# Chapter 10
# An Empirical Analysis of the Effects of China's Land Conversion Program on Farmers' Income Growth and Labor Transfer

**Shunbo Yao, Yajun Guo, and Xuexi Huo**

**Abstract** In this chapter, we hypothesize that in addition to participation status and household characteristics, the impacts of China's Sloping Land Conversion Program on income growth and labor transfer are determined by the local economic condition, program extent, and political leadership; and the income impacts may vary from sector to sector. To test these propositions, we compiled a dataset of 600 households in three counties of the Loess Plateau region, with observations for times both prior to and after the program initiation (1999 and 2006), both aggregate and categorical incomes, and both participating and non-participating households. Using a difference in differences model and the repeated cross-sectional data, we find that participation status, local economic condition, program extent, and political leadership have indeed made significant impacts on household income and off-farm employment. Moreover, the effects of participation on crop production income, animal husbandry income, and off-farm income vary substantially. These results carry major policy implications in terms of how to improve the effectiveness and impacts of ecological restoration efforts in and outside of China.

**Keywords** Sloping Land Conversion Program · Income increase · Labor transfer · Repeated cross-sectional data · Northern Shaanxi · Difference in differences model · Economic development · Program extent · Political leadership

## 10.1 Introduction

The Sloping Land Conversion Program, or SLCP, is a primary national program that has been launched by the Chinese government to mitigate soil erosion, desertification, and other ecological problems in order to achieve more sustainable development. In 1999, the pilot projects of this program were carried out in Shanxi, Gansu, and Sichuan. By the end of 2006, it has subsidized 32.5 million farm households

S. Yao (✉)
College of Economics and Management, Northwest A&F University, Yangling, Shaanxi 712100, P.R. China
e-mail: yaoshunbo@126.com

in more than 2,200 counties to retire and convert degraded (sloping) and deserti-fied croplands (State Forestry Administration, or SFA, 2007). Its ultimate goal is to convert 14.7 million ha of croplands to forest and grass coverage by the end of this decade, with a total investment of over 220 billion yuan (Yin, Yin, & Li, 2008).[1] The government claims that the program has made a predominantly positive impact on rural households' production and livelihoods as well as on the environment (SFA, 2007). The objective of this chapter is to assess whether or not implementing the SLCP has indeed led to an increase in farmers' income and a transfer of labor into off-farm sectors, and what the key conditions are in determining the program out-come.

Ever since the time when the SLCP was officially announced, its effectiveness and sustainability have been hotly debated. While the government has held a rosy view, scholars have found divergent and even contradicting evidence of the SLCP's impacts. Based on household data collected from Gansu and other provinces and descriptive statistics, Zhi (2004) showed that implementing the SLCP has promoted the transfer of rural labor out of the farming sector and the improvement of farm-ers' income. The study by Wang (2003) of the program's impact on production and income in Wuqi, Shaanxi, revealed that it has contributed to the improvement of pro-ductive efficiency, the increase of farmers' income, and the expansion of off-farm jobs. Dong, Zhong, & Wang (2005) found that the food security of households par-ticipating in the SLCP has been improved, compared either to the status of their own prior to implementing the program or to that of the non-participating households. Li (2004) showed that in many areas the adjustment of the rural economy, induced by the SLCP, has already benefited farmers' income growth. Given the detected posi-tive effects of labor transfer, economic adjustment, and income increase, a general implication of the above studies is that the SLCP can be sustained in the long run.

On the other hand, some researchers have questioned the effects of the SLCP on labor transfer and income increase and thus its sustainability. For instance, with household data collected in Shaanxi, Gansu, and Sichuan, Xu, Tao, & Xu (2004) found that until 2002, the SLCP had not made a significant impact on the adjust-ment of the production structure, employment in non-farming sectors, and increase in farmers' income. Using case studies in Sichuan, Guo, Gan, Li, & Luo (2005) indi-cated that because the animal husbandry was hit hard by implementing the SLCP, households participating in the program experienced a decline in their living stan-dards. Yi, Xu, & Xu (2006) also showed that while the effectiveness of the program was enhanced after 2004, its impacts on facilitating rural employment, production adjustment, and income growth remained insignificant.

Several observations can be drawn from the previous studies. First, those studies suggesting positive income and employment effects tend to focus on the direct gov-ernment subsidies that farmers have received, and the aggregate structural adjust-ment of the local economy that the program has implied. However, few have considered the induced reduction in crop and/or animal production and displacement

---

[1] This total investment is about US$32 billion, given the current exchange rate of $1 = 6.85 yuan.

of farm labor. And most of these studies lack rigor in their analyses. In contrast, those works showing insignificant or even detrimental program impacts seem to have taken a more quantitative approach as well as a more balanced and disaggregate view by incorporating the concomitant negative effects on production and employment. Moreover, they argue that without adequate government assistance and training, it is not all that easy to quickly adjust the local economy and transfer the displaced farming labor. Nonetheless, these scholars have rarely moved beyond the features of the retired lands and engaged households to account for the outcome of the program.

