China's Sloping Land Conversion Program: Does Expansion Equal Success?

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ABSTRACT. *This paper uses a 2003 household survey to examine implementation and impacts of China's Sloping Land Conversion Program. We find that land targeting has been strongly influenced by program goals, but that mistargeting also occurred. Using a treatment effects approach to evaluate program impact, we find evidence of positive impact on cropping, husbandry, and total income, though the results are not robust enough to support government claims of huge gains. We also find evidence that lack of participant choice could be dampening program impacts, and that allowing households autonomy could lead to improvement in program cost-effectiveness and outcomes.* (JEL Q28, Q57)

I. INTRODUCTION

In 1999, China initiated the most ambitious land conversion/afforestation program in the developing world. With a total budget of CNY 337 billion (around $48 billion), the Sloping Land Conversion Program (SLCP) plans to convert 14.67 million ha of fragile cropland to forests (4.4 million of which will be land with slopes of 25 degrees or greater) and has an additional "soft" target of afforesting an equal area of wasteland (State Forestry Administration 2003). To date, the program has already retired and afforested more than 9 million ha of cropland (*Economic Daily* 2007). As such, pending successful completion, the program could have significant implications for China's forests and remaining natural ecosystems, representing a 10% to 20% increase in current national forest area, and roughly a 10% decrease in China's cultivated area (Hyde, Belcher, and Xu 2003; *ZGTJNJ* 2001).[1]

The SLCP has expanded very fast since its initiation in 1999. By the end of 2003, fully 7.2 million ha of cropland had been enrolled, and the program encompassed more than 2,000 counties in 25 provinces across China. In 2004, the central government continued to push expansion and claimed that it is a key policy for restoring China's degraded ecosystems (e.g., *China Green Times* 2003, 2004, 2005). However, fast expansion does not necessarily imply success. There is still lack of empirical evidence to evaluate whether the earlier phase of the SLCP was successful enough to justify fast program expansion in recent years. This paper aims to fill this gap on the basis of a household and village-level survey

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[1] This is comparable to the other large land set-aside program in the world, the U.S. Conservation Reserve Program, which in 2000 had enrolled some 13.56 million ha, or nearly 10% of cropland in the United States (Heimlich 2003).

collected in three western provinces targeted by the program.

II. BACKGROUND

Stricken by a historic 267-day Yellow River dry-out in 1997, and the 1998 Yangtze River floods that caused significant economic damage and loss of life, the Chinese government claimed that it is necessary to take immediate action to alleviate water and soil erosion. In the aftermath of the floods, experts generally agreed that high rates of deforestation and the consequent increase in rates of soil erosion in the upper reaches of the Yangtze River Basin exacerbated, if not precipitated, the disaster (World Bank 2001a; World Wildlife Fund 2003). In general, soil erosion is one of China's most pressing environmental problems (Huang 2000). An estimated 2 billion tons of silt is released into the Yangtze and the Yellow rivers annually, with 65% of this coming from sloping cropland. Data suggest that west China, with 70% of the approximately 6.07 million ha of agricultural land with slopes greater than 25 degrees, contributes the majority of this (Xu, Katsigris, and White 2001). The central government thus initiated the SLCP in 1999 with particular emphasis on west China.

The SLCP is an important departure from China's other water and soil conservation and forestry programs. It is one of the first, and certainly the most ambitious, "payment for environmental services" programs in China. Most other large national forestry programs, such as the Natural Forest Protection Program (initiated in 1998) and the Northeast, North, and Northwest China Green Belt Program (initiated in the late 1970s) are directly implemented by either state-owned forest enterprises or by local forest authorities. In contrast, the SLCP uses a public payment scheme that directly engages millions of rural households as core agents of project implementation. As such, central to the program's long-term success is its incentive compatibility for participating farmers.

The program stipulates that farmers who convert degraded and highly sloping cropland back to either "ecological forest" (defined as timber-producing forests), "economic forest" (orchards, or plantations of trees with medicinal value), or grassland will be compensated with (1) an annual in-kind subsidy of grain, (2) a cash subsidy, and (3) free seedlings, provided to the farmer at the beginning of the planting period. To account for differences in regional average yields, the annual grain subsidy has been set at 2,250 kg/ha in the Yangtze River Basin, and 1,500 kg/ha in the Yellow River Basin. The cash subsidy is CNY 300/ha of eligible land ($43/ha) per year. Both grain and cash subsidies are for eight years if ecological forests are planted and for five years or two years if economic forests or grasses are planted, respectively (State Forestry Administration 2003).

Finally, SLCP is most notable for its sheer size. Under the program, the State Forestry Administration plans to convert around 14.67 million ha of fragile cropland to forest by 2010 (4.4 million of which is estimated to be on land with slopes of 25 degrees or more) and also has a "soft" target of afforesting an equal area of wasteland (State Forestry Administration 2003; World Wildlife Fund 2003). The central government poured CNY7.68 billion ($1.1 billion) in grain and cash subsidies into the program during the three-year pilot period alone, and by the end of 2003 total accumulated government expenditures approached CNY50 billion (over $7 billion), around 68% of which has been for grain subsidies (authors' calculations from State Forestry Administration 2003). Fifteen million farmers have entered the program in just the first five years, and leaders have estimated that upon completion it will affect 40 to 60 million rural households (Uchida, Xu, and Rozelle 2005). If the program is to be completed as the State Forestry Administration has planned, total program expenditures will reach CNY 337 billion (around $48 billion). In comparison, 13.56 million ha of cropland was enrolled in the U.S. Conservation Reserve Program in 2000, with estimated outlays in 2001 of $1.7 billion (Heimlich 2003).

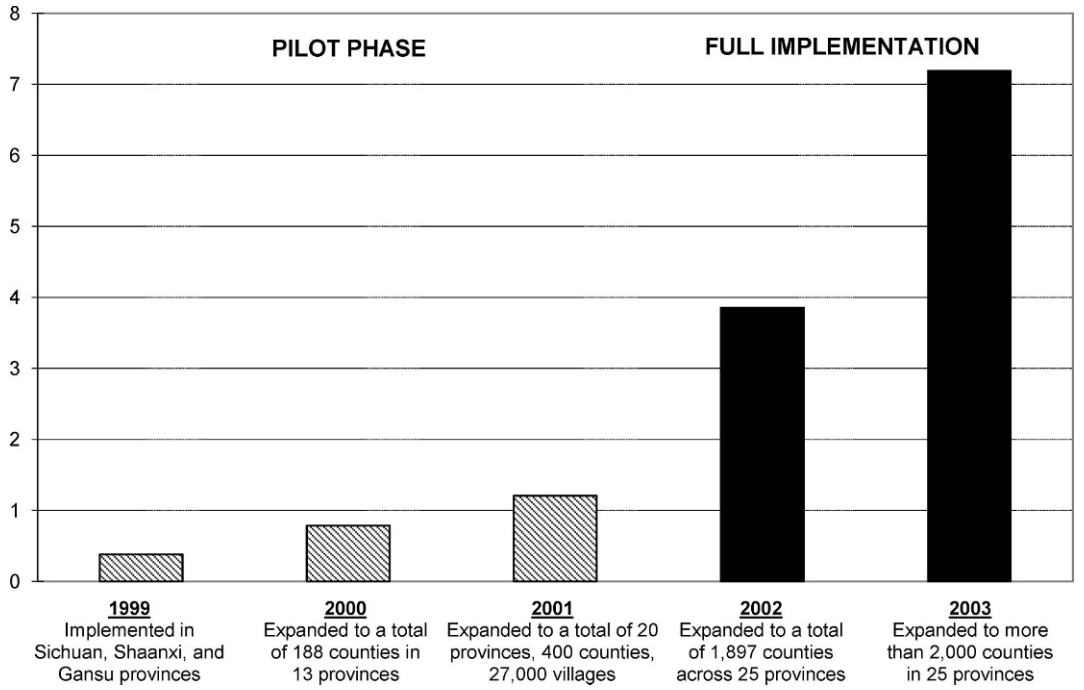

FIGURE 1
Sloping Land Conversion Program Total Converted Area, 1999–2003
(Million Hectares)
Source: Data from Xu et al. 2004; Uchida, Xu, and Rozelle 2005; Internal Chinese Government Reports.

III. PROGRAM EXPANSION

The SLCP has expanded very fast since its initiation in 1999. As detailed in Figure 1, during the pilot phase (1999–2001) an average of 402,000 ha of cropland was enrolled into SLCP annually. According to internal government reports, upon full implementation the rate of enrollment increased more than sixfold, averaging almost 3 million ha of cropland converted per year during 2002–2003. By the end of the pilot phase, 1.2 million ha of cropland and 0.47 million ha of barren land had been converted, and SLCP was being implemented in 400 counties across 20 provinces (Xu, Katsigris, and White 2001; Uchida, Xu, and Rozelle 2005). Just two years after this, at the end of 2003, fully 7.2 million ha of cropland had been enrolled and 4.92 million ha of barren land afforested, and the program encompassed more than 2,000 counties in 25 provinces.

