Published in final edited form as:

Popul Environ. 2018 December ; 40(2): 182–203. doi:10.1007/s11111-018-0307-5.

Determinants of Out-migration in rural China: effects of payments for Ecosystem Services

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Abstract

Rural out-migration has been a hallmark of socioeconomic development in China, but rapid economic development including deforestation also resulted in environmental degradation, leading to disastrous floods and droughts. In response, the Chinese government implemented Payments for Ecosystem Services (PES) programs for both environmental conservation and poverty alleviation, notably the Conversion of Cropland to Forest Program (CCFP) and the Ecological Welfare Forest Program (EWFP). In the context of a full model of the determinants of migration incorporating individual, household and community factors, we investigate the manner in which these programs influenced rural out-migration in a mountainous township in Anhui, China. Results show that the CCFP compensation for switching cropland to trees releases farm labor, leading to out-migration. Meanwhile, the EWFP compensation provides poor rural farmers with large areas of forest with sizable cash subsidies that reduces their motivation to migrate. Out-migration was also found to be affected by a number of individual, household and community characteristics.

Keywords

Rural out-migration; Payments for Ecosystem Services; forest policy; China; household survey; multilevel analysis

1. Introduction

1.1 Rural-Urban Migration

Rural out-migration is a major aspect of socioeconomic development throughout the developing world (e.g., Bilsborrow et al., 1987), including in China, the most populous developing country (Qin and Liao, 2016). Since the adoption of the Reform and Opening-up Policy in 1978, China's economy has witnessed double digit annual growth for three decades, which has led to unprecedented opportunities for residents in the countryside to move to the burgeoning cities. Recent reports reveal that China's migrant population has surpassed 200 million, the vast majority rural-to-urban migrants (NBS, 2012; Liang, 2016), which has substantially altered the demographic and economic landscape (Cai and Wang, 2003; Fan, 2005). Such mobility also has profound impacts on Chinese society. As a result, the study of rural out-migration in China is of considerable interest to both migration scholars and policy-makers.

Migration refers to the movement of people to change their residence from places of origin to places of destination which involves moving across a recognized political border (United Nations, 1998; Swanson and Siegel, 2004; Bilsborrow, 2016). Migration from rural to urban areas has been a key transformative process of population distribution in China.

Understanding rural out-migration in China should not be based on extrapolations from studies in other countries because of the unique Chinese household registration institution, the *hukou* system (Liu, 2005). The *hukou* system specifies an individual's residence type (agricultural or urban) and location of "permanent" residence. The *hukou* institution was imposed by the central government in the 1950s as a mechanism to monitor the location of the population, to keep rural residents from seeking employments in cities, reducing pressures on the government, to provide infrastructure and welfare for urban residents (Chan and Zhang, 1999). For example, a farmer born in the countryside with an agricultural *hukou* registration was not allowed to reside or work in a city. However, the Reform and Opening-up Policy adopted by the Chinese government led to high economic growth, creating a huge need for labor in cities. Therefore the Chinese government relaxed controls over population mobility from rural areas, allowing rural migrants to seek "temporary" employment in urban areas (Cai and Wang, 2003). Thus, a large number of rural persons, typically with low education, migrated to fill labor needs in the cities (Sun and Fan, 2011). Often referred to as the "floating population", they change jobs frequently, moving from city to city from year to year, although some eventually return to the original location where their *hukou* is located (Liang and Ma, 2004). Given this complex behavior of out-migration in rural China, empirical studies on the determinants of migration are needed to better understand the factors affecting this massive population redistribution as well as its implications for development.

Rural out-migration depends partly on the natural environment, referred to as the migration-environment nexus (Carr, 2005; Laczko et al., 2009; Bilsborrow and Henry, 2012). Land use and land management is a key link between the migration decision-making of rural populations and environmental change (Braimoh, 2004; Chen et al., 2014). For example, early rural residents who migrated out in response to degraded land subsequently degrade

the land elsewhere in areas of destination, causing further out-migration in a chain process (Charnley, 1997). Out-migration has also been viewed as an adaptation strategy by rural farmers to cope with high risks of crop failure under adverse and unpredictable environmental conditions (Ellis, 2003; Konseiga, 2007). The migration-environment relationship is thus of crucial importance for regional planning regarding both the environment and human society.

1.2 New Forest Policies Based on Payments for Ecosystem Services in China

Payment for Ecosystem Services (PES) has recently emerged as an innovative approach in environmental policies aiming to conserve ecosystem services, particularly for dealing with land use change (Engel et al., 2008; Pattanayak et al., 2010). The PES approach has been widely adopted in the form of cash incentives in Reducing Emissions from Deforestation and Degradation plus, namely REDD+ (Groom and Palmer, 2012). In REDD+ stakeholders, such as governments or Non-Governmental Organizations, pay landholders who provide ecosystem services to preserve or restore forests (Wunder, 2005; Engel et al., 2008; Mahanty et al., 2013). These programs also have an additional goal to create social “co-benefits” (e.g., poverty *stabilization* or *reduction*), complementing other development policies (Brown et al., 2008).

In the late 1990s, China implemented a series of new forest policies based on the PES principles in the aftermath of severe natural disasters (mostly floods) caused primarily by deforestation and land degradation (Liu et al., 2008). The largest PES program is the Conversion of Cropland to Forest Program (CCFP), which has been implemented in 25 of the 31 provinces of China starting around 2000. It has involved 32 million rural households and cost 430 billion yuan by 2013 (Bennett et al., 2014; Yin et al., 2014). Under the CCFP, participating farmers reforest cropland on moderately steep slopes (thus the program is also known as the Sloping Land Conversion Program) or otherwise ecologically-sensitive areas in return for grain (making the program also known as Grain for Green Program) or cash compensation from the central government based on the area reforested. A second PES program, the Ecological Welfare Forest Program (EWFP), aims to preserve existing natural forests by prohibiting commercial logging (State Forestry Administration, 1995; Dai et al., 2009). The government provides cash compensation to farmers to give up timber harvesting privileges based on the area of natural forests that a rural household owns. At the same time, the central government abolished all land taxes on these forests.