Also, it seems unrealistic to expect a uniform outcome of such a large program, given its broad coverage and the varying biophysical and socioeconomic conditions across the country. In addition, the location of the selected sample sites makes a difference in determining the program effects, just as the time span of an investigation does. More importantly, the effectiveness and impact of the program are predicated on the internal and external local conditions under which it is executed (Yin et al., 2008). It is thus critical to identify these conditions and incorporate them into the assessment of the SLCP impact, which is what we will do in this chapter.

Formally, the propositions we make here are that in addition to participation status and household characteristics, the impacts of the SLCP on income growth and labor transfer are determined by the local economic development, program extent, and political leadership; and the income impacts may vary from sector to sector. In other words, implementing the SLCP can result in quite different outcomes in farming, animal husbandry, and thus total income; and it is likely that the program will make a greater impact where there exist a better developed economy, a larger program extent, and a stronger political leadership.

To test these propositions, we have selected three counties – Wuqi, Dingbian, and Huachi in the Loess Plateau region covering two time periods – 1999 and 2007. While these counties are adjacent, they belong to different jurisdictions, which can better reflect the varying extents of program execution, political setting, and economic development. The time span of the study, from 1999 to 2007, represents the longest of this type of inquiry so far. Also, dividing the aggregate income into incomes from farming, animal husbandry, off-farm work, and other sources will enable us to look into the gains and losses caused to different sectors. Further, the difference in differences (DID) model that we adopt is well-suited to the task of quantifying the program's impacts on the transfer of rural surplus labor and the growth of farmers' income (Lee, 2005). So, we expect that our empirical analysis will generate a rich set of interesting results, and thus make a timely contribution to a better understanding of the program performance and a more thorough discussion of how to improve its effectiveness and impact. We also hope that our work will provide valuable information to other countries undertaking similar ecological restoration efforts.

Overall, it is found that along with other variables, participation status, local economic condition, program extent, and political leadership have indeed had significant influences on household income and off-farm employment. Moreover, the effects of participation on crop production income, animal husbandry income, and

off-farm income vary substantially. These results confirm our hypotheses and have major policy implications. The chapter is organized as follows: We devote the next two sections to theory and methods, and study site and data; then, we present our empirical results in section four and our conclusions in the final section.

## 10.2 Theory and Methods

We hypothesize that the impacts of implementing the SLCP on income growth and labor transfer are determined by the local economic development, program extent, and political leadership, in conjunction with the participation status, and the income impacts may well vary from sector to sector. Specifically, we argue that if the program implementation involves only a small portion of the sloping farmland, its impact will be marginal; otherwise, if it covers a large proportion of the land base, then it can cause a major impact (positive or negative). Therefore, the program extent should be considered when we examine its impacts.

It is straightforward to understand the relevance of local economic condition to the program impact. In a more developed and wealthier region, not only is it unnecessary for the local cadres to profit from the program by diverting farmers' subsidies and exaggerating the set-aside targets to their own benefits, but also more local financial and personnel resources can possibly be devoted to facilitating the program implementation (Xu, Yin, Li, & Liu, 2006). Additionally, a better developed economy will provide more opportunities to absorb the displaced farm labor into off-farm and/or non-rural jobs. As a result, it is more likely for the program to take effect in increasing farmers' income and transferring farm labor (Guo & Yao, 2007). In contrast, if the local economy is such that it has little means to provide the basic administrative support, let alone supplementing the implementation and absorbing the surplus rural labor, then it will be less likely to make a difference; and it may even open up the door for the local program managers to graft part of the subsidies (Xu et al., 2004).

In addition, the program outcome is associated with the political leadership that a locale has. If the local agency is committed to its implementation, then it is more likely for the program to succeed and thus lead to a more positive impact (World Bank, 2002). Also, in a transparent political environment, it is not so hard for the farmers to track the performance of their local leaders and detect any inappropriate behavior, including corruption (World Bank, 2002). Otherwise, a non-transparent political setting makes it easy for the local agency to engage in misconduct, which can inevitably compromise the program effectiveness and constitute a disincentive to the farmers. Finally, since participating in the subsidized land conversion affects various production activities in different ways, it is expected that incomes from these activities will change dissimilarly. That is, cropland retirement can cause a yield and thus income reduction if no more improved inputs and management practices are adopted to intensify land use. In contrast, if more improved inputs and management practices are adopted, then intensified land use will not lead to a proportionate yield and thus income decrease. Also, cropland conversion and/or crop yield reduction

may mean that open herding is restricted and/or feed stocks reduced, in which case income from animal husbandry can be negatively affected.