Though the sheer scale and budget of the SLCP are encouraging signals of the Chinese government's growing commitment toward the environment, they do not guarantee success. In fact, a growing body of evidence suggests that there are problems in program design and implementation that might risk the SLCP's long-term goals (Xu and Cao 2001; Zuo 2001). A key worry is that the program places undue burden and cost on local governments, which in turn could be causing problems in program administration observed during the pilot phase, such as low survival rates of planted trees, insufficient delivery of compensation to farmers, lack of respect for the principals of volunteerism, and difficulties in targeting and monitoring (Zuo 2001; Xu and Cao 2001). It has only been since 2002, in fact,

that the central government has allocated administrative fees to provincial governments for SLCP implementation, and these still appear to be insufficient. Fast expansion has thus created heavy administrative needs that have potentially exacerbated shortfalls in required funds, thus leading to problems in implementation and subsidy delivery.[2]

An important backdrop to the SLCP's fast expansion is China's unsuccessful grain policy, which during the second half of 1990s involved large-scaled grain procurements at above-market prices and a subsequent failed attempt at recentralizing grain markets. By 1999, the State Grain Bureau was burdened by severe financial stress and stocks of aging and unsold grain estimated to be larger than China's annual production (Lu 1999; Zhong 2001).[3] From the perspective of the central government, the ever-increasing deficit called for action to reduce grain stocks. The SLCP was then considered by the center as a way out, since it could not only reduce grain output but also help to consume the State Grain Bureau's existing grain stocks. Therefore, behind the SLCP's high grain subsidy standard and fast expansion has been the additional goal of aiding the state grain storage system. In fact, program grain has been purchased from state stocks at CNY 0.4/kg above market prices, which by the end of 2003 has resulted in a 24.55 million ton drawdown of stocks and an implicit CNY 9.8 billion subsidy to the State Grain Bureau (according to authors' calculations based on State Forestry Administration 2003).

[2] For example, in a township in a key project county in Shaanxi Province, half of the participating plots were not inspected and compensated on time. In another township of the same county, many participating plots had yet to be inspected even three years after they had entered the SLCP; though the county government recruited 30 additional staff to deal with these problems, manpower has still been far short of that required to inspect some 67,000 ha of converted land.

[3] Between 1996 and 1998, the financial loss of state grain enterprises grew by an astonishing CNY 100 billion and became the nonperforming loans of the State Agricultural Development Bank, which dispatched loans to the State Grain Bureau for grain procurement (Lu 1998).

Another backdrop to the SLCP's fast expansion is the financial incentives faced by local governments, which in many regions of China viewed the program as an opportunity to bring in much-needed government funding, and thus made every effort to push for larger land conversion quotas. Given that state subsidies had to go through the hands of local implementing agencies, local governments usually first overreached their land conversion quotas and then bargained for more subsidies. As shown later in this paper, diversion of funds in the SLCP has been no less frequent than in many other centrally funded programs as indicated in the literature on poverty reduction (World Bank 2001b; Park, Wang, and Wu 2002).

Since an important justification behind fast expansion has been claims made about the success of the pilot phase, the remainder of this paper analyzes, on the basis of a 2003 survey, the degree to which substantive evidence exists to justify the fast program expansion after the pilot phase.

IV. LACK OF VOLUNTEERISM, SHORTFALLS IN SUBSIDIES

Our data come from a household and village-level survey completed in 2003 by the Center for Chinese Agricultural Policy (CCAP), Chinese Academy of Sciences. The survey was conducted in the three provinces where the SLCP was first implemented, located at the upper reaches of the Yellow River Basin and the Yangtze River Basin: Shaanxi, Gansu, and Sichuan. Two counties per province, three townships per county, two participating villages per township, and 10 households per village were randomly selected, for a total of 36 village surveys and 360 household surveys. The surveys provide a comprehensive and comparatively long window into program implementation, since both the household and village surveys collected detailed information for 1999 and 2002 regarding both general characteristics and SLCP implementation.

TABLE 1
FARMER AUTONOMY IN SLOPING LAND CONVERSION PROGRAM PARTICIPATION (N = 345)

Measure of Autonomy	% That Said "Yes"			
	Participants, All (n = 264)	Shaanxi (n = 103)	Gansu (n = 85)	Sichuan (n = 76)
Were the villagers asked their opinion about the project and how it could be best designed prior to the time that the project was implemented?	42.8	41.7	41.2	46.1
When your village began the SLCP, did your household have autonomy to choose whether to participate?	61.7	72.8	43.5	67.1
Did you have autonomy in choosing the types of trees to plant?	36.0	47.6	34.1	22.4
Did you have autonomy in choosing which areas to retire?	34.5	53.4	15.3	30.3
Did you have autonomy in choosing which plots to retire?	29.9	40.8	12.9	34.2
	Nonparticipants, All (n = 81)	Shaanxi (n = 11)	Gansu (n = 34)	Sichuan (n = 36)
Could you participate in the SLCP if you wanted to?	25.9	45.5	29.4	16.7

Source: Adapted from Table 5 in Xu et al. 2004, with a different subsample.

One discovery from the survey is the predominantly topdown approach toward implementation that has been taken in the sample villages. Although the State Forestry Administration's plan emphasizes that farmers should have autonomy of choice in the participation decision, a significant portion of households reported that they had little or no choice about whether to participate. Based on the State Forestry Administration's plan, most if not all of the farmers in our sample should be eligible to participate, since while emphasizing that highly sloped plots should be targeted first, the plan also allows some leeway in targeting lower-sloped marginal land that has an impact on the local watershed (State Forestry Administration 2003). However, as detailed in Table 1, only around 53% of surveyed households felt that they could choose to participate (61.7% of the participants and only 25.9% of nonparticipants).[4] This ranges from 65.8% of households in Shaanxi, to 45.5% in Sichuan, to only 31% in Gansu Province. From our fieldwork, we believe that these responses can be taken at face value since households were aware of the details of the program and cognizant of their choices. For example, respondents reported lower levels of choice for aspects of program implementation requiring technical expertise, and therefore more likely the purview of program officials; only 36% of participant households said they could choose what kinds of trees to plant on their enrolled land, and only 34.5% and 29.9% of participant households felt that they could choose which areas and which plots, respectively, to retire.

Survey results also give evidence that lack of autonomy is, in part, the result of systematic differences in local implementation. Village share of households reporting that they have autonomy of choice, compared between villages in the same township, has a correlation coefficient of 0.7, significant at 1%. Results from binomial logit analysis of household autonomy status also support this. Two models using, alternately, township and county fixed effects, and conditioning on 1999 household and village characteristics, both find that household characteristics are statistically insignificant. At the same time, the marginal effects for 8 out of the 17 township indicators and 3 out of 5 county indicators

[4] These numbers do not change significantly when controlling for eligibility in terms of having sloping land; 88% of the sample has land with slope greater than 15 degrees, and 76.5% has land with slope greater than 25 degrees. Furthermore, of those households in the sample that had no sloped land (comprising 12% of the sample), 63% were found to be participating in the program.

are significant at 5% or better.[5] These indicators, furthermore, have large marginal effects: the average absolute value of impact on probability is 48%. These results suggest that households in the sample have had unequal access to the program and, in some cases, have been forced to participate when they would otherwise have not.

Lack of household autonomy in participation choice runs counter to the program's explicitly stated principal of volunteerism (State Forestry Administration 2003). As is well known in the literature (Pagiola, Landell-Mills, and Joshua Bishop 2002), use of market-based voluntary mechanisms of participation is key to the efficiency gains promised by payment for environmental services programs over traditional command-and-control approaches. In the case of the SLCP, since no bidding mechanism exists to optimally match payer benefits with participant costs, participation should, at minimum, be voluntary. This could improve cost-effectiveness by ensuring that households with the lowest opportunity costs participate, and would minimize the possibility that program participation is having negative welfare effects on some participants. The survey data, in fact, provide evidence that both of these outcomes have occurred.

Table 2 compares the 1999 (pre-SLCP) net income per hectare of retired plots, used as a rough measure of plot opportunity cost, with the real value of SLCP compensation standards (calculated as the cash standard plus the monetized grain subsidy standard). Though on average the participant rural households received a subsidy higher than their opportunity costs, at least in the case of Shaanxi and Sichuan, the SLCP standard was below pre-SLCP net income of enrolled plots in a number of cases. Among the 103 participant households in Shannxi province, 7 households incurred net loss. In Gansu and Sichuan, 42 out of 85 and 23 out of 76 participant households were net losers. respectively.[6]

Some may argue that this does not necessarily indicate problematic implementation, since one year's observation of net income is an imperfect measure of plot opportunity cost, and poorer households might prefer a low guaranteed subsidy over a high but highly variable expected plot income. However, if we take into account the fact that 1999 was a year of bad harvest due to serious drought in the surveyed regions (and thus the 1999 cropping income is below the cropping income of an average year), this implies that using the 1999 cropping income as the opportunity cost for program participation is more likely to underestimate participant farmers' real opportunity costs. Therefore, government subsidies lower than the 1999 cropping income for a significant share of participant farmers is indeed a serious issue.

[5] Full regression results are omitted here due to space limitations and are available from the authors upon request. Basically, the number of years a village has been implementing the program was also statistically insignificant in all models, providing evidence that household responses are not reflecting lack of information about the program. Household characteristics included are household head age and years of education, household population, labor, per capita income, per capita land, nonagricultural share of income and labor, and whether the household head is a party member. Village characteristics are village population, average per capita income, average per capita agricultural land, share of village population engaged in nonfarm work, village leader and secretary age and years of education, number of years the village has implemented the SLCP, share of village land with slope greater than 15 degrees, whether the village leader or village secretary worked previously in a forestry department, and number of villagers working in county-level forestry departments. Village characteristics were significant only in the model with county indicators; these were household population (−), share of village population in off-farm work (+), and whether the village secretary worked before in a forestry department (−).

[6] Further calculations show that the subsidy standard is below the 1999 net income of retired plots for a number of nonautonomous households. This group makes up 26% of the Gansu Province sample, in fact. For these households, the 1999 net income from retired plots was, in total, CNY 8,503 larger than the SLCP subsidy standard, equaling on a household basis about 5% of the average total 1999 household net income. In Sichuan, 9% of sample participants are nonautonomous households that are net losers, totaling a loss of CNY 7,386, or roughly 15% of the average total 1999 household net income. This suggests that these households would not have willingly participated had they been given a choice.

