducted in Tiantangzhai Township, located in the eastern Dabieshan mountainous region in southern Anhui Province of China. The township covers an area of 189 km² and has a population of 17,000 people. The elevation varies from 300 to 1700 m, with mean annual precipitation of 1,350 mm and mean annual temperature 16.4°C. The landscape of the township is dominated by natural forest aided by favorable weather and partially designated as a nature reserve. The study area is remote from the major development activities in the county, which is recognized by the central government as a county in poverty. Local residents depend primarily on farming staple crops, including paddy rice, corn, and sweet potatoes. Many also earn income from other activities such as raising animals, construction, local retail businesses, and migration out of the county. The government implemented CCFP in Tiantangzhai Township in 2002. Approximately 20% of rural households enrolled cropland into the program, with most planting ecological forests, specifically maple or Italian poplar (Song et al. 2014).

The questionnaire consisted of 20 modules capturing extensive individual- and household-level data. It included demographic information on all household members, both those currently living at home and out-migrants, along with information on their education, work status, earnings in the past 12 months, migration history, and remittances. Household-level questions captured land area and use; details of participation in CCFP, such as amount of land converted; housing quality, vehicles owned, and other assets; and income from crops, livestock, forest products, and household businesses.

Sampling and Data Collection

The sample was selected using two-stage random sampling to first select study communities and then households within those communities. To achieve a balanced sample from a region where only 753 of 4,369 households were participants, both stages were stratified and CCFP households were oversampled. In the first stage, 40 of the 165 resident groups were randomly selected. Resident groups are clusters of 10 to 50 households living relatively close to each other who shared communal croplands before China's rural reforms of the 1980s. In the second stage, 734 households were sampled—up to 20 households in each resident group (fewer from resident groups smaller than 20 households). Surveys were administered without replacement of absent or refusing households to avoid introducing bias. The result was a sample of 482 households, including 271 CCFP and 211 non-CCFP households. Seventeen households were dropped due to incomplete or unreliable data,

leaving the final sample for our analysis of 465 households, of which 259 were enrolled in CCFP.²

In addition to the data reflecting the survey year (the 12-month period prior to the survey conducted in July and August 2014), the questionnaire also captured information on migration in each year from 2000 to 2014, a feature that distinguishes our dataset from those used in other CCFP research. Respondents were asked whether, and which years, any household member had been a migrant (defined as living outside the county for at least 6 continuous months in a calendar year). From this question, we created our main outcome variable capturing the migration status of each household member in each of the 15 years, equal to 1 if the individual was a migrant and 0 otherwise. While recall error is possible, it is difficult to conceive of plausible reasons why errors would be systematically different for participants versus non-participants, suggesting a low likelihood of bias. To the extent there is randomly distributed recall error, our results represent conservative estimates.

From the household data for the survey year 2014, we created three additional outcome variables:

1. *Total income*: total household gross income, equal to the sum of all income sources: businesses, off-farm wages, remittances, agriculture, forest products, livestock, and ‘other’ (social gifts, rental property, and government subsidies, including CCFP). Respondents provided data from all sources with the exception of 40 missing values (about 9%) for government subsidies (interviewers reported that these respondents were simply not sure of the amount of government subsidies they received). After a number of regressions and t-tests suggested there was no association between subsidy amounts and other variables, we imputed missing values only for subsidies and only for the 40 affected households using the sample mean (1,826 yuan).³
2. *Income diversity index*: each of the seven income categories was divided by total household income, and the result was then squared. The reciprocal of the sum of these seven squared terms measures household income diversification (higher numbers indicating greater diversification).
3. *Asset Index*: an aggregate variable created by summing eight individual asset variables. Each ranged from 0 (low) to 5 (high), reflecting the level of household assets including: the family’s home, fuel use, water/sanitation facilities, electrical appliances, electronic equipment, farming equipment, transportation sources, and animal/livestock holdings. For instance, when enumerators asked respondents about their home’s water and sanitation facilities, a value of 5 was assigned for the prompted answer “Piped water and flush toilet”; 4 for “Piped water and

²Enumerators successfully interviewed 482 households. Seventeen were dropped from our analysis for the following reasons. One respondent provided virtually no answers. Official reports from local government officials indicated that eight (1.7%) households that reported they had never heard of CCFP were, in fact, CCFP participants. We dropped them given the questionable nature of their responses. An additional eight households were dropped because of missing values for income from remittances.