Our task in this chapter is to test the validity of the above hypotheses by fitting an adequate empirical model with a sound dataset. To that end, we have compiled repeated cross-sectional data of household production activities in three counties of the Loess Plateau region. With observations made for times both prior to and after the program initiation and for both participating and non-participating households, our DID model will allow us to detect the program impacts effectively. In particular, including variables of economic condition, program extent, and political leadership in the estimation will make it possible to explain the success or failure of the program in the proper context. To our knowledge, this is one of the first studies that have attempted to incorporate a broader set of variables, both internal and external to the program implementation, into its impact determination.

The concrete model is as follows:

$$Y_{it} = \alpha_0 + \alpha_1 T + \delta D_{it} + \beta Z_{it} + \gamma X_{it} + c_i + \mu_{it} \qquad (10.1)$$

where $Y$ is a dependent variable representing farmers' income (from different sources) or off-farm employment; $i$ and $t$ denote household and time, respectively; $T$ is a time dummy, taking values of 0 for prior to the program initiation or 1 for after it; $D$ is another dummy variable to reflect the status of program participation – taking a value of 1 if a household participates or 0 otherwise; $Z_{it}$ represents control variables affecting farmers' income and off-farm employment, including those commonly used ones, such as family size, number of household laborers, and farmland per capita, as well as the ones that we propose to use – local program extent, economic condition, and political leadership (see discussion below); $X_{it}$ is a group of variables that may not vary over time or may vary spontaneously, including age of the household head and a family relative serving as a village leader; $c_i$ is a set of unobservable variables that affect family income and off-farm employment as well; and $\mu_{it}$ is the error term. Included in the parameters to be estimated are $\alpha_0$, the intercept, $\alpha_1$, the time effect, $\delta$, the effect of the participation status on income growth and labor transfer, and $\beta$ and $\gamma$, the effects of the control variables on the dependent variables.

Understandably, the effects of local economic condition, program extent, and political leadership on farmers' income and labor transfer are conditional on the household's engagement in the program. If so, these variables may not be directly included in $Z_{it}$; rather, they should enter the above equation as interactive terms with the participation dummy. We use the per capita GDP of the township to which the household belongs as a proxy for the local economic condition, the percentage of retired cropland of a household as an indication of the program extent, and another dummy variable to distinguish the political leadership of the sample counties.

After first-order differencing, the above model becomes:

$$Y_{i1} - Y_{i0} = \alpha_0 + \delta D_{it} + \beta(Z_{i1} - Z_{i0}) + (\mu_{i1} - \mu_{i0}) \qquad (10.2)$$

Note that unobservable effect $c_i$ and time invariant (or spontaneously variant) factors $X_{it}$ have disappeared following the first-order differencing. In order to obtain consistent estimates, it is further assumed that self-choice is not a serious problem in the above model. That is, whether a household participates in the program is not an endogenous choice (Lee, 2005). Given the short time span of cropland set-aside planning and execution, this assumption seems plausible (Wooldridge, 2002). Xu et al. (2004) already demonstrated that the problem of self-choice in participation is negligible.

## 10.3 Site and Data

The site for this study constitutes three counties of the Loess Plateau region – Wuqi in Yan'an municipality of Shaanxi, Dingbian in Yulin municipality of Shaanxi, and Huachi in Qingyang municipality of Gansu. The rationale for this selection is the following. First, these three counties represent the typical ecological conditions found in the region, where land degradation and soil erosion were so severe that there had been a great need for farmland retirement and conversion. Second, their adjacent locations and similar landscapes as well as program implementing paths (all initiated the farmland conversion in the late 1990s and almost completely achieved the conversion by 2005) are conducive to a comparison between them. Third, their different jurisdictions make it more likely for us to capture the variations in program extent, political leadership, and economic status and thus their influences on the outcome of program implementation.

Before proceeding to presenting our data, a brief description of the basic conditions of these three counties is in order. Situated in the northeast of Yan'an, Wuqi has a total population of 127,369, of which rural residents account for 109,470. Like its neighbors, Wuqi is well known for its rich petroleum and gas reserves. But unlike its neighbors, the county has enjoyed a preferential treatment by the central government in exploiting its oil and gas reserves, which has enabled Wuqi's economy to grow rapidly in recent years. Wuqi was selected for this treatment in the mid-1980s as a result of its significance in contemporary Chinese history as the ending place of the Red Army's Long March and because of the area's extreme poverty (Wuqi SLCP Office, 2007). The county's GDP was 2.1 billion yuan in 2005, when its own revenue reached 0.7 billion yuan. Now, Wuqi has become one of the richest counties in western China (Wuqi Statistics Bureau, 2006).