TABLE 2

PARTICIPANT 1999 NET INCOME FROM ENROLLED LAND VERSUS SLOPING LAND CONVERSION PROGRAM (SLCP) COMPENSATION STANDARDS

	Net Losing Households			Net Gaining Households			All Participants		
	All	No Autonomy	Autonomy	All	No Autonomy	Autonomy	All	No Autonomy	Autonomy
Shaanxi (n = 103)									
Number of households	7	0	7	96	28	68	103	28	75
1999 average net income from enrolled land (RMB/ha)	4,833	—	4,833	181	173	186	507	173	673
Total converted land area (ha)	5.13	—	5.13	68.11	24.28	43.83	73.24	24.28	48.95
Average difference between SLCP standard and 1999 net income (RMB/ha)[a]	−3,033	—	−3,033	1,619	1,627	1,614	1,293	1,627	1,127
Share of subsidy beyond 1999 net income[b]	−1.68	—	−1.68	0.90	0.90	0.90	0.72	0.90	0.63
Gansu (n = 85)									
Number of households	42	22	20	43	26	17	85	48	37
1999 average net income from enrolled land (RMB/ha)	3,485	3,946	3,085	940	974	895	2,026	2,102	1,944
Total converted land area (ha)	8.52	3.96	4.56	11.44	6.48	4.96	19.97	10.44	9.53
Average difference between SLCP standard and 1999 net income (RMB/ha)[a]	−1,685	−2,146	−1,285	860	826	905	−226	−302	−144
Share of subsidy beyond 1999 net income[b]	−0.94	−1.19	−0.71	0.48	0.46	0.50	−0.13	−0.17	−0.08
Sichuan (n = 76)									
Number of households	23	7	16	53	18	35	76	25	51
1999 average net income from enrolled land (RMB/ha)	5,371	5,918	5,143	1,031	785	1,157	2,457	2,319	2,523
Total converted land area (ha)	7.47	2.19	5.28	15.26	5.14	10.12	22.73	7.34	15.40
Average difference between SLCP standard and 1999 net income (RMB/ha)[a]	−2,821	−3,368	−2,593	1,519	1,765	1,393	93	231	27
Share of subsidy beyond 1999 net income[b]	−1.11	−1.32	−1.02	0.60	0.69	0.55	0.04	0.09	0.01

Source: 2003 SLCP survey data.

[a] Subsidy grain was converted to cash based on the national market price of RMB 1/kg.

[b] This is the difference between the SLCP standard and 1999 net income, as a share of the SLCP standard. Thus, for example, 0.90 means that 90% of the subsidy standard compensates a household beyond 1999 net income.

Even more troubling are the findings, detailed in Table 3, that subsidies actually received by participants in the sample generally fell short of SLCP compensation standards. Nonautonomous households received on average only 46% of their owed subsidies in 2002, compared with the average 62% received by autonomous households, with this difference significant at 1%. In terms of the cash subsidy alone, nonautonomous households received on average only 21%, compared with 34% for autonomous households, with this difference significant at 5%. This suggests, at minimum, that significant problems in implementation exist. There were two main reasons for such shortfalls. The first is that local governments, in program implementation, have retained some subsidies to make up for expenditure shortfalls and tax arrears.[7] The second is that program expansion had been so fast that local government agencies responsible for program supervision have not had sufficient manpower to check whether the converted land satisfies government requirements (such as tree types and survival rates). Therefore, delivery of compensation was delayed in many regions.[8] Though it is worth examining whether these factors are related to the fact that nonautonomous households in the sample appear to be carrying the brunt of these shortfalls, analysis of this is beyond the scope of this paper. It is a fact, however, that many farmers have not received the full amount of subsidies owed them.

Overall, the State Forestry Administration and provincial and subprovincial forestry departments have been primarily responsible for targeting general areas of land for enrollment in the SLCP, as well as for setting and distributing enrollment quotas to local governments (Zuo 2001).[9] This topdown approach raises the question of whether participant welfare is being adequately considered when choosing land to enroll, and whether political/institutional factors unrelated to participant welfare or environmental or economic conditions could be influencing this choice. Shortfalls in subsidies actually received suggest that this could be a concern. Fundamentally, to evaluate implementation it is important to look both at the targeting of land for enrollment, and the program impact on participant income, since it is only by helping participants shift to other sufficiently lucrative and sustainable income-generating activities that program goals will be achievable in the long run. We examine this in the following sections.

V. LAND TARGETING

The survey finds evidence of mistargeting of plots for retirement in terms of the SLCP's stated target of highly sloping land. Low-sloping plots (with slope less than 15 degrees) were enrolled in the program in 26 of the sample villages, comprising on average 21% of total sample retired land. On average 71% of this land in each village (100% in 17 villages) could have been replaced with unenrolled highly sloping

[7] Our fieldwork found that this is related to recent rural tax reforms that deprived local governments of the power to levy various fees on farmers, and also according to the SLCP plan, local governments were no longer able to levy agricultural tax and fees on the retired land. Consequent high local government budget deficits combined with serious rural tax incompliance in many regions have created incentives for governments to expand their SLCP enrollment quotas so as to increase inflows of subsidies, a portion of which can be then retained for program costs and tax arrears.

[8] We observed in our survey in the three pilot provinces, and in visits to other provinces (e.g., Hunan and Hebei) that retention of SLCP subsidy funds by local governments is prevalent. In many regions, the cash subsidies never reached participating farmers. Again, this was related to the huge fiscal pressures local governments faced after the rural tax reform and the fact that no agricultural tax could be levied on retired land so that local governments in SLCP areas lost a significant share of their revenue and had to resort to retention of upper-level transfers such as the SLCP subsidy.

[9] In practice, bargaining between the central and the local governments on the land conversion quota has always been a part of the program. Given that subsidies are in most cases higher than forgone income of cultivation and need to go through the hands of local implementing agencies and local governments, such agencies usually overreached the land retirement quota set by the center to bargain for more subsidies.

TABLE 3

AVERAGE SHORTFALLS IN GRAIN AND CASH SUBSIDY IN SURVEYED AREAS, 2002

County and Township	Grain (kg/ha)[a]				Cash (RMB/ha)				Total Shortfall (RMB/ha)[b]		
		Actual Delivery				Actual Delivery					
	SLCP Standard	All	No Autonomy	Autonomy	SLCP Standard	All	No Autonomy	Autonomy	All	No Autonomy	Autonomy
Shaanxi (n = 103)											
Yanchuan	1,500				300						
Yanshuiguan		506	1,299	391		25	0	29	1,269	501	1,380
Majiahe		466	238	545		59	38	66	1,276	1,524	1,189
Yuju		94	23	193		8	13	0	1,698	1,763	1,607
Liquan	1,500				300						
Yanxia		1,074	863	1,122		112	0	137	614	937	542
Jianling		1,500	1,500	1,500		48	0	71	252	300	229
Chigen		1,471	1,500	1,468		78	96	76	251	204	257
Gansu (n = 85)											
Jingning	1,500				300						
Zhiping		574	517	638		104	114	94	1,122	1,169	1,068
Gangou		957	639	1,179		137	94	167	707	1,067	454
Lingzhi		1,170	1,100	1,217		201	198	203	429	502	380
Linxia	1,500				300						
Zhangzigou		499	602	0		86	83	100	1,215	1,114	1,700
Tiezhai		0	0	0		5	0	56	1,795	1,800	1,744
Hexi		588	270	1,131		36	14	74	1.176	1,516	595
Sichuan (n = 76)											
Chaotian	2,250				300						
Datan		1,849	2,250	1,408		87	117	54	614	183	1,088
Zhongzi		2,050	2,020	2,122		0	0	0	500	530	428
Shahe		2,177	2,128	2,250		39	50	24	334	372	276
Li	2,500				300						
Shangmeng		2,160	2,250	2,150		107	0	118	284	300	282
Puxi		2,250	2,250	2,250		231	300	225	69	0	75
Guergou		618	—	618		50	—	50	1,882	—	1,882
Average		856	705	1,343		70	49	111	1,021	1,177	1,602

Source: 2003 SLCP survey data.
Note: SLCP, Sloping Land Conversion Program.
[a] Sum of corn, wheat, white and paddy rice, and wheat flour subsidies. Both white rice and wheat flour were converted to unhusked weight equivalents at a factor of 1:1.4.
[b] This values grain at the national price of RMB 1/kg.

land (slope greater than 25 degrees) in the sample. This indicates that considerations other than plot slope have been important in the enrollment choice in these villages. Plot quality and opportunity cost for the household is likely an important factor and is not necessarily directly associated with slope.[10] In villages that enrolled low-sloping land, an average of 37.4% of it was described as "low quality" by the household, and 36.4% was affected by a disaster (mainly drought) in 1999. The program's other goal of poverty alleviation raises the possibility that enrollment targeting might also be influenced by household characteristics independent of plot traits. The transaction costs of program implementation and the political economy of the village, where considerations of equity likely come into play when deciding who gets program subsidies, could also play a part, as could upper-level pressure to enroll land, as well as rent-seeking behavior by local governments.

To examine these issues, we model enrollment of plot i in the SLCP by the end of 2002 as the outcome of a latent choice process,

$$\varphi_i = \mathbf{x}_i\alpha + \mathbf{z}_i^{\mathrm{H}}\beta^{\mathrm{H}} + \mathbf{z}_i^{\mathrm{V}}\beta^{\mathrm{V}} + \mathbf{d}_i\delta + \varepsilon_i, \quad [1]$$

which is a function of 1999 plot characteristics ($\mathbf{x}_i$), the 1999 characteristics of the household ($\mathbf{z}_i^{\mathrm{H}}$) and village ($\mathbf{z}_i^{\mathrm{V}}$) associated with the plot, as well as provincial and township indicators ($\mathbf{d}_i$) and other unobserved aspects of the choice (ε_i). Whether plot i is enrolled in the SLCP is thus the observed outcome of this process whereby

$$\text{plot } i \text{ is } \begin{cases} \text{enrolled in SLCP if} & \varphi_i \quad (.) < 0 \\ \text{not enrolled in SLCP if} & \varphi_i \quad (.) \geq 0 \end{cases}.$$

Assuming that the values of ε_i are an independent and identically distributed logistic, the probability that plot i is enrolled in the SLCP is

$$P(\text{plot } i \text{ is enrolled in SLCP}) = \Lambda(\mathbf{x}_i\alpha + \mathbf{z}_i^{\mathrm{H}}\beta^{\mathrm{H}} + \mathbf{z}_i^{\mathrm{V}}\beta^{\mathrm{V}} + \mathbf{d}_i\delta), \quad [2]$$

where $\Lambda(.)$ denotes the logistic cumulative distribution function.