A major challenge that the Chinese policy-makers face is the sustainability of the PES programs. Along with water and soil conservation, the central government expected these programs to provide poverty alleviation since the affected croplands generally belong to poor households (Song et al., 2014). Policy-makers hope that the PES programs will stimulate rural households to reallocate labor to non-farm activities, diversifying their livelihoods. This could also reduce the risk that participating households would reconvert the reforested cropland back to cultivation after government compensation ends. As one of the major common livelihood strategies of rural households all over the world (Ellis, 2000), remittances from former household members who migrated to cities could also serve as a major part of household income for poor rural households (Du et al., 2005). Despite a

number of evaluations of the impacts of PES programs on rural livelihoods, there has been virtually no research on the impacts on out-migration. This is due to the lack of adequate quantitative data sets and complicated by possible time-lags in the effects of programs on household livelihood strategies. As the PES programs have existed since 2000, it seems time to investigate their medium-term impacts on rural out-migration, ultimately to better understand their socioeconomic consequences and improve policy.

The present research thus aims to understand the roles played by the Chinese PES programs (CCFP and EWFP) on rural out-migration, drawing on a case study of Tiantangzhai Township in Anhui Province. Since migration decisions of rural farmers are also influenced by a host of personal and household characteristics and contextual factors, these drivers must also be taken into account. The specific objectives of this study thus include: 1) tracking temporal trends of out-migration in the study area during the implementation of the PES programs by comparing households with and without out-migrants, and 2) developing a statistical model to explore how the PES programs and other factors influence rural out-migration. Since the PES approach has been adopted virtually nationwide as a major tool for environmental conservation and restoration, the methods of this study should be useful for analyzing the impacts of PES programs in other areas in China as well, and therefore provide useful inputs for policy-makers designing or modifying PES programs in the future.

2. Materials and Methods

2.1 Study area

The study area, Tiantangzhai Township, is located in a mountainous region in western Anhui Province (Fig. 1), covering 189 km² with elevations from 363 m to 1,729 m. Tiantangzhai has a mild climate (mean annual temperature of 16.4 °C and precipitation of 1350 mm), albeit with rough terrain, suitable for abundant forest cover. The township is remote from the county capital (*Jinzhai* County) and the provincial capital, Hefei. The county is recognized as a poor county by the Chinese government. This township forms part of the Tianma Nature Reserve in the eastern Dabieshan Mountains, protecting the last remaining primary forests in eastern China. Due to the rich natural resources (including waterfalls, stunning views, and mountain trails), part of the reserve has been developed into an important ecotourism area, providing local residents with business opportunities.

Tiantangzhai is home to 4,369 households, distributed in seven administrative villages with varying levels of economic status. The central village in the immediate vicinity of the Tiantangzhai tourism is better off than the other villages due to tourist income from hotels and restaurants. With its low population density, it has only one junior secondary (middle) school, so students have to go to the distant county capital for high school. Overall social-economic conditions in the township are poor, and local farmers survive primarily on subsistence farming (rice, corn, etc.) on their own small land parcels. Before the rural reform in the early 1980s, land parcels were collectively managed by so-called production teams (Li et al., 1998). But under the Household Responsibility System, all land parcels were divided among the households, and each household had complete freedom to decide what to farm as long as it fulfilled its quota (i.e., amount of grain to be sold to the government at a contracted price). The previous closely-knit households in the “production team” essentially became

independent farm members of a “resident group”, which usually consists of a cluster of 10 to 40 households. There are currently 165 resident groups in the township.

While the study area is relatively small, it is fairly typical and representative of the majority of rural areas in central and eastern China, characterized by rugged terrain and sloping land. Some croplands before 2002 were located on cleared slopes leading to soil erosion and low productivity. Thus the local Tiantangzhai government accepted to implement the Conversion of Cropland to Forest Program (CCFP), starting in 2002, enrolling 753 households. Under the CCFP, farmers can either create ecological forests with trees, such as sweetgum or maple, or economic forests with species such as walnut or pecan, which can produce an income after a few years. Farmers receive cash compensation from the central government based on the area of cropland reforested. The CCFP required that 80 percent of planted trees be ecological trees, mainly sweetgum (*Liquidambar styraciflua*) in the study area. For ecological forests, the payment was 230 Yuan/mu/year (1 mu = 1/15 ha) for the first 8-year contract (2000–2008), which was cut to half (125 Yuan/mu/year) for the second 8-year contract (Song et al., 2014).

The township is also part of an area of National Nature Reserve where a separate forest conservation policy was implemented, for natural forests within the nature reserve designated as ecological welfare forests (Zhang et al., 2016). The Ecological Welfare Forest Program (EWFP) was created by the Chinese government for natural forest conservation. Because of the high forest cover in the study area, virtually every household owns some natural forests, but the area varies widely. Farmers received 8.75 Yuan/mu/year (through the data collection, in 2014) as compensation for foregoing commercial logging privilege, though subsistence use of the forest resources for fuelwood, etc., is allowed. In addition, about half of the households in Tiantangzhai engaged in extracting a forest resource, *Gastrodia Elata*, which is a fungus used for Chinese medicine. Selling *Gastrodia Elata* to Chinese tourists thus generates significant income and is significant for the rural livelihoods of some local farmers.