Before 1998, Wuqi had a cultivated land of 123,700 ha, or 3.40 ha per household, and a large number of the rural households also raised goats, whose population peaked to 280,000. As a consequence of extensive farming and open grazing, the land and vegetation were heavily degraded, making the problems of water runoff and soil erosion extremely severe. In response, in 1998 Wuqi began retiring croplands on steep slopes and converting them to forest and grass coverage. Taking advantage of the national initiative, Wuqi's land set-aside and conversion expanded tremendously in 1999. Croplands were cut back to 10,000 ha, and open grazing was banned in favor of raising goats in pen as well as vegetation recovery (Wuqi SLCP Office,

2007). To make the ecological and economic transformation, the county government has invested heavily in such activities as improving the quality of the remaining farmland, introducing new breeds of crops and animals, and promoting best land-use practices to supplement the SLCP. Now, over 97,000 ha of converted cropland has passed the national survival, growth, and stocking inspections (Wuqi SLCP Office, 2007). Because of its decisive action and tremendous change, Wuqi has attracted broad attention. Government leaders, program managers, and journalists across the country flock there to learn its experience and lessons, and scholars from research institutions travel there to conduct field experiments and surveys.

Lying in the transitional zone between the Loess Plateau and the Erdos Desert, Dingbian is located in the west part of Yulin. Of its population of 315,851, over 87% lives in rural areas (Dingbian Statistics Bureau, 2006). Huachi is located in the eastern part of Gansu, and 86% of its 130,175 population is rural residents (Huachi Statistics Bureau, 2006). Similar to Wuqi, extensive farming and open grazing existed in these two counties. Also similar to Wuqi, these counties are endowed with rich petroleum and gas resources. However, they have not been allowed to develop these resources locally as Wuqi has. Instead, the national company, Petro China, holds the exclusive right of exploration. While figures show that the GDP of Dingbian and Huachi in 2005 was close to 3 billion yuan and 4.6 billion yuan, respectively, higher than that of Wuqi, much of that was contributed by the national oil company, which did not benefit the local treasury and employment much. So, the total budget for Dingbian and Huanchi counties was less than 60 million yuan each in 2005 (Dingbian Statistics Bureau, 2006; Huachi Statistics Bureau, 2006).

These two counties have participated in the SLCP as well. Their total amount of retired cropland is 10,966 ha for Huachi and 21,905 ha for Dingbian, suggesting a much smaller extent of program implementation given their total cropland holding of 57,265 and 83,333 ha in 1997, respectively. Also, extensive farming and open grazing in these two counties are still the norm, rather than the exception. Furthermore, their local investment in the land retirement has been negligible, and incidences of delayed subsidy delivery and even deduction of farmers' subsidies have occurred (Dingbian SLCP Office, 2007; Huachi SLCP Office, 2007). Some township officials have even attempted to use the subsidies to offset households' tax and other financial obligations.

In sum, marked differences exist between Wuqi and the other two counties. Compared to Wuqi, Dingbian and Huachi lacked the political leadership, local investment, and extensive participation. We expect that these variations will be reflected in program impacts. To capture the difference in political leadership, the dummy variable we use is 1 for Wuqi and 0 for the other two.

In August 2007, our research team conducted a survey of 200 randomly chosen households in each of the three counties, and our questionnaire included basic household characteristics, production, consumption, income, and farmland retirement and conversion. The basic characteristics of surveyed households are listed in Table 10.1. It can be seen that there is little difference in number of labor, years of average education, and age of household head between participating and nonparticipating households. Noticeable differences exist in family size, cultivated land,

**Table 10.1** The Basic Features of the Surveyed Households in the Three Counties

| | Non-participating Households (131) | Participating households (469) | F-test of variance | T-test family differences |
|---|---|---|---|---|
| Family size | 4.95 (1.25) | 4.63 1.51 | 1.46* | 1.63* (0.104) |
| Number of laborers | 2.56 (1.18) | 2.45 (1.17) | 1.01 | 0.66 (0.51) |
| Years of education per person | 4.20 (3.67) | 4.39 (4.32) | 1.24 | 0.34 (0.73) |
| Age of household head | 50.53 (10.73) | 48.77 (10.99) | 1.05 | 1.15 (0.25) |
| Years of education for household head | 5.20 4.26 | 5.89 3.62 | 1.39* | 1.23 (0.21) |
| Cultivated land | 9.93 (5.29) | 11.42 (7.26) | 1.88** | 1.66* (0.09) |

Notes:

1. Of the 108 nonparticipating households, 2 in Wuqi, 62 in Dingbian, and 44 in Huachi; of the 492 participating households, 198 in Wuqi, 138 in Dingbian, and 156 in Huachi.

2. Columns 2 and 3 are the mean values for non-participating and participating households, figures in parenthesis are standard deviations; column 3 is the $F$ test of variance uniformity of the two groups; column 4 is the $t$ test of family characteristics.

∗, and ∗∗ represent significance at the level of 10, 5, and 1%, respectively.

and years of schooling for household head, calling for their inclusion in our formal analysis.