After data cleaning, 345 households were selected for the analysis, with a total of 2,004 plots. Table 4 details the characteristics of these sample plots. Overall, 27% of the sample plots were enrolled in the SLCP by 2002, ranging from 48% in Shaanxi Province, to 20.9% in Sichuan, and 18% in Gansu. Plot characteristics included in the model are pre-SLCP (1999) plot slope, size, land quality, irrigation conditions, land rights held by the household over the plot, and plot accessibility. Generally speaking, the Shaanxi and Sichuan samples have a large share of highly sloping plots and land that is low quality, whereas the Gansu sample has a much higher share of low-sloping, high-quality plots. The Shaanxi plots are also, on average, almost twice as large as those in Gansu and Sichuan and were much more often affected by a disaster in 1999.

Table 5 details the characteristics of the households and villages in the sample. Program implementation generally began earliest in Shaanxi Province (where 67% of the sample villages started the SLCP in 1999), followed by Sichuan (where 83% of the sample villages started in 2000) and then Gansu (where 50% of the sample villages did not start until 2001 or 2002). To examine the influence of household characteristics on plot choice, the model includes as explanatory variables household population, household head age and years of education, per capita income and land, household labor, the share of income from off-farm sources, and the share of labor engaged in part-time or full-time off-farm work. Households in Shaanxi Province are generally the poorest in the sample (1999 per capita income of CNY 991) and have the highest share of steeply sloping land (72%). They also have the highest per capita land area and lowest degree of land

[10] In the sample, the correlation coefficients between whether a plot is highly sloping (slope greater than 25 degrees), and two measures of plot quality (1999 per ha net income from the plot, and whether the household considers the plot to be "high quality") are −0.19 and −0.33, respectively, both significant at 0.1%.

TABLE 4
SAMPLE PLOT CHARACTERISTICS, 1999

	All (n = 2,004)		Shaanxi (n = 560)		Gansu (n = 755)		Sichuan (n = 689)	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Plot Characteristics								
Plot size (ha)	0.15	0.17	0.22	0.21	0.12	0.11	0.12	0.18
1999 net income/ha (RMB)	4,473	10,260	2,312	6,445	3,830	6,647	6,935	14,628
Distance								
To nearest road (km)	0.76	1.34	0.82	1.18	0.82	1.65	0.65	1.03
To nearest gully/ditch (km)	1.03	2.19	1.44	2.85	1.07	2.24	0.66	1.25
To home (km)	0.88	1.08	0.97	0.87	0.91	1.11	0.76	1.17
Share of Plots (%)								
Enrolled in the SLCP	27.3		47.9		17.9		20.9	
Affected by a disaster in 1999[a]	24.6		62.0		9.0		11.2	
With slope								
>25°	37.6		48.6		19.2		48.9	
15°–25°	14.4		18.9		10.2		15.2	
<15°[b]	48.0		32.5		70.6		35.8	
With land quality								
High	32.8		25.4		44.5		26.1	
Medium	29.1		34.3		26.8		27.4	
Low	38.1		40.4		28.7		46.4	
Irrigated with								
Surfacewater	12.5		2.7		14.0		18.9	
Groundwater	1.4		0.7		2.5		0.9	
Other	1.4		0.0		1.2		2.9	
No irrigation	84.6		96.6		82.3		77.4	
That are								
Private land	6.1		3.9		2.9		11.5	
Responsibility or ration land	81.2		74.5		90.3		76.6	
Contract land	8.2		17.9		5.2		3.8	
Other[c]	4.4		3.8		1.6		8.1	

[a] Defined as an exogenous negative production shock, including drought, flood, severe insect infestation, windstorm, and hail.
[b] Includes paddy and terraced fields, which comprised 5.8% of the plots in the sample.
[c] Includes developed wasteland, and land transferred into or out of the household.

fragmentation. In comparison, Sichuan and Gansu households are richer (CNY 1,435 and CNY 1,566 per capita, respectively) and have lower per capita land and a greater degree of land fragmentation. Gansu households also have a relatively low average share of land that is steeply sloped (31%).

To control for and examine the impacts of heterogeneity in local conditions, model explanatory variables also include village 1999 per capita income, per capita land, and share of village population in off-farm wage work (defined as part- or full-time off-farm day work, both in and out of the village, as well as work that involves leaving the village without returning for at least a week). Villages in Shaanxi have lower population density but depend more heavily on agriculture for their livelihood, as reflected in their low average number of rural enterprises in the village (0.25) and low average share of village population engaged in nonfarm wage work (11%, defined as work that involves leaving the village for a week or more). Gansu villages have on average 0.33 rural enterprises and fully 23% of village population engaged in nonfarm wage work in 1999, and Sichuan villages have 1.75 rural enterprises and 15% of village population engaged in nonfarm wage work. Villages in Shaanxi are also generally smaller, with the average 1999 population being 510, as compared with

TABLE 5

HOUSEHOLD AND VILLAGE CHARACTERISTICS, 1999

Variable	All		Shaanxi		Gansu		Sichuan	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Household characteristics	$n = 345$		$n = 114$		$n = 119$		$n = 112$	
% of sample participating in SLCP	76.5		90.4		71.4		67.9	
% of participants with sloping land (slope $> 15°$)	90.2		97.1		76.5		96.1	
% of nonparticipants with sloping land (slope $> 15°$)	81.5		81.8		73.5		88.9	
Household head age	44.3	11.4	44.4	10.6	44.9	11.7	43.7	11.9
Household head years of education	4.67	3.4	5.53	3.3	4.57	3.7	3.89	3.1
Household population	4.81	1.6	4.75	1.7	5.11	1.6	4.56	1.4
Household per capita income (RMB)	1,330	1,212	991	1,053	1,435	1,236	1,566	1,271
Nonagricultural share of household per capita income	0.39	0.39	0.40	0.46	0.44	0.32	0.32	0.36
Household per capita arable land (ha)	0.19	0.141	0.23	0.128	0.16	0.115	0.18	0.170
Household labor	3.51	1.32	3.67	1.59	3.56	1.23	3.29	1.06
Nonagricultural share of household labor [a]	0.34	0.26	0.30	0.26	0.39	0.26	0.34	0.25
Number of plots	5.81	2.23	4.91	1.83	6.34	2.24	6.15	2.32
Share of agricultural land with slope $> 15°$	0.57	0.357	0.72	0.297	0.31	0.299	0.68	0.318
Village characteristics	$n = 36$		$n = 12$		$n = 12$		$n = 12$	
Village population	790.5	586.2	510.2	221.8	1,177.2	797.1	684.2	384.0
Village average per capita income (RMB)	661	366	535	221	672	251	776	532
Village average per capita cropland (ha)	0.15	0.107	0.19	0.156	0.15	0.090	0.12	0.025
Share of village population working in nonfarm wage work [b]	0.16	0.112	0.11	0.101	0.23	0.073	0.15	0.126
Migrant labor as share of village population	0.13	0.099	0.06	0.054	0.20	0.080	0.11	0.103
Number of rural enterprises	0.78	1.569	0.25	0.622	0.33	1.155	1.75	2.137
Village leader years of education	7.28	2.7	7.75	2.8	6.67	3.2	7.42	2.3
Village secretary years of education	7.29	3.6	8.46	3.7	7.08	3.9	6.33	3.2
Village leader age	40.00	7.4	41.92	6.7	40.75	8.2	37.33	7.0
Village secretary age	45.08	8.3	43.50	6.7	47.58	7.8	44.17	10.1
Institutional factors								
Year village began the SLCP	2000	0.96	1999	0.67	2000	1.24	2000	0.43
Share of village agricultural land with slope $> 15°$	0.58	0.318	0.81	0.170	0.24	0.203	0.69	0.229
% of village leaders that worked previously in a forestry department	30.6		8.3		8.3		75.0	
% of village secretaries that worked previously in a forestry department	16.7		0.0		16.7		33.3	
Number of villagers working in the county forestry department	0.19	0.62	0.33	0.89	0.25	0.62	0	

Note: SLCP, Sloping Land Conversion Program.

[a]Calculated using the number of household laborers working part-time or full-time off-farm, and so not mutually exclusive with agricultural labor.

[b]Includes migrant labor and day workers working both outside and within the village.

1,177 and 684 for Gansu and Sichuan, respectively.

The effects of lag time and program transactions costs are captured with the number of years the village has been implementing the SLCP, and the village population, since implementation and monitoring likely take more time in larger villages. The model also includes share of village agricultural land with slopes greater than 15 degrees to instrument for SLCP quotas distributed to villages, since though quota determination involves a degree of negotiation between local governments and forestry officials, local geographic conditions are an important baseline determinant. Finally, we include variables to control for institutional heterogeneity that could influence program implementation. These include whether the village leader and whether the village secretary previously worked at a forestry department, the number of villagers that work in the county forestry department, and village leader and village secretary age and years of education.

To gain insight into the influence that households versus local governments have in plot enrollment choice, the model is estimated on the full sample as well as the subsamples of autonomous and nonautonomous households. In addition, two different forms of the model are estimated to examine the degree to which the systematic regional variation in plot and household characteristics could be picking up other regional effects unrelated to plot traits. The first model characterizes targeting as a direct function of plot, household, and village characteristics, while the second model includes interaction terms between provincial dummies and plot size, income per hectare, land quality, distance to nearest gully or ditch, household head per capita income, and household head per capita land. Model marginal effects and significance levels are presented in Tables 6 and 7.