Out-migration has had been an on-going process during and before the implementation of these forest policies in the study area. The economic compensation and the retirement of cropland may speed up or reduce the pace of out-migration. A previous pilot study found that rural households in the study area often relied more on remittances received from out-migrants and income from local off-farm work than agricultural income after ten years of CCFP (Song et al., 2014). The present research uses data from a considerably larger sample and a questionnaire that collected more detailed data on livelihoods, migration and the policies themselves, as well as for additional years (see below). Following the CCFP participation, people may have been even more motivated than before to move away from their origin farms to seek better economic opportunities elsewhere. Some household members move within the local area (county), where they are still able to provide farm labor for the origin household when needed, while others migrated out of the county, mostly to urban areas far from their origin households. Finally, there have been few in-migrants to the township, except for some return-migrants.

2.2 Data acquisition

The study draws on data collected primarily from a household survey conducted in Tiantangzhai Township in the summer of 2014. The study area is small, which more detailed household interviews. A comprehensive questionnaire was developed with 22 sections to obtain data on socioeconomic well-being, demographic characteristics, migration, land availability and agricultural activities, household living conditions, participation in PES programs, etc.

Since migration was a topic of major interest, we designed two sections to capture information relevant to it: a roster of household members and a section on out-migrants. Before the survey, definitions of key terms were clarified during interviewer training to ensure collection of consistent information across interviewers. An *out-migrant* was defined as a person who was a member of the household who had left at age 15–59 to live outside the county (*Jinzhai* County) for at least 6 consecutive months at some time since 2000 and who at the time of interview was still living outside the county. A *non-migrant* was defined as a person who never left the household to live away for more than 6 months since 2000 who was currently living in the household at the time of interview. The age range of 15–59 at the time of migration ensures the focus on those involved in the decision-making process (not dependent children or the elderly). To understand why some household members left while others did not, we obtained information on personal attributes, including age, gender, education, and marital status for both out-migrants and non-migrants. The questionnaire thus obtained retrospective data for not only the *out-migrant* at the time of out-migration (from some other household member remaining behind) but also a randomly-selected adult *non-migrant* in the migrant household referring to the time of migration of the household migrant. In households with no out-migrant over the period—around 24%—data were collected for a randomly selected non-migrant aged 15–59 pertaining to his/her situation five years prior to the survey, that is, near the midpoint of migration of the migrants observed. This will create a comparable population of non-migrants, and is an important contribution of the project methodology as it contrasts with the usual practice of collecting data for non-migrants only pertaining to the *time of the survey*¹.

In designing the sample, households with and without CCFP participation were both subjects of interest. Because the proportion of households in the CCFP in Tiantangzhai is fairly low (about 17 percent), it was desirable to first create strata based on the proportion of households in the resident group (RG) participating in CCFP, and then to use stratified disproportionate sampling to oversample RGs with higher proportions of households participating, and then in the sample RGs to also oversample households participating. These procedures generate a sample with roughly similar numbers of households with and without CCFP participation (see Bilborrow et al., 1984; and details in Song et al. (2018)). For the fieldwork, five interviewers were recruited from Anhui Agricultural University, trained for a week, and then tested in trial interviews in non-sampled households in the study area. The team, supervised by the first author, then visited the 482 occupied sample

¹See Bilborrow et al. (1984), Bilborrow (1997) and (Bilborrow, 2016). This continues to be an issue in the design of migration surveys and the analysis of determinants of migration based on the survey data.

households (only one refused) Thus, the household survey resulted in successfully collecting complete data for 481 households, 56 percent participating in the CCFP, yielding data for 1957 individuals in total.

In addition to the household survey, a survey was implemented at the RG or community level using a special structured questionnaire. We interviewed the resident group leader(s) of each resident group selected, to obtain data on resident group size (number of households), infrastructure, and geographic factors such as accessibility to the nearest hospital/clinic and primary school.

2.3 Analytical methods

The step was to examine the temporal trend of out-migration by calculating the proportion of migrants from the total source population within the age range (15–59) each year. We set the study period to 2000–2014 to capture migration just before as well as during the implementation of the CCFP. However, the survey was carried out in the summer of 2014 and hence could only track migration through the first half of 2014. Thus, out-migrants in 2014 were assumed to cover 50 percent of total expected out-migrants. The process covered a total of 1,236 individuals aged 15–59 during the study period, slightly over half of whom migrated out. We compared the temporal trends of out-migration of 1) households participating in the CCFP and those not, and 2) households receiving EWFP payments *above* the average and those below the average (470 yuan), since virtually all households in the sample received some EWFP compensation.

Before analyzing the determinants of migration, it is useful to compare individual characteristics (i.e., gender, age, education and marital status) of out-migrants and non-migrants. For marital status, individuals divorced or widowed (only 3.5 percent) were combined with those single since they are more like single persons than married ones in not being tied down by partners. Since the CCFP started in 2002 and the aim is to investigate its effects on migration, individuals aged 15–59 in any year in the time period 2003–2014 are included in the model in the year in which they have the age, creating a pool of persons “at risk of migration” each year. It seems reasonable to assume that there is a lag in migration decisions, that is, that the decision to migrate or not depends on circumstances in the previous year. Thus, migrants who left in 2002 are excluded as they would have been deciding based on information in 2001, which was prior to CCFP. This resulted in 1,137 individuals from 412 households selected for the descriptive comparison as well as the statistical modeling.