³A t-test of government subsidy values revealed no significant difference between CCFP and non-CCFP families. Further, regressing a number of additional variables (household size, other income sources, asset levels) on government subsidies yielded neither statistically significant coefficients nor a significant overall F-test, and the R^2 was just 0.0073. (Results not reported.) Given the lack of predictors for government subsidies, we imputed missing values using the sample mean.

outdoor latrine”; 3 for “Pressure well and outdoor latrine”; 2 for “Natural spring and outdoor latrine”; 1 for “Open water and outdoor latrine”; and 0 for “Harvest rain and outdoor latrine”. The variable for livestock holdings was created from the number and type of animals respondents held using tropical livestock unit values (cattle=0.70, pigs=0.20, etc.) Final values of the overall *Asset Index* variable range from 7 to 38. Admittedly, this is a coarse measure of well-being that treats each asset equally and relies on different scales across the assets.

Analysis

First we examined the individual-level data to ask whether CCFP influenced the likelihood of migration. One prominent challenge of measuring treatment effects is that rural migration rates, especially to China’s growing cities, were already high during the 15 years covered by this survey independent of any single policy or intervention. Liang, Li and Ma (2014) noted that the size of the country’s migrant population increased by nearly 90 million between 2000 and 2010. Further, they described fundamental changes in the living conditions of migrants to urban centers that affect migration rates, such as the passage of more protective labor laws, rising wages, and increased educational spending.

In order to isolate the effects of CCFP participation, our approach is to use a difference-in-difference (DID) method comparing participants and non-participants before and after program implementation. Specifically, we ran DID logit regressions on both the full sample and a subsample restricted to individuals in the core working/migrating ages of 16-to-50 to predict the likelihood of an individual being a migrant in pre-treatment year 2001 and post-treatment year 2006.⁴ We selected 2006 initially to represent post-treatment recognizing that family decisions as profound as household migration may plausibly take a few years to initiate. Subsequently, we extended the analysis using other years as post-treatment to determine whether and how the effects changed over the many years captured by the survey’s migration question. Our unit of analysis is the individual-year.

The first set of regressions used a parsimonious model that included three predictor variables: indicators capturing CCFP participation and the post-treatment year, along with an interaction of the two.

$$\text{Prob}(Y_{it}) = \Phi(\beta_0 + \beta_1 \text{CCFP}_i + \beta_2 \text{PostTreatment}_t + \beta_3 \text{CCFP}_i * \text{PostTreatment}_t + \varepsilon_{it}), \quad (1)$$

where $Y_{it} = 1$ if individual i was a migrant in year t ; t represents either 2001 or 2006; and Φ is the logit function.

Interaction terms like our DID variable function differently and are more complex to interpret in a non-linear logit model compared to ordinary least square (OLS) regressions. In OLS, an interaction term helps isolate the fact that the effects of *CCFP* on the outcome may

⁴We chose 50 as the maximum in our age range after running our full regression in Table 2 on all ages 16–65 and calculating the average marginal effects of CCFP at 5-year intervals. The effects switched from moderately significant ($p=0.075$) at 50 to insignificant ($p=0.132$) at 55.

vary depending on the value of another variable like *PostTreatment*. In a logit model like ours, though, the effect of *CCFP* already varies over the *pre* and *post* time periods even without the DID interaction variable. We kept *CCFP*PostTreatment* in our models, though, because it improves their ability to fit the data. The marginal effects we report below incorporate the effects of both *CCFP* and *CCFP*PostTreatment*.

In our second set of regressions, we added a fixed effect for resident group along with three covariates—sex, age, and years of education—that are well accepted by researchers as generally associated with migration (Greenwood 2016; White and Johnson 2016).

$$\text{Prob}(Y_{it}) = \Phi(\beta_0 + \beta_1 \text{CCFP}_i + \beta_2 \text{PostTreatment}_i + \beta_3 \text{CCFP}_i * \text{PostTreatment}_i + \beta_4 \text{female}_i + \beta_5 \text{educ}_i + \beta_6 \text{age}_{it} + \beta_7 \text{age}_{it}^2 + i. \text{residentgroup}_i + \varepsilon_{it}),$$

(2)

where $Y_{it} = 1$ if individual i was a migrant in year t ; t represents either 2001 or 2006; and Φ is the logit function.

Our age variable is not the static age of individuals captured in the 2014 survey, but was expanded to reflect the actual age of each individual in each of the 15 years. Recognizing that the influence of age on migration decisions may not be linear, we also added age^2 to the regressions. Finally, the resident group fixed effects are a recognition that these tight-knit social networks of households and their precise geographic location likely have an unobserved influence on families' migration decisions.

For our third and final set of regressions, we turned our attention to the end results of those migration decisions and examined whether *CCFP* participation is associated with the three 2014 household outcomes: total income, income diversification, and assets. We ran OLS regressions for the two continuous variables (total income and the income diversity index) on a *CCFP* dummy variable, age of the household head, and family size (the sum of individuals of all ages both at home and migrating away from home in the survey year). Additionally, we controlled for resident groups and used robust standard errors.

$$Y_i = \beta_0 + \beta_1 \text{CCFP}_i + \beta_2 \text{AgeHouseholdHead}_i + \beta_3 \text{FamilySize}_i + i. \text{residentgroup} + \varepsilon_{it} \quad (3)$$

For the count variable *Asset Total* (range is from 7 to 38), we used a Poisson model, choosing it over a negative binomial model because the latter did not produce an alpha factor significantly different from zero, suggesting a Poisson approach is appropriate. Covariates are the same as those in the OLS regressions of equation #3.