Model results provide evidence that while plot targeting has been strongly influenced by program goals, other factors have also been important. Overall, highly sloping, low-quality plots that are the least accessible to households are much more likely to be enrolled in the SLCP. That a plot has a slope greater than 25 degrees increases probability of enrollment by 11% to 27%, and if it is irrigated with surface water, its probability of enrollment is reduced at the margin by 5% to 13%. Whether a plot was affected by a disaster in 1999 is even more important, since if it was, the probability of enrollment increased by fully 34% to 48%. Larger plots and plots with shorter-term, more flexible household property right types (i.e., either "responsibility," "ration," or "contract" land) are also much more likely to be retired, suggesting that transaction costs are being minimized in implementation.[11] The significant and negative effect of distance to the nearest road in four of the six models also suggests this, since plots close to roads are easier to monitor.[12]

Though we are troubled by the lack of household autonomy in participation choice seen in the sample, it is encouraging to see that household characteristics are statistically insignificant in the nonautonomous subsample, since this suggests that selection of households into the SLCP for this group has been based primarily on land characteristics.[13] That said, comparison between the

[11] Land in most Chinese villages can be divided into two types: private plots (*ziliu di*, around 6%) and collectively controlled land (*jiti di*, more than 90%). In most villages, leaders do not intervene into decisions on private plots, and farmers enjoy a fairly high degree of security. Collectively controlled land includes three different tenure forms: ration land (*kouliang tian*), which goes to farmers mainly to meet household subsistence requirements with no tax obligations; responsibility land (*zeren tian*), which goes to farmers on the condition that farmers deliver a low-priced grain or cotton quota to the state; and contract land (*chengbao tian*), which is auctioned off or allocated by village leaders for a fee (Rozelle et al. 2002; Liu, Carter, and Yao 1998).

[12] However, this could also be viewed as supporting anecdotal evidence found in other case studies of one aspect of potentially nonoptimal implementation, whereby local leaders target plots close to roads in order to "showcase" implementation for higher-level officials (Zuo 2001; Xu and Cao 2001).

[13] This interpretation is strengthened by evidence that land distribution within villages in China in terms of effective per capita land is generally based on considerations of equity, suggesting that correlation between plot characteristics and household characteristics within villages is low (Rozelle et al. 2002; Kung 1995).

TABLE 6

PLOT ENROLLMENT IN THE SLOPING LAND CONVERSION PROGRAM (SLCP) BY THE END OF 2002, BINOMIAL LOGIT MARGINAL EFFECTS

	Levels		
Explanatory Variables[a]	All (n = 2,004)	Autonomy (n = 1,066)	No Autonomy (n = 938)
1999 Plot Characteristics			
Plot size (ha)	0.313****	0.444****	0.137***
1999 income/ha (RMB)	−0.000***	−0.000***	−0.000
Plot affected by a disaster in 1999 (1 = yes)	0.459****	0.449****	0.359****
Slope > 25°	0.247****	0.274****	0.123****
Slope 15°–25°	0.091**	0.082	0.060*
High-quality land	−0.034	−0.062	−0.004
Low-quality land	0.053**	0.127***	0.000
Land rights			
Responsibility or ration land	0.109***	0.163**	0.023
Contract land	0.201*	0.274*	0.021
Other	−0.062	−0.194****	−0.012
Irrigation			
Surfacewater	−0.129****	−0.125*	−0.064****
Groundwater	−0.067	−0.198****	0.073
Other	0.037	−0.170**	0.172
Distance			
To nearest road (km)	−0.014*	−0.043**	−0.001
To nearest gully or ditch (km)	0.014***	0.019***	0.003
To home (km)	0.041****	0.095****	0.009*
1999 Household Characteristics			
Household head age	−0.001	−0.001	0.000
Household head years of education	−0.006*	−0.014**	0.000
Household population	−0.013	−0.008	−0.001
Household per capita income (RMB)	0.000**	0.000***	0.000
Nonagricultural share of household head per capita income	−0.067**	−0.051	−0.028
Household per capita land (ha)	−0.166	−0.198	−0.012
Household labor	0.010	−0.004	0.004
Nonagricultural share of labor[b]	0.075*	0.054	0.018
1999 Village Characteristics			
Village population	0.000	0.000	0.000
Village per capita income (RMB)	0.001****	0.001****	0.000**
Village per capita agricultural land (ha)	0.865**	0.553	0.960***
Share of village population in nonfarm wage work	1.178****	0.778	1.349***
Village leader years of education	0.015**	0.010	−0.001
Village secretary years of education	0.006	−0.011	0.055***
Village leader age	0.010*	0.017*	−0.016***
Village secretary age	0.007*	0.004	0.020***
Institutional Factors			
Number of Years village has been implementing the SLCP	0.149****	0.175**	−0.008
Share of village agricultural land with slope > 15°	0.294**	0.434	0.069
Village leader worked previously at a forestry department (1 = yes)	0.052	0.098	−0.038
Village secretary worked previously at a forestry department (1 = yes)	0.384****	0.296	0.592***
Number of villagers working in the county-level forestry department	0.010	0.102	−0.189***
Pseudo-R^2	0.386	0.399	0.419
% correctly predicted	84.6	82.0	89.3

*Significant at 10%; **significant at 5%; ***significant at 1%; ****significant at 0.1%. Statistical results are based on robust standard errors clustered at the household level.

[a] Province and township dummies were used in the model but are not reported. Marginal effects for 0, 1 variables are for a discrete change from 0 to 1.

[b] Calculated using the number of head of household laborers working part-time or full-time off-farm.

TABLE 7
PLOT ENROLLMENT IN THE SLCP BY THE END OF 2002, BINOMIAL LOGIT MARGINAL EFFECTS

Explanatory Variables[a]	Levels with Regional Interactions[b]		
	All (n = 2,004)	Autonomy (n = 1,066)	No Autonomy (n = 938)
1999 Plot Characteristics			
Plot size (ha^2)	0.337***	0.704***	0.079*
1999 Income (RMB/ha^2)	−0.000	−0.000*	−0.000*
Plot affected by a disaster in 1999 (1 = yes)	0.479****	0.460****	0.341****
Slope > 25°	0.246****	0.267****	0.105***
Slope 15°–25°	0.095**	0.089	0.045
High-quality land[b]	−0.079*	−0.059	−0.023
Low-quality land[b]	−0.040	0.022	−0.022
Land rights			
Responsibility or ration land	0.102**	0.149**	0.026
Contract land	0.184*	0.241	0.077
Other	−0.057	−0.196****	0.003
Irrigation			
Surfacewater	−0.134****	−0.135**	−0.051****
Groundwater	−0.079	−0.212****	0.028
Other	0.023	−0.187***	0.067
Distance			
To nearest road (km)	−0.018**	−0.049**	0.001
To nearest gully or ditch (km)[b]	0.009	0.020	−0.003
To home (km)	0.041****	0.094****	0.006
1999 Household Characteristics			
Household head age	−0.001	−0.001	0.000
Household head years of education	−0.006	−0.012*	0.000
Household population	−0.015	−0.016	0.003
Household per capita income (RMB)[b]	0.000	0.000	0.000
Nonagricultural share of household per capita income	−0.075**	−0.045	−0.022
Household per capita land (ha)[b]	−0.328*	−0.488	0.051
Household labor	0.009	0.002	0.002
Nonagricultural share of Labor[c]	0.078*	0.070	0.028
1999 Village Characteristics			
Village population	0.000	0.000	0.000
Village per capita income (RMB)	0.001****	0.001***	0.001**
Village per capita agricultural land (ha)	0.945**	0.387	1.153***
Share of village population in nonfarm wage work	1.033***	0.577	1.570***
Village leader years of education	0.015**	0.006	−0.003
Village secretary years of education	0.002	−0.014	0.061***
Village leader age	0.012**	0.020**	−0.017***
Village secretary age	0.006	0.002	0.023***
Institutional Factors			
Number of years village has been implementing the SLCP	0.139****	0.148*	−0.003
Share of village agricultural land with slope > 15°	0.307*	0.520	0.179
Village leader worked previously at a forestry department (1 = yes)	0.046	0.021	−0.017
Village secretary worked previously at a forestry department (1 = yes)	0.314***	0.164	0.902****
Number of villagers working in the county-level forestry department	0.013	0.124	−0.209***
Pseudo-R^2	0.400	0.413	0.452
% correctly predicted	85.6	82.5	90.4

*Significant at 10%; **significant at 5%; ***significant at 1%; ****significant at 0.1%. Statistical results are based on robust standard errors clustered at the household level.

[a] Province and township dummies were used in the model but are not reported. Marginal effects for 0, 1 variables are for a discrete change from 0 to 1.

[b] To examine the affects of regional differences in natural and economic conditions, plot size, income/ha, land quality, distance to nearest gully or ditch, household per capita income, and household per capita land were interacted with province dummies. The marginal effects of these interaction terms are not reported above.

[c] Calculated using the number of household laborers working part-time or full time off-farm.

autonomous and nonautonomous subsamples is still revealing and indicates that when households have greater decision-making power in implementation they favor retirement of plots with lower opportunity costs. This can be seen in the indicator for low land quality (the household's subjective evaluation), distance to home, the irrigation condition variables, and the land rights variables, which are generally more often significant and larger in magnitude for the autonomous subsample overall, and especially in comparison to the nonautonomous subsample.

In the nonautonomous subsample, for example, land rights do not appear to play any significant role in enrollment targeting. From the perspective of the household, however, the degree to which rights over a plot are more stable and longer term has direct bearing on the plot's position in household input and investment choices.[14] Similarly, the effect of a plot's distance to home, a clear indicator of its opportunity cost to the household, is highly significant and 10 times larger for the autonomous than for the nonautonomous households. In sum, these results are important; they suggest that increasing household autonomy in participation choice could improve program cost-effectiveness by improving the likelihood that—pending eligibility—those plots of least cost for households will be chosen.