2.4 Statistical modeling

To model the determinants of out-migration, a multilevel model is used to identify individual, household and community effects as well as isolate the effects of PES programs from other factors. Multilevel models are used for analyzing hierarchically structured data, such as for modeling the determinants of individuals’ decisions within households nested in communities (Goldstein, 1994; Zhu, 1998; Raudenbush and Bryk, 2002). An individual’s decision about whether or not to migrate depends on not only his/her personal attributes but also household characteristics and contextual factors at the local or community level. Thus, a

multilevel model is appropriate for capturing the relationships of individual decisions made based on a hierarchy of individual, household, and community factors.

In this study, the dependent variable is dichotomous, i.e., whether an individual migrated out (=1) or not (=0) in a given year. Thus logistic regression was used for parameter estimation. We hypothesize the decision on whether or not to pursue opportunities through out-migration may be influenced by factors at multiple levels. At the individual level, these include gender, age, education and marital status. We also explore an interaction term of gender and marital status (*single female*) to capture possible effects beyond the direct effects of gender and marital status. Independent variables at the household level include the same four attributes of the household head, size of farm land under cultivation, house elevation, walking distance to nearest paved road, household size, an index of household wellness, and whether any other member of the household had migrated away previously (i.e., before the time of migration of the particular migrant). The model also includes variables reflecting household engagement in any of several main types of livelihood activities in the 12 months prior to the interview, including whether sold animals, engaged in local off-farm work, or extracted forest resources (mainly *Gastrodia Elata*). Finally, the model seeks to capture the effects of PES programs by including the *amounts of payments received* from the CCFP and the EWFP. Potentially relevant variables collected at the community level include community size and accessibility to facilities such as hospitals and primary schools.

The form of the model used is expressed in Eq. (1):

$$\log\left(\frac{\Pr(M_{ijk} = 1)}{\Pr(M_{ijk} = 0)}\right) = \alpha + \sum_{p=1}^P \beta_p X_{ijkp} + \sum_{q=1}^Q \gamma_q Z_{jkq} + \sum_{r=1}^R \theta_r C_{jkq} + \mu_k + \varepsilon_{ijk} \quad (1)$$

where M_{ijk} denotes out-migration (yes=1; no=0) of the i^{th} individual in the j^{th} household from the k^{th} community; X refers to individual attributes; Z to household characteristics, and C to community-level or contextual factors; P , Q , and R denotes the numbers of variables with respect to X , Z , and C . For the fixed effects, α captures the intercept; β , γ , and θ capture the slopes for X , Z , and C , respectively. The random effects at the individual/household level and the community level are captured by ε and μ , respectively.

Note that the model is estimated based on 1,137 individuals aged 15–59 for one or more years during the reference period 2003–2014 and thus constituting the population exposed to the risk of out-migration or not. Apart from age, which is tracked for each person, and household size, which varies with out-and return-migration, the model implicitly assumes that the characteristics of the individual, household and community as recorded at the time of the survey did not change over time, *except* for the key individual and household characteristics specifically obtained in the questionnaire pertaining to the *time of migration*². In fact, the key variable, total land available to the household, rarely changes over time since the government allocated fixed amounts of land to each household with long-term usufruct

². If a person migrated more than once, the questionnaire obtained the data pertaining only to the last migration.

rights, so households, even when members leave including all members, make sure some relative stays behind to continue to lay claim to the land for the household, to retain its *hukou* or legal household registration (Zhu, 2007).

The list of independent variables with detailed descriptions is presented in Table 1. It is important to note that all individual and household level variables in the multivariate model are weighted by the sizes of the populations they represent based on the complex sampling scheme involving oversampling households participating in the CCFP program.

3. Results

3.1 Temporal trend

Fig. 2 (Panel 1) shows the percentage of population within the age range of 15–59 in households with and without CCFP who migrated out each year. Out-migration generally rose over time during 2000–2013. Looking at the annual fluctuations for the CCFP households, there is a moderate increase immediately after 2002 when the CCFP was first implemented, followed by a second surge in 2010 when the first 8-year contract was completed so households could renew for a second 8-year contract. The dip in 2008 might be due to the impact of the global economic recession, when it was harder for migrants to find jobs in cities. Then the larger apparent increase after 10 years of the implementation of the CCFP in 2013 may be partly due to respondents engaging in a common practice in interviews, first, remembering and reporting events better in the most recent years and second sometimes thinking of them as occurring more recently than they did (viz., reporting events occurring in 2012, a year of relatively low out-migration, as occurring in 2013).

We now compare the probabilities of out-migration from households with and without CCFP participation since 2002, still in the top panel. On the one hand, the proportion of out-migrants from CCFP households was overall higher than that from households not participating. During 2009–2010, the out-migration rate from CCFP households increased and reached a small peak while the rate for nonparticipating households remained the same or even decreased later in 2011. This may be due to households receiving the modest CCFP payment recovering more quickly from the economic recession. However, both groups had a sharp increase in out-migration in 2012–2013, which might be linked to a major rural economic stimulus program³ of the central government (Csanádi et al., 2015). There was a surge in real estate development from the stimulus, attracting rural labor for construction.

Panel 2 of Figure 2 provides a *prima facie* assessment of whether the amount of money from the Ecological Welfare Forest Program (EWFP) has had any evident effect on stimulating out-migration. The two almost parallel lines suggest the difference is small, but that those households receiving higher EWFP payments were in general *less* likely to have out-migrants, though this was also true just prior to the CCFP implementation (2000–2002). Thus the difference in out-migration rates is the *opposite* to that of CCFP participation. This is probably because households who received more compensation from the EWFP tend to live in higher elevation, more isolated areas and are less involved in off-farm market

³The State Council of the People's Republic of China announced the economic stimulus plan on November 9, 2008.

employment. Another key difference between these two PES programs is that EWFP has no impact on freeing farm labor as does the CCFP, by taking cultivable land out of cultivation to reforest it.