Endogeneity tests

In order to obtain unbiased estimators, we must rule out endogeneity possibly created by households self-selecting into the program. Many other researchers who have published previous studies on the impacts of CCFP have discounted the likelihood of self-selection by accepting the program's merely quasi-voluntary nature (Xu et al. 2004; Yao et al. 2010; Li et al. 2011; Démurger and Wan 2012; Liang et al. 2012; Kelly and Huo 2013). That is, while participation is voluntary in principle, in reality the areas to be converted to forest under CCFP have been targeted by local governments according to the specific biophysical conditions (for instance, slope and contiguity with other forested lands to be put in the program), and participation is considered strongly encouraged if not outright mandatory for those selected by local planners. Early research confirmed households' general lack of autonomy, with only 15% of CCFP participants and 28% of non-participants declaring they had any autonomy in participation (Xu et al. 2004). Participants also generally felt they had little or no say about which plots to retire.

To establish that participating households are similar to non-participants, we took two extra steps, starting with running t-tests of sample means (Table 1). The few differences that exist between the two groups are largely expected. The difference in household elevation was highly significant, as the program explicitly targets sloping croplands for conversion. Gross income in 2014 from forest products was also significantly higher for CCFP participating households. Distances to a paved road and to the county capital were weakly significant. Age of all individuals was also weakly significant, although notably neither the age of the household head nor the age of the working-age subsample significantly differed between the two groups. Importantly, average family size is the same across the two groups, suggesting that any differences in migration are not due to CCFP households having more or fewer members to send away.

Second, we sought to establish a critical identifying condition for a DID model: that treatment and non-treatment households were on identical paths with regards to migration before the program effect kicked in. To create a baseline period, we lumped 2002 and 2003 together with years 2000 and 2001 because CCFP implementation, begun in 2002 in the study area, took a year to extend across the province and take full effect. Parallel trends between individuals in treatment and non-treatment households in the four years from 2000–2003 would suggest that any divergence in migration in the post-treatment period would more likely be the result of CCFP and provide evidence that program participation was exogenously determined. We ran a simple OLS regression twice, once for individuals in participating households and a second time for those in non-participating households:

$$Y_{it} = \beta_0 + \beta_1 \text{Year}_t + \varepsilon_{it}, \quad (4)$$

where $Y_{it} = 1$ if individual i was a migrant in year t , and t ranges from 2000 to 2014.

We then ran a second OLS regression to calculate the difference between the two lines for the years from 2000–2003:

$$Y_{it} = \beta_0 + \beta_1 \text{Year}_t + \beta_2 \text{Year}_t * \text{CCFP}_i + \varepsilon_{it}, \quad (5)$$

where $Y_{it} = 1$ if individual i was a migrant in year t , and t ranges from 2000 to 2003.

Results of these robustness checks are presented in Fig. 1 and Appendix Table 5. Figure 1 graphs the coefficients from both versions of equation #4, providing visual evidence that before and during program implementation, the trend lines for CCFP and non-CCFP households track each other closely, then diverge after 2004, frequently at increasing rates. Appendix Table 5 quantifies the differences from equation #5. The coefficients on the year variables are either weakly (2001) or highly (2002 and 2003) significant, suggesting that compared to 2000, overall migration rates were on the rise. The coefficients on all four interaction variables, however, are not significant, indicating that independent of broader trends towards more migration, the probability of individuals migrating from CCFP households prior to 2004 was indistinguishable from the probability for individuals in non-CCFP households.

Findings from both the t-tests and the regressions are encouraging and satisfy a key identifying criterion of a DID analysis: that the CCFP participants are, in fact, similar to non-participants and that the two groups had been on similar paths with respect to migration. Like previous authors, but supported by our more rigorous analysis, we conclude it is likely that CCFP participation is not endogenous and that our findings do not suffer from selection bias.

Results

Regressions on migration behavior

Results of our logit, DID regressions from equations #1 and #2 are presented in Table 2. All four specifications use 2001 as the pre-treatment period and 2006 as post-treatment, and test whether being enrolled in CCFP exerts an influence over an individual's likelihood of being a migrant (that is, living away from home for at least six continuous months in a calendar year). Specifications #1 and #3 include family members of all ages, while #2 and #4 are restricted to individuals 16–50 whom our analysis suggested were most likely to be influenced to possibly migrate. Though the interaction terms in Table 2 are not significant, we cannot rely solely on that evidence (unlike in a linear OLS model) to determine the effects of CCFP participation. For that, we examine the *average marginal effect* of CCFP (which, in our logit regressions, incorporates the effects of both the *CCFP* and *CCFP*Treatment* variables) and find it to be positive and significant in Regressions #1, #3, and #4, providing evidence that members of participating families migrate at higher rates than non-participants. In the full specification for individuals 16 to 50, the average marginal effect is 0.0371 ($p=0.044$). That is, on average, CCFP participants' likelihood of migrating increased 3.71 percentage points more than non-participants. At the average predicted probability of 0.1317, that equates to a 28.17% increase.

