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The implementation and impacts of China's largest payment for ecosystem services program as revealed by longitudinal household data

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ABSTRACT

As the largest payment for ecosystem services initiative in the developing world, China's Sloping Land Conversion Program subsidizes households to restore marginal croplands and other degraded fields. While it has attracted broad attention, many questions regarding its performance remain unanswered. Using descriptive and econometric analyses based on a longitudinal dataset containing a large number of surveyed households over 1999–2008, we examine the multi-faceted changes in program enrollment, land and labor allocation, agricultural production, and income structure and inequality. We find that the program has affected land use substantially by simultaneously retiring degraded cropland and increasing forest and vegetation covers, which have accelerated labor transfer into off-farm sectors. Meanwhile, households have intensified agriculture by increasing their production expenditures, enabling them to offset some of the negative effects of the cropland set-aside and reduced farm labor use. While the subsidies have been a significant source of income to the participants, most households have had a larger portion of their income come from non-farming jobs, leading to the increase of average family income by over 250%, and the reduction of rural poverty and thus the most vulnerable population. As impressive as these changes may be, the program still faces great challenges before the ecosystems are adequately recovered to provide their services.

Introduction

Driven by population expansion, economic growth, and poor governance, among other factors, China's terrestrial ecosystems experienced tremendous destruction during the second half of the last century, as evidenced by the depletion of primary forests, the deterioration of vast grassland, and the degradation of fragile cropland (Liu and Diamond, 2005; Wang et al., 2007; Yin, 2009). These trends led to worsening soil erosion, wildlife habitat loss, greenhouse gas emission, and many other environmental problems; meanwhile, people's livelihoods were adversely affected, as indicated by the incidence of poverty, food insecurity, and the high rate of joblessness (Xu et al., 2006; Uchida et al., 2007). To tackle the challenges, China has been undertaking several major ecological restoration programs since the turn of the century, including the Sloping Land Conversion Program, the Natural Forest Protection Program, and the Desertification Combating Program (Wang et al., 2007; Yin, 2009).

As a primary initiative of payment for ecosystem services (PES), the Sloping Land Conversion Program (SLCP) subsidizes farmers in mostly poor rural areas of western China to retire marginal, sloping cropland and other heavily degraded fields and restore them to forest and vegetation covers (Liu et al., 2008; Bennett, 2008; Cao et al., 2009). Because of its huge public investment (over 430 billion yuan), along with its broad geographical coverage (25 provinces and autonomous regions) and participation by rural households (over 30 million), the SLCP has become the largest PES program not only in China and but also in the developing world (Liu et al., 2008; Bennett, 2008). It is expected that in addition to improving China's own environmental conditions, this and other PES programs also will benefit the rest of the world in terms of climate change mitigation, biodiversity protection, and duststorm control, to name a few (Daily and Matson, 2008; Yin, 2009). Even though the SLCP has

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been implemented for more than a decade, however, a lot of the program detail in terms of participation and enrolment, land and labor allocation, agricultural production, and income structure and inequality, remains poorly understood. This paper aims to fill these salient knowledge gaps by presenting a comprehensive profile of the program and a careful econometric analysis based on a large longitudinal dataset of household surveys.

The environmental aspiration of the SLCP is to increase the country's forest and grassland covers and thus reduce soil erosion, flooding, and desertification and other ecological disasters by primarily retiring and converting marginal, sloping lands from farming. The original target of cropland set-aside was set at 14.67 million hectares (ha) by 2010. Further, a comparable amount of abandoned farming and grazing fields and even denuded lands on hillsides was included for voluntary forest and vegetation recovery. Another goal of the program is to reduce poverty and promote rural development (Uchida et al., 2007; Yin and Zhao, 2012). According to the original program stipulation, farmers would receive a grain subsidy of 2.25 tons/ha (150 kg/mu) per year for retiring and restoring their cropland in the Yangtze River basin and 1.50 tons/ha (100 kg/mu) per year in the Yellow River basin.[1] Thus, the program also has been known as the "Grain for Green Program" (Li et al., 2011; Uchida et al., 2009) and the "Grain to Green Program" (Liu et al., 2008). In addition, a cash outlay of 300 yuan/ha per year would be provided for farmers to purchase seeds or seedlings and to conduct tending activities.[2]

On paper, the subsidy duration would be eight years if environmentally benign trees are planted mainly for providing ecological functions and services; five years if commercial trees are established for producing timber, fruits, nuts, and other products; and two years if grassland is rehabilitated. In reality, however, most of the retired cropland has been planted with trees of mixed species and enrolled for eight years. This is because of the biased preference of the State Forestry Administration (SFA), who is in charge of implementing the program, toward tree-planting on the one hand and participating farmers' desire to get government subsidies for a longer duration on the other (Yin and Yin, 2010; SFA, 2009).