3.2 Descriptive analysis

Of the 1,137 individuals aged 15–59, nearly half (516) out-migrated during 2003–2014 (Table 2). Figure 3 (in Appendix) shows the extent of the differences between out-migrants and non-migrants in the top panel of Table 2. Compared to non-migrants, out-migrants tend to be more male, younger, more educated, and not married (including divorced and widowed). All four of these individual attributes are similar for those from households with and without CCFP participation. Examining male-female differences reveals small differences in age, with males older than females by 3 years for both out-migrants and non-migrants, and both male and female migrants 15 years younger than their non-migrant counterparts. The education gap between males and females is small for (more educated) migrants (gap of one-third of a year) compared to the gap for non-migrants of over 2 years. This is an extraordinary difference, and suggests that there may more equality in gender roles among out-migrants than among non-migrants. Thus those who migrated are already “different” from those that do not, the latter perhaps having more traditional values that reduce their “risk-taking” as migrants. Finally, marital status differs between migrant males and females, and in an apparent surprising way: migrant females are more likely to be married than migrant males. Since there are more males than females migrating, the explanation is that most women who migrate do so with (or following) their husbands, and that the “surplus” single migrants are mostly males (see Figure 3 in Appendix).

3.3 Determinants of migration

Here we present the results (odds ratios and significance levels) of applying the multilevel multivariate model of Eq. (1) above to examine the factors linked to out-migration. We also provide the marginal effects to show the effects of a change in each factor on the probability of out-migration, keeping all other independent variables at their mean levels. Results show significant effects of a number of factors at all three levels: personal attributes, household characteristics, and contextual factors (Table 3).

Beginning with the results for individual attributes, note first that males, younger persons (aged 15–59), those with more education, and married persons are more likely to migrate out from rural areas, even when all the other factors are controlled for. The results for gender, age and education are also as anticipated and consistent with most prior studies of migrants in developing countries, including China. The results for marital status appear surprising at first, but not when one considers that it is common in rural areas of China for women to “marry in” (move into the house of their husband’s family/parents, which is usually where he is still living with his parents when he first gets married). Then, after a time, either the husband or both the husband and wife move away to work in urban areas, whether at the same time or with the husband going first. In contrast, when an unmarried son or daughter is living with parents, he/she is somewhat less likely to migrate out, in order to help on the farm (and often ultimately taking over, if male). The exception to this is that single women living with their parents are more likely to migrate away than single sons, which is captured

by the “single female” interaction variable. This represents an interesting cultural change, since in Chinese tradition it was expected that a single daughter is the one most responsible for remaining behind to care for elderly parents. But nowadays it seems more common in rural China for sons to do this, likely related to the physical advantages of the son in managing a farm. Thus despite the *overall* negative relationship between out-migration and female gender, a *single* female is 2.6 times more likely to out-migrate than a male or married female, once other factors are taken into account. In contrast, married women are more likely to stay home to take care of any children, at least up to when the children start school at age 5 or 6, while their husbands migrate-out to earn a higher income to support the family through remittances (Zhu, 1998), remittances accounting for nearly a third of mean rural household incomes in the study area (Zhang, 2017).

Moving on to household variables, first, several are examined pertaining to the attributes of the household head, but only one is associated with out-migration, with *older* age significantly increasing the probability of out-migration, while gender, education, and marital status have no significant effects. While it might be anticipated that older heads would be associated with *less* out-migration of other household members (viz., their children), who should stay behind to care for them, in most cases, the older heads in the study population are not so old (mostly 40–65) and are in decent health so that is usually not an issue (though it occurs, of course). In contrast, as the heads move on from their 20's and 30's into their 40's and 50's, their households are likely to become better off due to having more experience in farming and/or off-farm work, and hence more able to provide support for travel and initial assistance to an out-migrating son or daughter compared to younger heads. In addition, a younger household head is less likely to have a son or daughter reaching the most common age of migration (25–30).

Among the other household variables, first, a number do *not* have statistically significant effects, including household size, house elevation or walking distance to the nearest paved road, and household wellness. In many developing countries where household sizes are often large (much larger than in China, with its low fertility and much prior out-migration already), a positive relation tends to be observed with out-migration, since more members facilitates the household diversifying its sources of income and when landholdings are minimal, may alleviate food consumption deficiencies (Brown and Lawson, 1985; Bilsborrow et al., 2004; Braimoh, 2004; Barbieri et al., 2009). On the other hand, a household which has had a former member migrated out is much more likely (2.5 times) to have another member out-migrate later, because prior migrants may offer assistance and information, as hypothesized above regarding migrant networks (Massey, 1990; Barbieri et al., 2009).

In terms of the livelihood variables, households with larger areas of land in cultivation or with a household member engaged in local off-farm work are *less* likely to send an out-migrant, as these livelihood activities require labor. However, using forest resources or selling animals does not have significant effects, because these require less labor and are also rarely significant sources of income of the rural households, rather serving as supplements (Zhang, 2017).

Moving on to the two key PES policy variables, both CCFP and EWFP payments have significant effects on individual out-migration, but perhaps surprisingly *their effects are opposite*. For CCFP households, the compensation for enrolling land has a positive effect on out-migration. The mechanism of the CCFP effect involves not only the modest cash compensation (a small income effect) but mainly the effects of the decline in land available for cultivation, which reduces the demand for labor for farm work and may also have other indirect impacts on rural households. First, the subsidy initially provides low-income households with a little financial support, which could be used to cover household needs or alternatively the initial costs of out-migration, such as transportation and labor market searching (Curran and Rivero-Fuentes, 2003). Second, and clearly the dominant effect, the reduction in cropland available can free up farm labor for other activities, including out-migration (Uchida et al., 2009; Groom and Palmer, 2012). Indeed, unless land-and labor-intensifying technological change is adopted on the remaining farmland available (Boserup, 1965; Bilsborrow and Geores, 1992, 1994), the decline in the cropped area reduces the household's need for labor (Liu and Lan, 2015). Like most rural areas in China, farmers in Tiantangzhai used to be constrained to remain on their land due to insecure land tenure (Mullan et al., 2011), but this is no longer the case as they tend to have "unlimited" usufruct rights to the land.