While 2006 was a reasonable starting point as a DID post-treatment period, we were interested in whether our results were robust to using other years as post-treatment, and how households adjust their migration strategies over time. To test these questions, we replicated regression #2 (full set of covariates, restricted to working-age individuals) ten times, varying the post-treatment year to all the other years from 2004 to 2014. Partial results are presented in Table 3. For simplicity, we limit our reporting to only the coefficients on *CCFP* and *CCFP*Post-Treatment* (columns 2 and 3), along with the average marginal effects (column 4). In addition to the initial findings using 2006 as the post-treatment period, results also show that differences in changes in migration rates were highly significant ($p=0.005$) when 2011 was used as post-treatment; significant when 2007 was used; and weakly significant using 2004, 2005, and 2010. These quantitative results are also consistent with a rough visual examination of Fig 1. The lines are close together in the period from 2000 to 2003, start to diverge in the middle of the decade, then partially converge in 2008 and 2009, after which they split apart at an even greater rate before tightening up somewhat in the final years.

Regressions on income, diversification, and asset outcomes

Having established that CCFP did have a positive effect in several years on the amount of household labor dedicated to migration, we examine the question of whether program participation is associated with other household-level end results: household income (logged value), income diversification, and assets. Positive associations would potentially provide evidence that families are ultimately realizing some benefit from either the program subsidies or from the decisions (including increased migration) influenced by the program. Table 4 presents results for all three versions of equation #3, including the average marginal effects of variables in the Poisson regression on asset levels. They show (1) a weakly significant ($p=0.059$), positive association between CCFP participation and income diversification; (2) no significant association between CCFP and annual income; and (3) a weakly significant ($p=0.070$), positive association with asset levels.

Discussion

The objective of this paper is to determine if households participating in CCFP make significantly different migration-related decisions compared to non-participating households and whether a household's CCFP status and migration behavior affect outcomes like annual income, income diversification, and assets. The significant, positive association we found between CCFP and migration rates is an indication that participating households are reallocating freed-up labor from farming to migration. Such a reallocation of labor suggests that participants are, in fact, using migration to diversify their income streams and make sustainable changes to their livelihood strategies that would eventually help them overcome withdrawal of CCFP subsidies without converting their forests back to crops. We caution that because the data come from a single Chinese province from 2000–2014, care should be taken before generalizing our conclusions to different locations and times. Previous analyses of other case studies have demonstrated the difficulty of interpreting programs and their effects from their form alone and highlight the importance of specific context in determining how interventions function (Agrawal 2014).

One of the distinguishing features of our dataset is the information capturing individuals' migration activity over 15 years, including a pre-treatment period from which we were able to establish baseline behavior and confirm that CCFP and non-CCFP households started on statistically the same path. Our analysis of individual-level data provides encouraging results suggesting that participating families responded to the program by turning to migration as a means to reallocate freed-up labor at a greater rate than non-CCFP families. The increase in migration though was not constant over time. The marginal results in the first couple years post-implementation suggest that many households perhaps needed some time to plan and implement a decision as substantive as the migration of a family member.

Alternatively, results could suggest that migration was delayed as some families took the household labor freed up by cropland reductions in the initial years to perform labor-intensive planting and replanting before migrating (Zhang et al. 2017). Thus, not until 2006 and 2007 do we see increases in migration rates among CCFP families that are significantly greater than increases among non-CCFP families. For instance, comparing 2001 and 2006, individuals aged 16–50 in participating households increased their migration by 3.7 percentage points more than those in non-participating households (results were robust to other specifications in Table 2); the magnitude of the difference remained the same using 2007 as the post-treatment time period. Given an average predicted probability of being a migrant in 2007 of 0.1394, a 3.7 percentage point average marginal effect means that individuals in CCFP households increased their migration rates 26% more than individuals in non-CCFP households.