Table 10.2 compares per capita incomes of the two household groups in Wuqi between 1999 and 2006. Except for the animal husbandry income of the participating households, all incomes increased during that period of time. The crop production income of non-participating households rose from 5,591 yuan in 1999 to 5,788 yuan in 2006, while that of participating households rose from 3,733 yuan in 1999 to 4,653 yuan in 2006. The animal husbandry income of non-participating households grew from 1,162 to 1948 yuan, but that of participating households declined from 3,575 yuan in 1999 to 1,409 yuan in 2006. The off-farm income of non-participating households rose from 2,475 to 2,917 yuan, whereas that of participating households increased from 10,404 yuan in 1999 to 13,785 yuan in 2006.

In 1999, the crop production income of non-participating households was 1,859 yuan, which was significantly higher than that of participating households. In 2006, however, this gap shrank to 1,136 yuan and became insignificant. Even though the cultivated land of participating households was greatly reduced, their improved productive efficiency could have reduced the gap of crop production income, compared to non-participating households (Chapter 13). Before the land set-aside, the two groups had significant differences in their incomes from animal husbandry, off-farm employment, and other sources as well as total income.

**Table 10.2**  Per Capita Income of Surveyed Households in Wuqi in 1999 and 2006

| | Non-participating households | | Participating households | | Between group income difference | |
|---|---|---|---|---|---|---|
| | 1999 | 2006 | 1999 | 2006 | 1999 | 2006 |
| Crop production income | 5,591 (7,303) | 5,788 (12,417) | 3,733 (3,907) | 4,653 (8,860) | 1,859 (2.3)* | 1,136 (0.7) |
| Animal husbandry income | 1,162 (1,734) | 1,948 (3,163) | 3,575 (11,951) | 1,409 (1,540) | −2,413 (−2.0*) | 539 (1.5) |
| Off-farming income | 2,475 (5,711) | 2,916 (7,733) | 10,404 (13,867) | 13,785 (24,502) | −7,930 (−5.3**) | −10,869 (−4.3**) |
| Other income | 0 (0.0) | 5,411 (3,494) | 61 (603) | 6,778 (8,244) | −61 (1.0) | −1,367 (−1.5) |
| Total income | 9,228 (5,835) | 16,064 (7,158) | 17,773 (12,697) | 26,625 (20,664) | −8,544 (−5.3**) | −10,561 (−3.4**) |

Notes:

1. Crop production income is income from producing corn, potatoes, and other minor crops; animal husbandry income is income from raising livestock, predominantly goats; off-farm income is income from off-farm employment, mainly construction and service work in local towns as well as large cities; other income is income from other sources, such as family properties and government subsidies; and total income is the gross income from all sources. Note that because these statistics are rounded mean values, they may not add up to the total exactly.

2. Columns 2–5 are the mean values for the two groups, standard deviations are in parentheses; columns 6–7 are the between-group differences, the $t$ statistic is in parentheses.

∗, and ∗∗ represent significance levels of 10, 5, and 1%, respectively.

But the animal husbandry income gap narrowed and was no longer significant in 2006 due to banning open grazing, which adversely affected both groups. The difference of income from other sources between the two groups was never significant.

Table 10.3 compares incomes of the two household groups in Huachi and Dingbian between 1999 and 2006. All households witnessed an increase in their crop production income, off-farm income, income from other sources, and total income. The animal husbandry income of non-participating households dropped from 2,371 to 1,591 yuan, whereas that of participating households declined slightly. The crop production income of non-participating households increased from 2,176 yuan in 1999 to 4,511 yuan in 2006, and that of participating households also increased from 2,475 to 4,614 yuan. The off-farm income of non-participating households dropped from 6,409 to 5,568 yuan, while that of participating households rose from 6,642 yuan in 1999 to 9,912 yuan in 2006. In 1999, the crop production income of participating households was 299 yuan higher than that of non-participating households. In 2006, this gap narrowed to 104 yuan. The insignificant differences in crop production income, off-farm income, and total income between the two groups in Huachi and Dingbian indicate that their smaller share of land retirement did not make a large difference.

**Table 10.3** Per Capita Income of Surveyed Households in Huachi and Dingbian in 1999 and 2006

|  | Non-participating households | | Participating households | | T-test of between-group difference | |
|---|---|---|---|---|---|---|
|  | 1999 | 2006 | 1999 | 2006 | 1999 | 2006 |
| Crop production income | 2,176 | 4,511 | 2,475 | 4,615 | –299 | –104 |
|  | (3,282) | (4,193) | (2,708) | (4,363) | (–0.9) | (–0.6) |
| Animal husbandry income | 2,371 | 1,591 | 1,358 | 1,265 | 1,012 | 326 |
|  | (8,136) | (1,830) | (1,514) | (1,186) | (1.5) | (1.5) |
| Off-farm income | 6,409 | 5,568 | 6,642 | 9,912 | –234 | –4,344 |
|  | (9,802) | (19,489) | (13,823) | (24,765) | (–0.1) | (–1.4) |
| Other income | 1,459 | 1,708 | 487 | 535 | 972 | 1,172 |
|  | (1,355) | (5,275) | (1,020) | (1,247) | (5.8**) | (1.9*) |
| Total income | 12,414 | 13,379 | 11,962 | 16,327 | 1,452 | –2,948 |
|  | (12,661) | (1,906) | (9,703) | (12,802) | (–0.4) | (–1.9) |

Notes:

1. Crop production income is income from producing corn, potatoes, and other minor crops; animal husbandry income is income from raising livestock, predominantly goats; off-farm income is income from off-farm employment, mainly construction and service work in local towns as well as large cities; other income is income from other sources, such as family properties and government subsidies; and total income is the gross income from all sources. Note that because these statistics are rounded mean values, they may not add up to the total exactly.