EWFP payments, on the other hand, are found to have statistically significant negative effects on individual out-migration. The mean EWFP payment (470 yuan/year) is triple the mean CCFP payment (150 yuan/year) in the township (see Table 4 in Appendix). Although the compensation *rate* per unit of land is extremely low (8.75 Yuan/mu/year), the mean *area* of EWFP forests owned by households (49 mu) is far larger than the mean area of CCFP land (1.14 mu). Local forest station records indicate that the maximum amount of EWFP compensation in the study region was over 10,000 yuan in 2013. This means that even the mean area's generation of 470 yuan will provide meaningful support for a rural household, making additional income from out-migrant remittances less needed than in households receiving less EWFP compensation even if they also receive the modest CCFP compensation. Note that the EWFP has no direct effect on farm labor, unlike CCFP, as it does not involve cropland. Households receiving higher amounts of EWFP compensation due to having more forested lands are likely to be located higher up in the mountains, and hence farther from roads, which may contribute to the lack of the statistically significant (positive) effects of two other household variables: house elevation and walking distance to the nearest paved road.

Finally, we examine community or contextual factors to see what structural factors may condition out-migration of people from the 40 sample communities. Although no differences in community mean characteristics were observed between households with and without out-migrants (see Table 4 in Appendix), in the multivariate analysis significant contextual effects are observed, of both distance to nearest school (at the 9 percent level) and to the nearest hospital (at the 1 percent level). Due to the lack of educational facilities in the communities and their distance, children usually have to walk far for primary schooling, even live in the township center on weekdays for middle school, and go much farther for secondary or higher education. Similar to education, the lack of or distance to a hospital or health clinic seems to contribute to some people to move. However, nearness to or presence

of both the education and health facility variables may also reflect better living conditions in general in the community, as other community-level variables were not available. In any case, similar effects of access to health and education facilities were found in a very different context, the Ecuadorian Amazon (Barbieri et al., 2009), suggesting there is some effect, and that the empirical model of migration should not neglect contextual effects.

4. Discussion

Rural out-migration is the key form of migration and a major contributor to the transformation and modernization of the economy in China. This out-migration also likely contributes to poverty reduction among rural households in many areas of China as in most developing countries around the world. Over the course of many centuries of civilization, expanding the cropland area in China has been critical to feeding its growing population. Cropland expansion often occurs at the expense of forests, in the case of China, particularly in the past century as population has more than quadrupled. The extensive deforestation led to severe soil erosion that in turn contributed to devastating natural disasters, such as droughts and flooding. Ironically, these natural disasters have functioned as a major driving factor in China's on-going forest transition (Zhang et al., 2015), including the development of the two PES policies evaluated here, the Conversion of Cropland to Forest Program (CCFP) and the Ecological Welfare Forest Program (EWFP). The present paper reports on a multilevel statistical analysis of the determinants of out-migration from farm households in one region of China, where part of the households have been participating in the CCFP and virtually all in the EFWP. One important conclusion is the finding that CCFP payments are associated with increased out-migration, the main mechanism appearing to be the effects of the CCFP program on reducing the area in cropland. This in turn reduces the demand for farm labor, which then has other induced effects on rural livelihood strategies, including in some cases increased out-migration. Thus while the CCFP subsidy is too small to reduce rural poverty, the program still stimulates some members of rural farm households to migrate to urban areas. Meanwhile, the policy achieves the main goal of reforestation on sloping land, the success of which is evident in satellite imagery (Zhang et al., 2016).

At the same time, EWFP payments discourage rural out-migration. Despite the far smaller payment per unit of land, the far larger areas involved results in the much larger total amount of payment (three times as high per household on average), providing sizable compensation to households with large areas of natural forest. Thus, EWFP payments tend to both keep farmers in rural areas and preserve existing forests. This sometimes appears to offset the effects of CCFP payments motivating people to out-migrate: if a household receives the mean values of subsidies from both programs (has a mean area of natural forest), then the person will tend to not move since the marginal effect on stimulating out-migration per thousand yuan of 0.32 (when other factors are at their means) of CCFP payments on out-migration is about three times that per thousand yuan of EWFP (-0.12), so the effects approximately cancel each other, though the two policies still achieve the government goals of reforesting cropland and preserving existing forests, respectively. Thus, if a household receives both subsidies and natural forest land is less than the mean, a CCFP household would tend to have an out-migrant, while one with more natural forest than the township mean would tend to no have an out-migrant.