In 2008 and 2009, the differences in migration between treatment and non-treatment households decreased, becoming statistically insignificant. Most plausibly, this 2008–2009 shift in behavior could reflect diminished economic opportunities throughout China triggered by the global recession, because in 2010 and 2011, CCFP and non-CCFP families diverge again in their migration decisions. Migration rates among working age individuals in participating households exceeded that of non-CCFP households by 5.9 percentage points in 2011 ($p=0.003$). This provides further encouraging evidence to policy makers in China that families who faced the loss of agricultural production did, in fact, turn to migration more frequently than those not enrolled in the program. A more comprehensive question may ask how all the other income sources (businesses, off-farm wages, and animal and forest products) adjusted over the years in response to the loss of some croplands, in recognition that not all families may be able or willing to allow a member to migrate. We were not able to ask that question since our historical data (2000–2014) were restricted to migration activity. But perhaps other CCFP families did fill the agricultural loss by turning more to other income sources. All are worthy subjects for future analysis.

The extensive information from 2014 in our dataset did allow us to examine static income diversification after CCFP households had ten years to adjust to the loss of some croplands. Our results, while not highly significant, are at least encouraging and corroborate the migration findings above: CCFP families showed greater diversification among income sources (suggesting enhanced risk management) than did non-participating families ($p=0.059$). This evidence, albeit weakly significant, linking positive changes in income diversification with CCFP is a welcome sign for policy makers attempting to create a

sustainable program that incentivizes families to maintain their forests over the long term. However, given data restrictions, it remains inconclusive whether CCFP households changed their diversification strategies in response to the program or whether there are other unobserved reasons or predispositions explaining these positive income strategies. Determining this would be a productive topic for future research.

Finally, we looked at 2014 income and asset levels to examine whether one group of households was better off than the other. The difference separating the annual income of participants from non-participants was not significant, but CCFP families did score higher ($p=0.070$) on our aggregate asset index. The marginal effect of the program though was arguably not substantial, only about 1 point in value (sample values ranged from 7 to 38), implying that CCFP families on average responded only one level higher on only one of the eight asset variables. To illustrate, a 1-point difference could be reached if households had one more piece of electronic equipment, such as a radio or TV, but scored the same on all other assets, including home, fuel sources, water/sanitation facilities, electrical appliances, farming equipment, livestock, and vehicles. Similar to our analysis above regarding income diversification results, we cannot conclusively say that the greater asset accumulation is an effect of the program, merely that the two are associated.

Conclusion

This paper contributes to the existing literature on payment for ecological services schemes in general, and the Conversion of Cropland to Forest Program in particular, by demonstrating that participating households in Anhui Province responded to the government incentives by increasing the migration rates of their household members from 2000–2014. Our analysis advances the research on CCFP outcomes in two new and significant ways. First, our conclusions regarding program effects on increased migration are based on 15 years of information. Second, we corroborated other authors' prevailing assumption of exogeneity with respect to selection bias into CCFP by performing t-tests and, more importantly, by demonstrating that individuals in treatment and non-treatment households were on the same path with respect to migration before the full program effects kicked in. Results of our logit difference-in-difference regressions suggest that CCFP was associated with higher rates of migration, but the effects were not uniform across all years, disappearing during the Great Recession then rebounding and reaching their peak in 2011, eight to nine years after implementation. Additionally, CCFP was weakly, positively associated with income diversification and household assets during the survey year 2014, though there was no significant difference between annual income of participants and non-participants. These are promising results for policy makers who administer CCFP and other payment for ecological services schemes across the world because they suggest that households are not relying solely on government payments to fill any income gap left by reductions in agricultural production.

Along with the encouraging results, however, policy makers should also note that our analysis examined only one of 25 provinces in which CCFP has been implemented, and that our asset, income, and diversification variables represented only the survey year. As this and other studies have noted that results of PES schemes are dependent on cultural, political, and

biophysical contexts, subsequent research would better advance CCFP analysis by examining data from different time periods and a variety of geographic regions. Finally, our conclusions would also be valuable to examine in context of other income sources. That is, policy makers would be best served knowing whether and to what extent CCFP households turned to income diversification strategies beyond migration, such as business income, local employment, forest products, and animal products.

Appendix

Table 5

Regression results for robustness check, 2000–2003, individuals aged 16 to 50

Variable	Coefficient (std. error)
<i>Year2001</i>	0.0275 [*] (0.0161)
<i>Year2002</i>	0.0651 ^{***} (0.0162)
<i>Year2003</i>	0.0957 ^{***} (0.0162)
<i>Year2000</i> *CCFP	0.0188 (0.0152)
<i>Year2001</i> *CCFP	0.0068 (0.0152)
<i>Year2002</i> *CCFP	−0.0032 (0.0152)
<i>Year2003</i> *CCFP	0.0024 (0.0114)
<i>Constant</i>	0.0113 (0.0114)
N	4,027
R ²	0.0189
F	11.08

*
p<0.10,
**
p<0.05,

p<0.01

References

- Agrawal A, Wollenberg E, Persha L (2010) Governing agriculture-forest landscapes to achieve climate change mitigation. *Global Environmental Change* 28: 270–280
- Alix-Garcia J, Wolff H (2014) Payment for Ecosystem Services from Forests. *Annual Review of Resource Economics* 6: 361–380
- Bennett MT (2008) China's sloping land conversion program: Institutional innovation or business as usual? *Ecological Economics* 65(4): 699–711