2. Columns 2–5 are the mean values for the two groups, standard deviations are in parentheses; columns 6–7 are the between-group differences, the $t$ statistic is in parentheses.

∗, and ∗∗ represent significance levels of 10, 5, and 1%, respectively.

## 10.4 Estimated Results

Table 10.4 lists the estimated results. The goodness of fitting ranges from 0.58 to 0.25 in four of the six cases, which is encouraging for first-order differenced models. Even in the two cases (income from other sources and total income) where the $R^2$ is very low, it is not unusual for this type of policy, or more broadly treatment, effect assessment model (Woodridge, 2002; Lee, 2005). First, all the variables have a positive effect in the crop production income regression. Compared to that of non-participating households, the crop production income of households participating in the SLCP increases by 131.1 yuan, which is not a large figure in magnitude but significant at the 99% level. A better developed local economy, a larger program extent, and a stronger political leadership, respectively, result in an increase of the household's crop production income by 619.3, 170.2, and 251.3 yuan at the 99% significance level. Together, these add up to a sizable amount (1,240 yuan), and they have partially confirmed what we hypothesized – variations in local programmatic, economical, and political conditions all impact the crop production income. Education level of the household head also has a significant influence on crop production income, with one more year of schooling leading to an increase of 83.6 yuan. Other variables like number of household laborers, per capita cultivated area,

**Table 10.4**  Regression Results of Income and Off-Farm Employment, 1999–2006

| | Crop production income | Animal husbandry income | Off-farm income | Other income | Off-farm employment | Total income |
|---|---|---|---|---|---|---|
| Status of | 131.11 | –2,445.52 | 3,170.06 | 382.16 | 0.09 | 5,397.04 |
| participation | 6.23 | –2.67 | 1.54 | 0.14 | 3.05 | 3.87 |
| Economic | 619.27 | 202.64 | 187.94 | –269.32 | 0.25 | 286.52 |
| condition | 5.90 | 1.04 | 2.63 | –0.68 | 8.00 | 2.35 |
| Program extent | 170.25 | 73.69 | 62.95 | –145.46 | 0.12 | 175.97 |
| | 2.57 | 0.63 | 2.63 | 0.05 | 2.15 | 1.97 |
| Political | 251.33 | 68.18 | 55.18 | –50.79 | 0.07 | 91.63 |
| leadership | 9.08 | 1.14 | 2.16 | –0.05 | 11.48 | 2.39 |
| Education of | 83.55 | 191.92 | 522.17 | 138.29 | 0.02 | 1,059.97 |
| household head | 67.11 | 1.26 | 1.61 | 1.22 | 1.35 | 2.83 |
| Family size | 8.37 | 507.66 | 191.12 | 1,309.85 | 0.14 | 1,867.99 |
| | 2.11 | 1.05 | 0.19 | 3.63 | 3.60 | 2.02 |
| Number of | 190.59 | 258.93 | –1,792.95 | –498.13 | 0.07 | 1,376.97 |
| laborers | 2.07 | 1.62 | –1.17 | –0.59 | 1.76 | 3.13 |
| Non-agricultural | 187.41 | –606.91 | 9,191.11 | 126.79 | – | 11,046.10 |
| employment | 21.71 | –1.25 | 5.09 | 0.20 | – | 3.44 |
| Per capita | 984.56 | –159.15 | –328.14 | 252.31 | –0.02 | 231.62 |
| cultivated land | 2.59 | –0.34 | –0.33 | 0.69 | –4.19 | 0.13 |
| Intercept | –543.62 | 1,726.65 | 7,536.26 | –596.58 | 0.49 | 3,052.57 |
| | –0.18 | 0.99 | 0.94 | –0.23 | 1.54 | 0.21 |
| $R^2$ | 0.58 | 0.40 | 0.25 | 0.20 | 0.48 | 0.15 |

Note: Corresponding to each variable, the figure in first row is the estimated coefficient, and the figure in the second row is the *t* statistic value.

and non-agricultural employment lead to a significant increase of crop production income as well.[2]

Second, the regression of animal husbandry income reveals that participation status is negatively associated with income at the 95% significance level. The animal husbandry income of participating households is depressed by 2,445.5 yuan, in comparison to that of non-participating households. Here, program extent, economic development, and political leadership do not matter much. Variables like schooling years of household head, family size, and number of household laborers have a positive but statistically insignificant effect. Likewise, per capita cultivated area and local non-agricultural employment have a negative but statistically insignificant effect.