These effects of the PES programs (including other possible changes, such as changes in crops grown due to less land, increases in off-farm employment, creation of new businesses, receipt of remittances) are of paramount interest not only to assess the *full* effects of the CCFP program including on rural households and poverty, but also in the study of human-environment interactions more broadly (Engel et al., 2008; Raymond et al., 2013). These induced effects have not been investigated in prior studies of these PES programs in China (and little in other countries as well), but this should be done to develop a full understanding of the impacts of the PES programs. It is the rural farmers who ultimately make decisions about land use, who may or may not participate in the PES programs, and who may or may not alter their livelihoods in response—i.e., by out-migration, by changing crops and/or adopting more land-intensive agricultural technologies, and/or by reallocating (remaining, in the case of out-migration) household labor to other uses, such as off-farm work. If the overall consequences of PES programs on livelihoods are not positive for participating farm households—whatever their positive effects on re-greening the landscape—they will tend to be *non-sustainable*: i.e., once subsidies are ended, farmers will be likely to revert to previous behaviors, including cutting down forests to expand their cultivated area and to sell trees commercially (if the EWFP program ends). Remittances from former household members who have migrated away contribute to nearly a third of mean household incomes in Tiantangzhai. Hence studying the factors that affect individual out-migration as a household livelihood strategy is thus essential for understanding the sustainability or not of such programs on reforestation, where they have been observed to have clear environmental success in China (Uchida et al., 2005; Grosjean and Kontoleon, 2009; Démurger and Wan, 2012), but does not provide a full analysis. Understanding the relationship between PES programs and out-migration is thus crucial for environmental policy-makers as well as for those concerned with rural poverty, inequality and development in China.

5. Conclusions

In this article, we examine the factors affecting out-migration from rural households in a mountainous study region of central China, drawing on household and community survey data. To summarize the main findings, first, apart from the PES variables, we found that the principal factors at the individual level were gender (males somewhat more likely to out-migrate) followed by education; at the household level, the main factors were cultivated land area and involvement of the household in the local labor market (both reducing out-migration), and previous migration experience in the household (stimulating it). The contextual factors available had weaker effects, but greater distance to the nearest primary school or hospital was linked to more out-migration. This suggests that policies to expand the provision of or access to schools and health facilities to improve livelihoods (perhaps small clinics short of full hospitals) in the local area (and/or improve access through improved roads or transportation). Thus, poor accessibility to schools and hospitals appears to act as “push” factors that contribute to some rural households send household members away.

In the determinants of migration model, the inclusion of the PES payment variables directly reflects policy instruments, so the results here should be useful for the design of future incentive programs. First, compensation from the CCFP gave farmers incentives to both

improve the environment and adjust their livelihoods. As farm households increasingly adopt out-migration as one of the livelihood response strategies, there would appear to be less likelihood that they will turn reforested land back to cropland even after subsidies end. On the other hand, the larger amounts of EWFP payments make it easier for the more isolated, higher elevation households (with more land in forests) to continue their existing ways of life, *reducing* incentives for them to change or diversify livelihoods or out-migrate, but only as long as payments continue. But is that also a policy goal? It could be, as a *quasi-permanent* subsidy to those living in the mountains, in exchange for their provision of the ecosystem services provided by their forests, as well as to reduce their poverty. On the other hand, if the goal is to encourage those more isolated farmers to also diversify their sources of livelihood, or even migrate away from the mountainous rural area, then other policies are desirable. These could include more local economic development policies in the county to provide more non-farm jobs, or policies to resettle farm households elsewhere in China. In the absence of such other new policies, if EWFP payments cease, these farmers would likely need to rely more on logging and selling wood if not also clearing more steeply sloped land to increase cropland, reversing the intended effects of the CCFP and EWFP policies and degrading the ecosystem services the forests provide. In sum, the larger, more complex implications of both CCFP and EWFP policies need to be considered and evaluated to decide about the desirability or not of their continuation and in what form.

Appendix

Figure 3.

Personal attributes of gender, age, education and marital status for non-migrants and out-migrants aged 15-59. The y-axis is the percentage of individuals. White histogram bars indicate non-migrants, black bars out-migrants.

Table 4

Means, standard deviations, minimum and maximum values of variables for non-migrants and out-migrants aged 15-59 in Tiantangzhai Township (asterisks indicate when differences between migrants and non-migrants are statistically significant).

Variable	Non-Migrants (N=621)				Out-Migrants (N=516)			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
<i>Individual-level (N=1,137)</i>								
Gender ***	0.55	0.50	0	1	0.44	0.50	0	1
Age ***	43.3	10.9	15	59	28.7	11.4	15	59
Education ***	0.63	0.48	0	1	0.91	0.29	0	1
Marital status ***	0.86	0.35	0	1	0.57	0.50	0	1
Single female ***	0.06	0.24	0	1	0.17	0.37	0	1
<i>Household-level (N=412)</i>								
Gender of HH head	0.04	0.19	0	1	0.06	0.23	0	1
HH Head's age ***	47.9	8.6	10	79	51.8	9.4	14	81

Variable	Non-Migrants (N=621)				Out-Migrants (N=516)			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
HH Head's education	0.74	0.44	0	1	0.77	0.42	0	1
HH Head's marital status**	0.94	0.25	0	1	0.88	0.32	0	1
House elevation	679	103	413	974	666	105	414	974
Walking distance	11.7	14.1	1	80	11.0	14.8	1	90
Household size	3.69	1.25	1	8	3.75	1.21	1	8
Household wellness	21.2	4.52	7	32	21.0	5.12	3	33
Previous migration***	0.25	0.43	0	1	0.41	0.49	0	1
Cultivated land***	5.13	3.22	0	18	4.44	3.37	0	18
Sell animals	0.18	0.38	0	1	0.15	0.36	0	1
Local off-farm work***	0.67	0.47	0	1	0.51	0.50	0	1
Use forest resources***	0.65	0.48	0	1	0.55	0.50	0	1
CCFP payment [†]	0.14	0.19	0	1.13	0.16	0.21	0	1.13
EWFP payment**	0.54	0.68	0.02	4.15	0.44	0.54	0.02	4.15
<i>Community-level (N=40)</i>								
Community size	25.8	8.6	9	41	26.2	8.7	9	41
Distance to school	20.1	25.6	2	150	20.1	24.4	2	150
Distance to hospital	18.4	15.6	1	60	19.3	16.0	1	60

[†] p < 0.1

* p < 0.05

** p < 0.01

*** p < 0.001

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Figure 1.
Study area: Tiantangzhai Township in Anhui, China.