- Carr D (2009) Population and deforestation: Why rural migration matters. *Progress in Human Geography* 33(3): 355–378 [PubMed: 20485541]
- Chen X, Frank KA, Dietz T, Liu J (2012) Weak Ties, Labor Migration, and Environmental Impacts: Toward a Sociology of Sustainability. *Organization and Environment* 25(1): 3–24
- China State Forestry Administration (2014) National Report of the Ecological Monitoring of the Conversion of Cropland to Forest Program. China Forestry Press
- Daniels AE, Bagstad K, Esposito V, Moulaert A, & Rodriguez CM (2010) Understanding the impacts of Costa Rica's PES: Are we asking the right questions? *Ecological Economics* 69(11): 2116–2126
- Delang CO, Yuan Z (2015) China's Grain for Green Program: A Review of the Largest Ecological Restoration and Rural Development Program in the World. Springer International Publishing, Cham
- Démurger S, Wan H (2012) Payments for ecological restoration and internal migration in China: the sloping land conversion program in Ningxia. *IZA Journal of Migration* 1(10): 1–22
- Greenwood MJ (2016) Perspectives on Migration Theory—Economics In: White MJ(ed) *International Handbook of Migration and Population Distribution*, Springer, New York, pp 31–40
- Groom B, Grosjean P, Kontoleon A, Swanson T, Zhang S (2010) Relaxing rural constraints: a 'win-win' policy for poverty and environment in China? *Oxford Economic Papers* 62(1): 132–156
- Grosjean P, Kontoleon A (2009) How sustainable are sustainable development programs? The case of the Sloping Land Conversion Program in China. *World Development* 37(1): 268–285
- Hecht S (2010) The new rurality: Globalization, peasants and the paradoxes of landscapes. *Land Use Policy* 27: 161–169
- Kelly P, Huo X (2013) Land Retirement and Nonfarm Labor Market Participation: An Analysis of China's Sloping Land Conversion Program. *World Development* 48: 156–169
- Li J, Feldman MW, Li S, Daily GC (2011) Rural household income and inequality under the Sloping Land Conversion Program in western China. *Proceedings of the National Academy of Sciences* 108(19): 7721–7726
- Liang Y, Li S, Feldman MW, Daily GC (2012) Does household composition matter? The impact of the Grain for Green Program on rural livelihoods in China. *Ecological Economics* 75: 152–160
- Liang Z, Li Z, Ma Z (2014) Changing patterns of the floating population in China, 2000–2010. *Population and Development Review* 40(4): 695–716 [PubMed: 26213427]
- Liu Z, Lan J (2015) The Sloping Land Conversion Program in China: Effect on the Livelihood Diversification of Rural Households. *World Development* 70: 147–161
- Nielsen ØJ, Rayamajhi S, Uberhuaga P, Meilby H, Smith-Hall C (2013) Quantifying rural livelihood strategies in developing countries using an activity choice approach. *Agricultural Economics* 44(1): 57–71
- Pattanayak SK, Wunder S, Ferraro P (2010) Show Me the Money: Do Payments Supply Environmental Services in Developing Countries? *Review of Environmental Economics and Policy* 4(2): 254–274
- Pfaff A, Amacher GS, Sills EO (2013) Realistic REDD: Improving the forest impacts of domestic policies in different settings. *Review of Environmental Economics and Policy* 7(1): 114–135
- Qin H (2010) Rural-to-Urban Labor Migration, Household Livelihoods, and the Rural Environment in Chongqing Municipality, Southwest China. *Human Ecology* 38(5): 675–690
- Qin H, Liao T (2016) Labor out-migration and agricultural change in rural China: A systematic review and meta-analysis. *Journal of Rural Studies* 47: 533–541
- Reardon T, Berdegue J, Barrett CB, Stamoulis K (2007) Household income diversification into rural non-farm activities In: Haggblade S, Hazell P, Reardon T (eds) *Transforming the Rural Nonfarm Economy*, Johns Hopkins University Press, Baltimore, pp 115–140
- Song C, Zhang Y, Mei Y, Liu H, Zhang Z, Zhang Q, Zha T, Zhang K, Huang C, Xu X, Jagger P (2014) Sustainability of forests created by China's Sloping Land Conversion Program: A comparison among three sites in Anhui, Hubei and Shanxi. *Forest Policy and Economics* 38: 161–167
- Song C, Zhang Y (2009) Forest cover in China from 1949 to 2006. In: Nagenda H, Southworth J (eds) *Reforestation Landscapes*, Springer, Netherlands, pp 341–356
- Sun J, Zhao C, Wang L (2002) The long march of green: the chronicle of returning agricultural land to forests in China. China Modern Economics Press, Beijing