Since its initiation in 1999, the SLCP has undergone substantial modifications. First, due to dwindling public reserves, the gain subsidy was abruptly phased out by 2004 and replaced with a monetary compensation by setting the grain price at a constant rate of 1.40 yuan/kg (Yin and Yin, 2010). Related to this change has been the significant scale-back of the program due to concerns with national food security (Yin et al., 2010; Bennett, 2008). Moreover, because many participating farmers still had difficulty finding alternative job and income sources to improve their livelihoods, the State Council decided in 2007 to extend the program for another round—until about 2020. At the same time, the primary component of the subsidies—compensation for lost grain yields—was halved to 1575 yuan/ha a year in the Yangtze River basin and 1050 yuan/ha a year in the Yellow River basin, respectively.

As shown in Table 1, the SLCP already slowed considerably in its implementation after 2003 and almost came to a complete halt later. By 2008, it retired and converted 8.0 million ha of cropland, less than 60% of its original target; it also established forests on another 4.2 million ha elsewhere. Given that, obviously, the original target of cropland retirement has not been achieved. Nonetheless, it remains true that the SLCP has led, among other things, to a substantial increase in China's forest and grass covers, along with a marked reduction in cultivated land (Yin and Yin, 2010; Li et al., 2011; Bennett, 2008).

Table 1
National statistics for the SLCP implementation.

	Forestation on retired cropland (1000 ha)	Annual investment (1,000,000 yuan)	Afforestion elsewhere (1000 ha)
1999	381.5	335.9	211.6
2000	328.4	1540.8	280.3
2001	386.1	3145.5	217.3
2002	2039.8	11061.0	676.4
2003	3085.9	20855.7	824.4
2004	824.9	21429.1	473.3
2005	667.4	24041.1	408.3
2006	218.5	23214.5	409.5
2007	59.5	20840.9	315.1
2008	2.2	24897.3	469.0
Total	7994.2	151361.8	4285.2

Data source: China Forestry Development Report (SFA, 2009). The exchange rate is $1 = 6.3 yuan in January 2012. The consecutive growth of the annual investment is driven by the multi-year durations of the subsidy schemes.

The most relevant measures of the performance of the SLCP are its efficacy of implementation and significance of impact (Yin et al., 2010). Implementation efficacy refers to what the program has achieved in relation to its operational targets, whereas impact significance concerns how a program's execution has served its ultimate goals (Parris and Kates, 2003). The former can be gauged with such indicators as land area converted or conserved, effectiveness of site selection and preparation for tree/grass planting, survival and stocking rates of vegetation rehabilitated, and cost savings relative to the budgeted expenditure for a given task. The latter can be elucidated by the induced environmental and socioeconomic changes (Ostrom, 2007; Yin, 2009). The former are reflected in ecosystem functionality and stability, such as the status of erosion control, biodiversity conservation, and carbon storage; the latter are represented by such indicators as poverty reduction, income growth, and labor transfer. Thus far, a majority of the studies assessing the SLCP have concentrated on evaluating its short-term, local socioeconomic impacts based on household survey data, as well as its implementation efficacy (Yin et al., 2010).

In addition to overviewing the early SLCP implementation and discussing the challenges it encountered, several articles have reported the induced short-term, social–ecological changes using secondary evidence and/or government statistics (Wang et al., 2007; Liu et al., 2008; Yin and Yin, 2010). Meanwhile, empirical analyses of the socioeconomic effects have begun to appear in the international literature. For instance, Uchida et al. (2007) identify a moderate success of the SLCP in achieving its poverty alleviation goal, and Uchida et al. (2009) further show that participating households are increasingly shifting their work time from on-farm to the off-farm labor market, with the effects dependent on the initial level of human and physical capital. Yao et al. (2010) find that the effects of program participation on incomes from crop production, animal husbandry, and off-farm work vary a great deal, and these effects are mediated by local economic conditions and political leadership. Likewise, Groom et al. (2010) study the effect of program participation on labor reallocation toward off-farm activities and find heterogeneous effects. Mullan et al. (2011) further examine the role of incomplete property rights as well as participating in the SLCP in the migration decisions of rural households; their results indicate that tenure insecurity reduces migration, but participating in the SLCP does not increase migration significantly. Li et al. (2011) also demonstrate that participation in the SLCP has significant positive impacts on household income, especially for low- and medium-income families; and income inequality is lower among participating households.

As interesting and insightful as these findings are, one common limitation of the previous studies is that their sample size is small

[1] Note that mu is a Chinese measure of land area and 1 mu = 1/15 ha.
[2] 1 US dollar = 6.3 yuan, according to the exchange rate in January 2012.