Figure 2.

Panel 1: Proportion of household members aged 15–59 out-migrating each year during 2000–14, households with and without CCFP; Panel 2: Proportion migration who received EWFP payments above and below the mean.

* The asterisk for 2014 indicates that data were available only for the first half of 2014 since the survey was carried out in July 2014. The 2014 value is based on an annualized estimate to compare with other years.

Table 1

Description of independent variables for modeling out-migration.

Variable	Description
<i>Individual-level</i>	
Gender	0=male, 1=female
Age	Age in years completed
Education	Whether finished primary school (0=no, 1=yes)
Marital status	Marital status (0=single, divorced or widowed; 1=married)
Single female	Interaction term of gender and marital status
<i>Household (HH)-level</i>	
Gender of HH head	0=male, 1=female
HH Head's age	Age of household head in years
HH Head's education	Whether household head finished primary school (0=no, 1=yes)
HH Head's marital status	0=single, divorced or widowed, 1=married
Elevation	House elevation above sea level (meters)
Walking distance	Walking distance to nearest paved road measured by time (minutes)
Household size	Number of people living in household
Household wellness	Wellness index of household (score range 3–33)
Previous migration	Whether any current member aged 15+ has previous out-migration experience (0=no, 1=yes)
Cultivated land	Total area of land under cultivation (mu)
Animal sale	Whether household has any income from selling domestic animals in past 12 months (0=no, 1=yes)
Local off-farm work	Whether any household member was engaged in local off-farm employment in past 12 months (0=no, 1=yes)
Use forest resources	Whether household extracted forest resources, such as herbal medicines, in past 12 months (0=no, 1=yes)
CCFP payment	Compensation received from CCFP in past 12 months (1,000 yuan)
EWFP payment	Compensation received from EWFP in past 12 months (1,000 yuan)
<i>Community (RG)-level</i>	
Community size	Number of households in resident group
Distance to school	Distance to nearest primary school in walking time (minutes)
Distance to hospital	Distance to nearest hospital or clinic in walking time (minutes)

Table 2

Mean values of individual-level variables for out-migrants and non-migrants aged 15–59 at the time of out-migration/non-migration, by CCFP participation and by gender.

Variable	Out-Migrants (N=516)		Non-Migrants (N=621)	
<i>CCFP participation</i>	CCFP=1	CCFP=0	CCFP=1	CCFP=0
Gender	0.41	0.47	0.54	0.55
Age	28.8	28.6	43.5	43.0
Education	8.23	8.36	5.43	5.43
Marital status	0.57	0.56	0.87	0.85
Number	307	209	343	278
<i>Gender</i>	Male	Female	Male	Female
Age	30.1	27.0	44.9	42.0
Education	8.45	8.08	6.53	4.51
Marital status	0.53	0.62	0.83	0.88
Number	290	226	282	339

Gender: percentage female

Age: in years

Education: in years completed

Marital status: percentage of individuals currently married (not including divorced or widowed)

Table 3

Results (odds ratios and marginal effects) for determinants of out-migration from multilevel model.

Variables [§]	Odds Ratio (Robust Std. Err.)	z	P> z	Marginal Effect [¶]
<i>Individual-level (N=1,137)</i>				
Gender ^{***}	0.21 (0.07)	-4.87	0.000	-0.3142
Age ^{***}	0.85 (0.01)	-10.01	0.000	-0.0332
Education [*]	3.08 (1.59)	2.17	0.030	0.2081
Marital status [*]	3.73 (2.21)	2.23	0.026	0.2414
Single female [*]	3.65 (2.26)	2.10	0.036	0.2855
<i>Household-level (N=412)</i>				
Gender of HH head	0.20 (0.20)	-1.62	0.105	-0.2440
HH Head's age ^{***}	1.13 (0.03)	5.32	0.000	0.0251
HH Head's education	1.53 (0.57)	1.14	0.256	0.0837
HH Head's marital status	0.32 (0.29)	-1.25	0.212	-0.2527
House Elevation	1.00 (0.00)	0.42	0.672	0.0003
Walking distance	0.97 (0.02)	-1.32	0.186	-0.0056
Household size	1.06 (0.11)	0.58	0.560	0.0120
Household wellness	0.99 (0.03)	-0.39	0.698	-0.0024
Previous migration ^{***}	3.48 (0.92)	4.73	0.000	0.2676
Cultivated land ^{***}	0.85 (0.04)	-3.56	0.000	-0.0339
Animal sale	0.62 (0.20)	-1.47	0.142	-0.0939
Local off-farm work ^{**}	0.25 (0.12)	-2.99	0.003	-0.2991
Use forest resources	1.23 (0.42)	0.60	0.548	0.0425
CCFP payment ^{**}	4.78 (2.71)	2.76	0.006	0.3223
EWFP payment ^{**}	0.60 (0.09)	-3.32	0.001	-0.1068
<i>Community-level (N=40)</i>				
Community size	1.01 (0.02)	0.46	0.642	0.0018
Distance to school [†]	1.01 (0.00)	1.72	0.086	0.0017
Distance to hospital [*]	1.02 (0.01)	2.52	0.012	0.0035
Intercept	0.33 (1.26)	-0.29	0.772	
Intercept variance	0.40 (0.26)			

[†] p < 0.1;^{*} p < 0.05;^{**} p < 0.01;^{***} p < 0.001.

Bold indicates significant at 5% level or better.

The log pseudo-likelihood is -3629 and the Wald χ^2 is 1753 with p-value 0.000 .

[§] All data used in the model are weighted.

[¶] Marginal effects are the effects on probabilities of out-migration when the other variables are at their means.

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