- Uchida E, Xu J, Rozelle S (2005) Grain for Green: Cost-Effectiveness and Sustainability of China's Conservation Set-Aside Program. *Land Economics* 81(2): 247–264
- Uchida E, Xu J, Xu Z, Rozelle S (2007) Are the poor benefiting from China's land conservation program? *Environment and Development Economics* 12(4): 593–620
- Uchida E, Rozelle S, Xu J (2009) Conservation payments, liquidity constraints and off-farm labor: impact of the Grain-for-Green program on rural households in China. *American Journal of Agricultural Economics* 91(1), 70–86
- Xu Z, Bennett MT, Tao R, Xu J (2004) China's Sloping Land Conversion Programme four years on: current situation and pending issues. *International Forestry Review* 6(3–4): 317–326
- Xu J, Yin R, Li Z, Liu C (2006) China's ecological rehabilitation: Unprecedented efforts, dramatic impacts, and requisite policies. *Ecological Economics* 57(4): 595–607
- Wang F, Li R, Wen Z, Zhou L (2003) Problems and recommendations for the conversion of cropland to forest (grassland) program: survey and analysis of test sites for conversion of cropland to forest (grassland) program in Ansai County, Shaanxi Province. *Journal of Northwest Sci-Tech University of Agriculture and Forestry* 3(1): 60–65
- White MJ, Johnson C (2016) Perspectives on Migration Theory—Sociology In: White MJ (ed) *International Handbook of Migration and Population Distribution*, Springer, New York, pp 69–90
- Yang X, Xu J (2014) Program sustainability and the determinants of farmers' self-predicted post-program land use decisions: evidence from the Sloping Land Conversion Program (CCFP) in China. *Environment and Development Economics* 19(1): 30–47
- Yin R, Yin G (2009) China's ecological restoration programs: Initiation, implementation, and challenges In: Yin R (ed) *An Integrated Assessment of China's Ecological Restoration Programs*, Springer, New York, pp 1–19
- Yin R, Yin G (2010) China's primary programs of terrestrial ecosystem restoration: initiation, implementation, and challenges. *Environmental Management* 45(3): 429–441 [PubMed: 19771465]
- Yao S, Guo Y, Huo X (2010) An empirical analysis of the effects of China's land conversion program on farmers' income growth and labor transfer. *Environmental Management* 45(3): 502–512 [PubMed: 19777292]
- Zhang A, Zinda JA, Li W (2017) Forest transitions in Chinese villages: Explaining community-level variation under the returning forest to farmland program. *Land Use Policy* 64: 245–257
- Zhao J, Barry PJ (2014) Income diversification of rural households in China. *Canadian Journal of Agricultural Economics* 62: 307–324

Fig 1.
Predicted likelihood of being a migrant, individuals aged 16 to 50, by GfG participation status

Table 1

Mean, standard deviation, and t-test results for CCFP participating and non-participating individuals and households

Variables	Participating households	Non-participating households	Difference in means	N
Ever migrated, proportion	0.4138 (0.0152)	0.3682 (0.0167)	0.0456 ^{**}	1,887
Household size	4.08 (0.09)	4.03 (0.10)	0.05	465
Age of household head	52.67 (0.68)	52.34 (0.76)	0.33	465
Age, overall	39.66 (0.62)	37.81 (0.71)	1.85 [*]	1,887
Age (excl. children & elderly)	40.53 (0.49)	40.82 (0.57)	0.29	1,391
Percent female	46.78	48.86	2.08	1,887
Percent currently married ^a	71.46	70.93	0.53	1,540
Education (years), household head	6.10 (0.18)	5.75 (0.23)	0.36	465
Distance in minutes to:				
paved road	13.37 (0.98)	10.68 (1.07)	2.69 [*]	465
middle school	41.45 (2.63)	39.15 (2.55)	2.30	455 ^d
county capital	213 (4.59)	200 (5.34)	13 [*]	440 ^e
Elevation (m.a.s.l.)	696 (6.60)	647 (6.21)	49 ^{***}	465
2014 total gross income ^b	34,337 (2460)	29,406 (2085)	4,930	465
2014 total gross income/capita (yuan)	8,656 (668)	7,529 (551)	1,127	465
2014 forest product gross income (yuan)	4,426 (551)	2,784 (374)	1,643 ^{***}	465
2014 crop income (yuan)	1,328 (99)	1,179 (119)	149	465
Paddy + dry land (mu)	5.70 (0.19)	5.45 (0.18)	0.25	465
Household assets ^c	23.44 (0.35)	22.91 (0.38)	0.54	465

Variables	Participating households	Non-participating households	Difference in means	N
Percent built new house since 2000	54.83	58.74	3.91	465

*
p<0.10,

**
p<0.05,

p<0.01

^a Marriage captured for individuals aged 18 and older.