VI. PROGRAM IMPACT ON INCOME

Central to the realization of the SLCP's long-term goals is whether it is adequately incentive-compatible for participants. Most immediately, program subsidies need to at minimum offset each participant's opportunity cost of the enrolled land during the subsidization period. Beyond that, the economic gain to farmers from the timber forests, orchards or pastures planted—and from other activities engaged in—as a result of SLCP participation needs to be large enough by the end of the subsidy period to ensure that participants do not return enrolled land back to cultivation. Postprogram land use decisions of participating farmers, in fact, have been one of the biggest concerns in conservation set-aside programs elsewhere (Cooper and Osborn 1998).

Though official reports and news in government publications on the SLCP implementation, progress, and socioeconomic impact are abundant (e.g., State Forestry Administration 2003; *China Green Times* 2003, 2004, 2005), rigorous analyses are rare. Not surprisingly, government reports all claim that the SLCP has had a significant positive impact on program areas. However, the validity of these official statements needs to be examined further due in part to questions about the quality of the survey data used, since it has been gathered via the government reporting system and thus may contain substantial bias in favor of program implementation agencies. The only rigorous analysis of program impact to date is by Uchida et al. (2007), who used propensity scoring matching to evaluate the social and economic impacts of the program. Overall, they found evidence of a significant negative impact on cropping income, a significant positive impact on husbandry income and inventories, and a significant positive impact on productive and housing assets. At the same time, however, impact on total household per capita income is estimated to be small and statistically insignificant.

Table 8 presents the 1999 and 2002 components of total income for participant and nonparticipant households, by province.[15] These numbers suggest that the

[14] For more evidence, please refer to Liu et al. (1998), Carter and Yao (1998), and Rozelle et al. (2002).

[15] Cropping income consists of total crop production valued at average village market price, net of materials and hired labor costs. Husbandry income includes both sales income and own consumption, valued at market prices. Off-farm income includes all nonagricultural production activities, comprised mainly of sideline activities and wage labor income. Income from sideline activities is net of production costs and other business-related expenditures. Wage income includes both cash and in-kind income, valued at market prices. Other income consists of aquaculture, rental and interest income, gifts, pension income, and government subsidies and transfer payments. The SLCP subsidy is calculated as the subsidy received by the household for 2002.

TABLE 8
PER CAPITA NET INCOME OF PARTICIPANT AND NONPARTICIPANT HOUSEHOLDS, 1999 AND 2002

	Nonparticipant Households				Participant Households			
	1999		2002		1999		2002	
Income Component[a]	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Shaanxi								
Total without subsidy	940	777	1,335	930	986	1,077	1,325	1,874
Total with subsidy received	—		—		—		1,394	1,877
Cropping without subsidy	465	521	626	429	420	672	401	622
Cropping with subsidy received	—		—		—		470	628
Husbandry	6	23	17	63	18	78	208	916
Off-farm	388	623	590	947	401	554	525	680
Other	82	233	101	234	147	686	191	826
Gansu								
Total without subsidy	1,803	1,681	2,021	1,741	1,287	980	1,287	942
Total with subsidy received	—		—		—		1,317	942
Cropping without subsidy	484	350	360	246	589	523	370	320
Cropping with subsidy received	—		—		—		399	345
Husbandry	17	53	119	220	6	30	113	222
Off-farm	1,192	1,570	1,346	1,624	633	679	681	647
Other	110	515	196	541	59	204	124	393
Sichuan								
Total without subsidy	1,419	1,425	1,654	1,271	1,635	1,195	1,961	1,524
Total with subsidy received	—		—		—		2,067	1,514
Cropping without subsidy	721	938	506	633	829	931	472	590
Cropping with subsidy received	—		—		—		577	583
Husbandry	33	42	202	200	49	75	459	1,187
Off-Farm	543	953	714	987	674	897	869	971
Other	122	295	232	476	83	251	161	375

Source: Data from Table 6, Xu et al. 2004.
[a] All units are in 1999 RMB, adjusted using the Rural Consumer Price Index.

SLCP has indeed induced a restructuring of agricultural production, whereby participants have shifted relatively more of their inputs out of cropping and into husbandry. In Shaanxi Province, growth rates for cropping income were 35% for nonparticipants compared with only 12% for participants (including subsidies received). In Gansu, these were −26% and −32%, respectively, and in Sichuan cropping income declined by 30% for both groups. Conversely, growth rates for husbandry were higher for participants than for nonparticipants. In Shaanxi, average household per capita husbandry income for participants increased more than 10-fold, compared to only 175% for nonparticipants. In Gansu, participants' husbandry income grew by 1,744%, compared with only 586% for nonparticipants, and in Sichuan these numbers are 845% and 514%, respectively. Differences between participants and nonparticipants in change of total income are less systematic across regions. In Shaanxi, total income (including subsidies received) increased by 41% and 42% for participants and nonparticipants, respectively. For Gansu these numbers are 2.3% and 12%, respectively, and for Sichuan they are 26% and 17%, respectively.

Since such numbers could be the result of factors unrelated to SLCP implementation, we use a first-differences model explaining change in household per capita net income between 2002 and 1999 to more rigorously estimate program impact on income. A

simple regression specification for explaining change in income is

$$\Delta y_i^k = \alpha + \delta(prog_i) + \delta^{\mathrm{L}}(pyrs_{\mathrm{i}}) + \Delta \mathbf{x}_i^{\mathrm{H}} \beta^{\mathrm{H}} + \Delta \mathbf{x}_i^{\mathrm{V}} \beta^{\mathrm{V}} + \mathbf{d}_i \gamma + \Delta \mu_i,$$

where Δy_i^k denotes the change in household i's per capita net income component k between 1999 and 2002, $prog_i = 1$ if household i is a participant, $\Delta \mathbf{x}_i^{\mathrm{H}}$ and $\Delta \mathbf{x}_i^{\mathrm{V}}$ are vectors of household and village-level characteristics, respectively, $\mathbf{d}_i$ is a vector of provincial- and county-specific time-trend dummies, and $\Delta \mu_i$ is the difference in idiosyncratic disturbances across periods. Since households entered the program at different times between 1999 and 2002, we also include in one specification the number of years household i has been in the SLCP before the end of 2002 ($pyrs_i$) to control for lagged program impacts not picked up in the first difference.

Of interest for program evaluation is δ, generally referred to as the difference-in-differences estimator. This captures the difference, controlling for household and village-level factors, in average income change between participants and nonparticipants that can be attributed to program participation (Wooldridge 2002). A central concern in the literature on program evaluation is the impact of selection bias on estimates of program impact. If selection bias is an issue, then the outcomes of nonparticipants cannot be used to estimate the counterfactual outcomes for participants were they not to have participated. In the case of our survey, we believe the effects of selection bias can be largely controlled for due, ironically, to the predominantly topdown approach toward implementation observed in the survey. This gives us a subsample of households that have not self-selected to be participants or nonparticipants, allowing for empirical examination of selection bias in the sample.

To do this, we estimate [3] above in a treatment effects model framework wherein program participation is assumed to be the observed outcome of a latent process that is a function of household characteristics and county and provincial intercepts, so that

$$prog_i = \begin{cases} 1 & \text{if } p^* > 0 \\ 0 & \text{otherwise} \end{cases}$$

and

$$p^* = \mathbf{x}_i \gamma^{\mathrm{x}} + \mathbf{z}_i \gamma^{\mathrm{z}} + \mathbf{d}_i \lambda + \varepsilon_i, \qquad [4]$$

where the vector $\mathbf{x}_i$ contains household characteristics shared with the income difference model [3], $\mathbf{z}_i$ is a vector of household characteristics serving as instruments for identification of p^* and therefore not shared with [3], and $\mathbf{d}_i$ is a vector of provincial- and county-specific intercepts. Since selection bias occurs when participation and outcomes are the result of common, unobserved variables, the error terms of the income difference and selection models, $\Delta\mu$ and ε, are assumed to be distributed bivariate normal with zero mean and covariance matrix

$$\begin{bmatrix} \sigma_{\Delta\mu} & \rho \\ \rho & 1 \end{bmatrix}.$$

For our purposes, this characterization is preferred to a two-stage IV regression, since it allows for direct estimation via maximum likelihood of ρ—the correlation coefficient between ε and $\Delta\mu$. The statistical significance of ρ as well as its estimated sign and magnitude provide tests of the presence, direction, and importance of selection bias in the sample, all of which are of interest for evaluating program implementation, especially given the significant share of sample households that reported lack of autonomy in participation choice.

To control for selection on observables, 1999 household characteristics shared across the selection and outcome equations include per capita income, per capita number of plots affected by disaster, years of education of the household head, per capita arable land, and number of household laborers working in (1) agriculture, (2) "outside area" wage labor, and (3) self-

employed in nonfarm work.[16] The 1999–2002 changes in household population and labor are also included in the outcome equation [3]. To control for exogenous village-level factors impacting outcomes across households, 1999–2002 change in village population, change in the share of village households with telephones and with tap water, change in the number of long-distance buses that run through the village, and the 1999 number of village enterprises were also included in equation [3].[17]

Though not critical for identification in this specification, the use of good instrumental variables (z_i) helps to ensure that the model is well specified (Maddala 1983; Wooldridge 2002). Household autonomy in the participation decision was identified as an excellent candidate. It is not only significantly correlated with program participation in the sample, but uncorrelated with any of the income change variables.[18] Furthermore, in the logit analysis of household autonomy status discussed above, program participation was found to have a large and highly significant positive marginal effect as an explanatory variable, while household per capita income was insignificant. To be able to compare model estimates between the full sample and the subsample of nonautonomous households, two additional variables were also selected as candidates for instruments. Based on observations made in the field, we suspect that (1) whether the household had a member in the Communist party in 2002 and (2) whether the household had a member in village government in 2002 are also related to the participation decision but not to income change.[19] Note that when estimating the model on the subsample of nonautonomous households, selection bias can still come into play if program officials have selected certain types of individuals based on unobserved characteristics that are correlated with outcomes. As such, we think that (1) and (2) could also be good instruments in this type of selection process.