Third, the off-farm income is positively related to participation status and years of schooling for household head at the 90% significance level. Participation allows farmer household's off-farm income to increase by 3,170.1 yuan, and one more year of schooling for household head leads to an increase of 522.2 yuan. Local economic

---

[2] Off-farm employment includes employment in local non-agricultural activities and off-village employment as migratory workers.

development, program extent, and political leadership cause the household off-farm income to increase by, 187.9, 62.9, and 55.2 yuan, respectively. These effects are all highly significant. Additionally, non-agricultural employment has a positive effect at the 99% significance level; one more person in the non-agricultural sector results in the household's off-farm income to increase by 9,191.1 yuan. In contrast, family size, number of household laborers, and per capita cultivated area do not have strong correlations with the off-farm income. As to income from other sources, the regression has only one significant variable – family size, suggesting that the larger the family, the higher the income. All of the other variables, including the policy ones, have little effect.

Fourth, the regression of off-farm employment shows that participation has a positive effect on off-farm employment at the 95% significance level. Other things being equal, participation causes 0.09 unit of labor to shift out. Although there is a positive relation with years of schooling for household head, this relation was statistically insignificant. While family size and number of household laborers have positive effects on off-farm employment, per capita cultivated area has a negative effect on the off-farm employment. These results illustrate that: (1) the more surplus labor a family has, the more off-farm income it generates; and (2) the larger the per-person cultivated area, the less likely for the household to engage in intensive farming, making it harder to shift labor out. Local economic development has a positive relation with the off-farm employment; a coefficient of 0.25 indicates that the condition is a key factor of labor transfer. Program extent has an effect of 0.12, and political leadership has an effect of 0.07. Together, these variables cause 0.45 unit of labor to shift out of farming, which is more than four times the coefficient of participation status alone. This has further proven the hypothesis we proposed – the realized transfer of surplus farming labor depends on both the internal and external conditions, coupled with the program participation.

Fifth, the total income has a positive correlation with years of schooling for household head, family size, number of laborers, and non-agricultural employment. The contributions of these variables are 1,056 yuan from one more year of household head education, 1,870 yuan from one more person in the household, 1,377 yuan from one more family laborer, and, more substantially, 11,046 yuan from one more non-agricultural job. Participation in the land conversion program results in an increase of total income by 5,397 yuan. In addition, local economic development, program extent, and political leadership are positively correlated with the total income. Their coefficients are 287, 176, and 91.6 yuan, respectively. Again, these findings validate our basic hypothesis – the impacts of the SLCP on farmers' income are determined by local conditions, in conjunction with participation status.

## 10.5  Conclusions and Discussion

We set out to test the hypothesis that the impacts of implementing the SLCP are determined by the local economic conditions, program extent, and political leadership, in conjunction with participation status. We also speculated that the income

effects may vary across sectors. To that end, we have estimated a difference in differences model with data collected from 600 households in three counties of the Loess Plateau region, covering both time before and after the program initiation (1999 and 2006) and both participating and non-participating categories. Our empirical results have confirmed our hypotheses nicely.

It is found that participation in the SLCP has affected incomes from different sectors in different ways. While it has a significant positive impact on crop production income, the magnitude of this effect is small. In comparison, better local economic condition, larger program extent, and stronger political leadership have much greater impacts. These results suggest that cropland retirement does not necessarily cause a reduction of cropping income if the production mode can be sufficiently transformed by adopting more improved inputs and management practices. However, participation has a substantial negative effect on income from animal husbandry, which is almost ten times the combined positive impacts of local economic condition, program extent, and political leadership. Clearly, animal husbandry was hit hard by the grazing and feeding constraints in carrying out the SLCP, even with local efforts in maintaining its vitality.

On the other hand, participation has a very large positive effect on both off-farm income and total income. In combination, these results indicate that although animal husbandry is negative affected, the program's impacts on other sectors are positive and thus more than offset the negative effects in aggregation. The results of the off-farm employment and income regressions highlight that participating in the program has accelerated the transfer of farming labor and greatly stimulated the income growth from off-farm opportunities. Moreover, these positive effects are reinforced by better economic development, larger program extent, and stronger political leadership. These findings are new to the literature, and they have provided further supportive evidence to our claim that the socioeconomic impacts of the program are indeed predicated on the local program extent and conditions, coupled with participation status. Also, they indicate that it is essential to incorporate the relevant variables into any reliable assessment of the SLCP impacts.