^b Includes income from crops, livestock, forest products, business, off-farm earnings, remittances, and other (a subtotal of social gifts, rental income, and government subsidies).

^c Sum of eight ordinal variables with values from 0 (low) to 5 reflecting the level/quality of a family's home, type of fuel use, water/sanitation facilities, electrical appliances, electronic equipment, farming equipment, means of transportation, and animal holdings.

^d Does not include 10 households with missing values.

^e Does not include 25 households with missing values.

Logit coefficient estimates, standard errors, and average marginal effects comparing 2001 (pre) to 2006 (post) (resident group fixed effects in Regressions #3 and #4 not reported)

Table 2

Variable	Regression 1: all ages		Regression 2: ages 16–50		Regression 3: all ages		Regression 4: ages 16–50	
	Coefficient/ (std error)	Avg Marginal Effect/(std error)	Coefficient/ (std error)	Avg Marginal Effect/(std error)	Coefficient/ (std error)	Avg Marginal Effect/(std error)	Coefficient/ (std error)	Avg Marginal Effect/(std error)
CCFP	0.302 (0.309)	0.0188** (0.0084)	0.169 (0.319)	0.019 (0.014)	0.387 (0.352)	0.0265** (0.0118)	0.413 (0.359)	0.037** (0.018)
Post-Treatment	1.773*** (0.269)	0.1023*** (0.0084)	1.791*** (0.275)	0.170*** (0.014)	1.901*** (0.284)	0.1103*** (0.0089)	1.983*** (0.291)	0.170*** (0.014)
CCFP*Post	−0.020 (0.340)		0.021 (0.355)		0.079 (0.363)		0.015 (0.374)	
Female					−0.598*** (0.153)	−0.0358*** (0.0091)	−0.673*** (0.162)	−0.059*** (0.014)
Education					0.095*** (0.027)	0.0057*** (0.0016)	0.085*** (0.030)	0.0075*** (0.0026)
Age					0.414*** (0.041)	−0.00042* (0.00025)	0.180** (0.071)	−0.00639*** (0.00090)
Age-squared					−0.00774*** (0.00074)		−0.0046*** (0.0012)	
Constant	−3.869*** (0.245)		−3.209*** (0.247)		−8.272*** (0.806)		−3.948*** (1.220)	
Number of obs	3,774		2,036		3,174		1,936	
Pseudo-R ²	0.0786		0.0925		0.2904		0.2591	

* p<0.10,
 ** p<0.05,
 *** p<0.01

Table 3

Select difference-in-difference logit regression results on probability of being a migrant (full specification, working age individuals, pre-treatment year 2001)

Post-Treatment Year	CCFP logit coeff (std error)	CCFP*Post logit coeff (std error)	Average Marginal Effect of CCFP
2004	0.466 (0.364)	-0.121 (0.387)	0.027 *
2005	0.409 (0.363)	-0.069 (0.380)	0.028 (0.018)
2006	0.413 (0.359)	0.015 (0.373)	0.037 ** (0.018)
2007	0.382 (0.354)	0.037 (0.370)	0.037 ** (0.018)
2008	0.373 (0.354)	-0.082 (0.368)	0.029 (0.019)
2009	0.299 (0.353)	-0.146 (0.365)	0.018 (0.019)
2010	0.232 (0.353)	0.112 (0.366)	0.033 * (0.019)
2011	0.259 (0.349)	0.349 (0.361)	0.059 *** (0.020)
2012	0.145 (0.348)	0.193 (0.360)	0.034 * (0.020)
2013	0.180 (0.354)	0.238 (0.366)	0.041 ** (0.020)
2014	0.115 (0.357)	0.241 (0.368)	0.033 * (0.020)

*
p<0.10,

**
p<0.05,

p<0.01

Table 4

Regression results on 2014 household-level outcomes (resident group fixed effects not reported)

	Income diversification	Household income (log)	Household asset index	
	coef/(se) (OLS)	coef/(se) (OLS)	coef/(se) (Poisson)	AME ^a /(se) (Poisson)
CCFP	0.164 [*] (0.087)	0.168 (0.135)	0.049 [*] (0.027)	1.14 [*] (0.63)
Age of household head	0.0141 ^{***} (0.0034)	-0.0098 ^{**} (0.0049)	-0.0053 ^{***} (0.0010)	-0.124 ^{***} (0.023)
Household size	0.041 (0.024)	0.198 ^{***} (0.037)	0.0435 ^{***} (0.0071)	1.01 ^{***} (0.16)
Constant	1.394 ^{***} (0.390)	9.729 ^{***} (0.441)	3.282 ^{***} (0.077)	
Number of observations	465	464	465	
R ² , Pseudo R ²	0.2156	0.1839	0.0535	

*
p<0.10,**
p<0.05,***
p<0.01^a Average marginal effects