Tables 9 and 10 present model estimates. The first pair of models uses only variables (1) and (2) and their interaction as instruments and was estimated both on the full sample and the nonautonomous subsample for comparison. The results indeed provide evidence that selection bias exists in the full sample but not in the subsample. In particular, for cropping income the corre-

[16] We compared mean 1999 household characteristics between participants and nonparticipants for both the full sample and the subsample of nonautonomous households. For the full sample, household labor population was 0.227 larger for participants, significant at 10%, household total arable land was 0.242 ha larger and per capita land was 0.042 ha larger for participants, significant at 0.01% and 10%, respectively, and per capita number of plots affected by disaster was 0.317 larger for participants, significant at 0.01%. For the nonautonomous subsample, number of workers in "outside area" wage labor was 0.205 larger for participants, significant at 5%, total arable land was 0.254 larger for participants, significant at 5%, and per capita number of plots affected by disaster was 0.265 larger for participants, significant at 0.01%.

[17] We argue that 2002 party membership is a valid proxy for 1999 membership (and the underlying unobserved characteristics it captures); entering the communist party in rural China involves a long process of letter-writing and application. We make similar arguments for the 2002 village official variable, since often village government posts rotate regularly and have both costs and benefits associated with them. Thus, it is also likely to be associated with probability of participation, but not with outcome.

[18] Its pairwise correlation with participation is 0.3043, significant at 0.01%. In the probit model explaining autonomy status, mentioned above, program participation was estimated to have a large and highly statistically significant marginal effect, while household per capita income was not statistically significant.

[19] (1) and (2) are included as proxies for these characteristics in 1999, since the survey collected data on these only for 2002. Note that both party membership and village government positions generally are the outcomes of relatively long term processes, and so we are comfortable using the 2002 levels as proxies for preprogram status. In rural China, communist party membership does not provide any clear financial benefits to members or their families, who come from a wide range of backgrounds and income strata. Similarly, village government membership encompasses a variety of positions with a wide variation in actual power and responsibility and also can entail significant opportunity costs in areas where village government finances are strained, suggesting no clear relationship with household per capita income. In the sample, this variable is in fact uncorrelated with any income component changes. However, neither (1) nor (2) is significantly correlated with program participation in the sample, while (1) is negatively correlated with change in husbandry income, significant at 0.5%.

TABLE 9
PROGRAM IMPACT ON PARTICIPANT INCOME, TREATMENT EFFECTS MODEL: ALL HOUSEHOLDS ($N = 345$)

	Without Autonomy Status as an Instrument			
	Impact		Impact with Lag	
Income Component	Estimate	ρ[a]	Estimate	ρ
Program Impact (δ)				
Cropping before subsidy	263.07*** (45.62)	−0.851*** (0.043)	341.83*** (45.62)	−0.827*** (0.051)
Cropping with subsidy	303.17*** (48.73)	−0.819*** (0.05)	371.58*** (48.73)	−0.808*** (0.054)
Husbandry	311.30* (185.86)	−0.0806999 (0.139)	389.22* (185.86)	−0.081 (0.139)
Total agricultural before subsidy	272.67 (199.36)	−0.149 (0.139)	477.19** (199.36)	−0.148 (0.138)
Total agricultural with subsidy	318.57 (203.52)	−0.144 (0.141)	491.47** (203.52)	−0.143 (0.141)
Off-farm	−30.56 (153.91)	−0.013 (0.204)	−43.68 (153.91)	−0.013 (0.205)
Noncropping	296.83 (238.79)	−0.088 (0.156)	361.1 (238.79)	−0.087 (0.156)
Other	−6.81 (87.27)	−0.039 (0.195)	37.22 (87.27)	−0.040 (0.193)
Total before subsidy	280.88 (273.08)	−0.167 (0.158)	510.48 (273.08)	−0.163 (0.156)
Total with subsidy	325.75 (277.86)	−0.162 (0.16)	524.43 (277.86)	−0.159 (0.159)
Program Lagged Impact (δ^L)				
Cropping before subsidy		—	−39.49** (16.19)	—
Cropping with subsidy		—	−30.87* (16.43)	—
Husbandry		—	−30.76 (49.08)	—
Total agricultural before subsidy		—	−81.68 (52.25)	—
Total agriculture with subsidy		—	−68.95 (52.75)	—
Off-farm		—	5.12 (30.21)	—
Noncropping		—	−25.56 (57.83)	—
Other		—	−17.23 (17.82)	—
Total before subsidy		—	−93.39 (64.97)	—
Total with subsidy		—	−80.69 (65.42)	—

lation between the error terms is large, negative, and highly statistically significant in both specifications for the full sample, while insignificant for the nonautonomous subsample. This makes sense, since it suggests that households with lower opportunity cost for retiring their land—in terms of their foregone cropping income—are more likely to participate when given the freedom to choose. It thus also suggests that ensuring that households have autonomy in participation choice could improve program cost-effectiveness.

In the selection equations for the full sample, the variable capturing whether the household has a member in village government is positive, and its interaction with household having a communist party member is negative—both significant at 10%—in the majority of specifications. When estimated on the subsample, the variable capturing whether the household has a communist party member is negative and significant at 5% in the selection equation for the majority of specifications. The second pair of models for the full sample adds autonomy status to the list of instruments. Autonomy status is indeed found to be positive and significant at 0.01% in the selection equation for all specifications. Similar to the first pair of models, these results also provide evidence of selection bias in the sample for cropping income, since the correlation between errors is statistically significant in these models, though only weakly so in the model that does not include an impact lag variable.

Overall, model estimates for the full sample provide evidence that the program is inducing farmers to intensify agricultural production on their remaining plots, while also shifting into husbandry. Estimated impacts on cropping income are positive and significant at 0.01% in all specifications run on the full sample, and range from CNY 194 to CNY 263 per capita for cro-

TABLE 9
(Extended)

Including Autonomy Status as an Instrument			
Impact		Impact with Lag	
Estimate	ρ	Estimate	ρ
233.67*** (49.88)	−0.830* (0.054)	321.65*** (61.58)	−0.802*** (0.065)
266.74*** (54.33)	−0.787* (0.066)	345.93*** (66.75)	−0.777*** (0.07)
389.63** (160.71)	−0.159 (0.118)	472.52** (204.24)	−0.161 (0.117)
347.95** (174.96)	−0.224 (0.12)	561.36** (219.09)	−0.227 (0.119)
397.68** (177.81)	−0.221 (0.121)	579.12*** (222.54)	−0.224 (0.12)
−17.55 (140.54)	−0.034 (0.194)	−30.81 (162.68)	−0.033 (0.195)
397.22* (204.64)	−0.173 (0.132)	466.78* (252.36)	−0.173 (0.132)
−61.7 (89.79)	0.101 (0.212)	−15.45 (100.04)	0.091 (0.206)
335.21 (242.3)	−0.215 (0.141)	578.19** (291.11)	−0.217 (0.139)
384.39 (245.66)	−0.213 (0.143)	595.66** (295.11)	−0.215 (0.141)
	—	−43.71*** (16.17)	—
	—	−34.96** (16.48)	—
	—	−32.16 (49.07)	—
	—	−83.6 (52.21)	—
	—	−70.9 (52.71)	—
	—	4.93 (30.24)	—
	—	−27.1 (57.81)	—
	—	−16.84 (17.83)	—
	—	−95.6 (64.91)	—
	—	−82.91 (65.36)	—

Note: Standard errors are in parentheses. Selection and impact equations were estimated simultaneously via maximum likelihood.
[a] Significant levels for the correlation coefficient are for chi-squared tests.
* Significant at 10%; **significant at 5%; ***significant at 1%.

pping income without subsidy.[20] Average impacts on husbandry range from CNY 299 to CNY 390. Model results for the full sample also suggest that the program could be having a positive impact on total income, though the estimated impact is statistically significant only for the model with program lag variables using household autonomy status as an instrument. Estimates of average program impact on total income without subsidies range from CNY 238 to CNY 335 in the full sample.

As a comparison with the results for the full sample, model estimates from the nonautonomous subsample provide little evidence of positive impact on participant total and cropping income, and only weak evidence of positive impact on husbandry income. These are presented in Table 10. Estimates of average impact on cropping income without subsidy for the subsample range from CNY 54 to CNY −84 per capita. Estimated average impacts on total income without subsidy range from CNY −7 to CNY −27. Although estimates for the full sample attempt to correct for selection bias, they do not allow for the possibility that selection bias could also come into play through systematic differences in the parameters for household characteristics. If that were the case, and taking the tests for selection bias at face value, it would suggest that the nonautonomous subsample, as a sample of individuals that are "randomly" assigned treatment, might provide better estimates of program impact within this modeling framework. Though further exploration of this is beyond the scope of this paper, these

[20] The sample average number of years in the program of 2.92 and 2.57 for the full sample and nonautonomous subsample, respectively, were used for calculations using the models with lagged impact variables.