The government should take these elements into account in its program planning and execution. For one thing, in case it delivers great ecological benefits, the program should concentrate more on the selected sites where the local agencies are committed to an effective and transparent implementation and the local economies are conducive to intensifying cropping on reduced land, absorbing displaced surplus labor, and/or sustaining animal husbandry. But it should be made clear that the evolving local economy can alter the comparative advantages of various production and income opportunities. As such, tradeoffs between them must be weighted properly. This means that the government should identify where and by how much the production and income will contract or expand and design measures to deal with the associated winners and losers. It also implies that it may not a simple matter for the program to fulfill its dual objectives of poverty alleviation and ecological restoration.

While the findings of the negative effects of participation on animal husbandry income and the positive effect on off-farm employment and total income conform

what was previously reported (Guo et al., 2005; Dong et al., 2005), the finding of a positive effect on cropping income is also new. The latter result implies that cropland reduction will not inevitably cause a crop yield and thus income decline. We conjecture that the significance of these effects has to do with the features of our sample, including selection of representative study site, coverage of a long time span, and division of total income into specific categories. It seems that in these aspects lies the distinction between our results and those of Xu et al. (2004) and Yi et al. (2006).

In addition, as an indication of family human capital accumulation, the number of schooling years of household head contributes to cropping income as well as total income. This validates the importance of education to family livelihoods (Hayami, 2003). Meanwhile, number of laborers and family size boost income from crop production, off-farm employment, and thus total income. Further, family size helps increase income from other sources, and number of laborers benefits income growth from animal husbandry. Also reasonable is the evidence that per capita cultivated land favors income from cropping and leads to less off-farm employment, which implies that while cropland retirement reduces crop production and income, it accelerates labor shift out of farming as well. Moreover, it is encouraging to observe that more favorable local conditions can work to more than offset the negative effect of land retirement on income from crop production.

Finally, it is worth noting that because the data used in this study cover only three counties in the Loess Plateau region, our findings may not apply elsewhere. To reach broader conclusions, more data should be collected from other regions. Also, follow-up analyses should be pursued to examine what will happen to the sample site of this study in the longer term.

# References

Dingbian SLCP Office. (2007). *A summary report of Dingbian's implementation of the Sloping Land Conversion Program*.

Dingbian Statistics Bureau. (2006). *2005 Dingbian statistics yearbook*.

Dong, M., Zhong, B. N., & Wang, G. J. (2005). An empirical analysis of the effect of China's farmland conversion program on food security in Ningxia Hui autonomous region. *China's Population, Resources, and Environme*nt, *1*, 104–108.

Guo, X. M., Gan, T. Y., Li, S., & Luo, H. (2005). An investigation of the Sloping Land Conversion Program implementation in Tianquan, Sichuan. *China Rural Observation, 3*, 73–79.

Guo, Z. Q., & Yao, S. B. (2007). A study of the sustainability of China's Sloping Land Conversion Program in Wuqi. *Forest Economics, 5*, 21–25.

Hayami, Y. (2003). *Development economics*. Beijing: Chinese Social Science Press.

Huachi SLCP Office. (2007). *A summary report of Huachi's implementation of the Sloping Land Conversion Program*.

Huachi Statistics Bureau. (2006). *2005 Huachi statistics yearbook.*

Lee, M. J. (2005). *Micro-econometrics for policy, program, and treatment effects.* Oxford, UK: Oxford University Press.

Li, R. N. (2004). The influence of China's land retirement efforts on rural economy in Luoyang, Henan. *Agriculture Modernization Research, 5,* 363–366.

State Forestry Administration. (2007). *2006 China forestry development report.* Beijing: China Forestry Press.

Wang, J. J. (2003). The economic and ecological foundations for converting farmland into forest and grass coverage. *Agricultural Economic Issues, 8,* 21–27.

Wooldridge, J. M. (2002). *Econometric analysis of cross section and panel data.* Cambridge, MA: The MIT Press.

World Bank. (2002). *Building institutions for markets.* Oxford: Oxford University Press.

Wuqi SLCP Office. (2007). *A summary report of Wuqi's implementation of the Sloping Land Conversion Program.*

Wuqi Statistics Bureau. (2006). *2005 Wuqi statistical yearbook.*

Xu, J. T., Tao, R., & Xu, Z. G. (2004). An empirical analysis of the cost effectiveness, structural adjustment, and long-term sustainability of the farmland conversion program in three western provinces. *Economic Research Quarterly, 4,* 139–162.

Xu, J. T., Yin, R. S., Li, Z., & Liu, C. (2006). China's ecological rehabilitation: Progress and challenges. *Ecological Economics*, 57(4), 595–607.

Yi, F. J., Xu, J. T., & Xu, Z. G. (2006). An analysis of the income and employment impacts of the farmland conversion program. *China Rural Economy, 10,* 28–36.

Yin, R. S., Yin, G. P., & Li, L. Y. (2009). Assessing China's ecological restoration programs: What's been done and what remains to be done? *Environmental Management* (submitted).

Zhi, L. (2004). Research on the multiple goal characteristics of our country's relief by grain from the backgrounds of Chinese and foreign returning farmland to forests. *Forest Economy*, 7, 29–32.