TABLE 10
PROGRAM IMPACT ON PARTICIPANT INCOME, TREATMENT EFFECTS MODEL: HOUSEHOLDS WITHOUT AUTONOMY (N = 161)

	Impact		Impact with Lag	
Income Component	Estimate	ρ[a]	Estimate	ρ
Program Impact (δ)				
Cropping before subsidy	54.54 (252.76)	−0.559 (0.621)	52.55 (214.78)	−0.191 (0.679)
Cropping with subsidy	141.22 (141.63)	−0.622 (0.299)	199.54 (211.59)	−0.512 (0.536)
Husbandry	176.97* (106.8)	−0.098 (0.18)	194.43 (136.61)	−0.098 (0.18)
Total agricultural before subsidy	78.42 (141.63)	−0.138 (0.208)	220.35 (171.86)	−0.136 (0.206)
Total agriculture with subsidy	131.3 (146.18)	−0.141 (0.216)	257.67 (175.82)	−0.137 (0.214)
Off-farm	−45.86 (189.18)	−0.025 (0.236)	−46.54 (226.64)	−0.025 (0.236)
Noncropping	135.61 (219.67)	−0.081 (0.219)	152.35 (267.29)	−0.081 (0.218)
Other	−94.18 (251.23)	0.118 (0.573)	2.53 (215.58)	0.093 (0.454)
Total before subsidy	−7.29 (303.84)	−0.101 (0.269)	217.62 (344.28)	−0.097 (0.263)
Total with subsidy	45.79 (316.07)	−0.102 (0.281)	254.92 (354.49)	−0.097 (0.274)
Program Lagged Impact (δ^L)				
Cropping before subsidy	—		−52.47** (21.71)	—
Cropping with subsidy	—		−44.31* (23.24)	—
Husbandry	—		−7.25 (35.37)	—
Total agricultural before subsidy	—		−59.78 (41.84)	—
Total agricultural with subsidy	—		−53.51 (42.09)	—
Off-farm	—		0.28 (51.62)	—
Noncropping	—		−6.96 (63.31)	—
Other	—		−35.77 (30.71)	—
Total before subsidy	—		−95.34 (73.7)	—
Total with subsidy	—		−89.1 (74.06)	—

Note: Standard errors are in parentheses. Selection and impact equations were estimated simultaneously via maximum likelihood.
[a] Significant levels for the correlation coefficient are for chi-squared tests.
*Significant at 10%; **significant at 5%; ***significant at 1%.

results suggest at minimum that lack of autonomy in participation choice could be dampening program impacts.

In addition to these findings, it is also interesting to note that for both the full sample and subsample, estimated average program impact on change in off-farm income is small and not statistically or economically significant in any specification, which is contrary to government claims regarding program impacts. In fact, farmers in the sample reported they had to spend considerable time planting and caring for trees on enrolled land so as to guarantee that they received subsidies. Combined with the model results, this suggests that rather than freeing up labor, program participation could be tying up labor to manage retired land, at least over the short term. Furthermore, though production risk is likely a significant concern for households in the sample, participation in the SLCP might simply be replacing one type of risk for another.

Specifically, program stipulations requiring a minimal survival rate of trees or grass planted on retired land in order for subsidies to be delivered, combined with the uncertainties and lag time involved with implementation and inspection by village and higher-level authorities, suggest that participation itself entails a form of non-negligible income risk. Our survey tells us that in only 5 of the 18 sample townships were survival rates consistently above the government standard (70% in Gansu and Shaanxi, 85% in Sichuan). In Li county in Sichuan, survival rates were below the standard in all but one inspection in one township, and this had been declining in recent years. According to farmers surveyed, survival rates were even below 40% in many places, and significant replanting has had to be done. Pervasive replanting

has led to shortfalls in government seedling subsidies of around CNY 50 per mu according to our survey. Moreover, in many regions even replanting cannot guarantee survival rates due to lack of water, and in many cases is simply done to pass government inspections so as to obtain program subsidies (Du and Xu 2003).

Households, as the core agents engaged by the government to implement the SLCP, are in the best position to know whether program participation will benefit them. Lack of choice could thus be increasing the likelihood that households not well positioned to benefit from the SLCP, or whose income prospects would suffer as the result of participation, are being selected into the program.

VII. CONCLUSION

Though the representativeness of the data set used for this analysis is open to debate in light of the huge diversity of local institutional, economic, and ecological conditions encompassed by the program, it is nonetheless the best available to evaluate the program's implementation over a relatively long period. Overall, though our results provide some support for the government's positive view of the program, they are not strong enough to justify the fast expansion of the SLCP after the pilot period. Our targeting analysis, while indicating that land enrollment choice has indeed been strongly influenced by program goals, also points to significant mistargeting of fertile flatland for retirement. This suggests some inconsistencies with the SLCP's emphasis on retirement of highly sloped land so as to reduce soil erosion. The income impact analysis results, though providing evidence of positive program impacts on cropping, husbandry, and total income, fall short of the claims made by the government about the huge success of the pilot phase, and it is such claims that have served to justify the breakneck speed of expansion seen during full implementation.

Most troubling is the finding that, though on paper a payment for environmental services scheme, the SLCP appears to be in practice just another in a long line of topdown, campaign-style programs implemented by China's central government. The importance of farm households as the key long-term actors in implementation makes participant willingness and choice necessary conditions to program success. Both the plot targeting and income impact analysis results, in fact, suggest that significant gains in the cost-effectiveness of the program could be achieved by ensuring that households have autonomy of participation choice. In particular, the results indicate that when given the choice, households with lower opportunity costs are more likely to select into the program, and plots with lower opportunity costs for participant households are more likely to be enrolled.

These results are important, since in absence of significant and sustainable gains in the development of sources of noncropping and off-farm income, participants who originally did not wish to participate, who are not being adequately compensated for their opportunity costs of participation, may easily return land to cultivation upon the end of the subsidy period. And results from the survey indicate that this is not a small share of participants.[21] Survey evidence, in fact, suggests that farmers could face significant added income risk due to program participation. For participants in the sample, per capita cropland decreased by 43% on average overall, and by 57% for households in Shaanxi Province in particular (from 0.24 ha in 1999 to only 0.09 ha in 2002). Considering the adverse climate conditions and frequent natural disasters in this region, reducing both household per capita land area and the number of plots that households have distributed across local microclimates could significantly impact households' ability to hedge against

[21] Bennett (2008) calculates from the survey data that only about 20.8% of participant households (representing 23.7% of retired area) indicated that they would allow program-planted trees to reach maturity. Another 36.7% of participant households (representing 30.5% of retired area) said that they could maintain their livelihood with revenue from current activities.

significant production risk in absence of alternative sources of income.

The stability of such alternative sources of income, furthermore, is questionable. First, the future value and shorter-term income-generating capacity from timber forests (i.e., "ecological forests") and orchards (i.e., "economic forests") planted under the SLCP does not look promising. For timber forests, this is due to low timber forest survival and growth rates in many regions as a result of lack of rainfall and unsuitable conditions for timber trees (especially in the arid northwest provinces of Gansu and Shannxi), the uncertainties in the future of China's forest sector reforms, and the potential oversupply of timber due to large-scale plantations in the south. Regarding economic forests, the fast expansion in the SLCP has led to many different regions in China planting similar orchard crops, raising concerns about future oversupply and dampened economic value of these forests.

Overall, the SLCP, a program implemented in a period of grain surplus, was expanded too fast as a result of the interplay between the central government's underlying goal of reducing State Grain Bureau grain stocks, and local government interest in increasing subsidy inflows. Lack of successful experiences in the past and excessively fast program expansion have created significant fiscal risk for governments, income risks for participants, and ecological risks for program-covered areas.[22] In fact, due to such risks, the government significantly slowed the rate of expansion in 2005 and is currently discussing how to scale back the program.

Though the government's growing largesse toward environmental initiatives is encouraging, large-scale campaign-style programs may not be the way to reverse adverse environmental outcomes stemming from a complex combination of factors. Improvements in program design that allow for greater local initiative, flexibility, and the use of more market-based instruments could help to improve program cost-effectiveness by better matching participant opportunity cost with program subsidies, thus increasing the possibility of program success. At the same time, ironically, the lack of household autonomy seen in our sample suggests that the lessons learned and approach toward program evaluation adopted here could also be applied to other, more compliance based conservation programs internationally, especially as world policy moves toward greater emphasis on environmental protection via public regulatory schemes. That said, voluntary participation remains an important principle to insure the cost-effectiveness and eventual success of the SLCP.

Finally, the results of the analysis—which find no statistically or economically significant positive program impacts on off-farm income growth—argue against the validity of a key underlying assumption of the SLCP: retiring land from cultivation would automatically lead to desirable rural economic restructuring that in turn would reduce the risk of returning retired land to cultivation after the subsidy period. In the fast expansion of the program, neither the central nor the local governments have designed and installed sufficient coordinated policies to induce effective income restructuring within and permanent migration out of the program target regions. In fact, effective government support for the noncropping agricultural sectors, balanced with policies to promote nonagricultural sectors and permanent migration out of ecologically fragile regions, may well be more effective in relieving pressure on sloping, marginal cropland than the cam-

[22] Most of the SLCP-covered area in northwestern China is arid or semi-arid land suitable only for grass or shrub plantation. Timber tree plantation would indeed hamper the water conservation function of soil or even lead to further land desertification because timber trees need much more water than grass or shrubs. The low survival rates of timber trees has been very apparent in China's other ecological programs implemented in early periods, such as the Northeast, North, and Northwest China Green Belt Program. One example is Mingqin County, Gansu Province, where the area of government afforestation was as high as 87,000 ha, but only 20,000 ha survived (Jiang 2003).

paign-style government program we have witnessed. Only by positioning the SLCP within an array of coordinated policies can the dual goals of environmental amelioration and poverty alleviation be realized.

References

Bennett, Michael T. 2008. "China's Sloping Land Conversion Program: Institutional Innovation or Business as Usual?" *Ecological Economics* 65 (4): 699–711.

Carter, Michael, and Yang Yao. 1998. "Property Rights, Rental Markets, and Land in China." Working Paper. Madison: Department of Agricultural and Applied Economics, University of Wisconsin–Madison.

China Green Times. 2003. "The Sloping Land Conversion Program Provides More Than CNY 60 Million in Benefits to Farmers." [In Chinese.] Beijing: China Green Times Publishing. Available at www.greentimes.com (accessed October 16, 2003).

———. 2004. "The Six Big Forestry Programs: The Heroic Feat of Recovering the Beautiful Landscape." [In Chinese.] Beijing: China Green Times Publishing. Available at www.greentimes.com (accessed September 10, 2004).

———. 2005. "The Sloping Land Conversion Program Is Key for Building the Ecosystem." [In Chinese.] Beijing: China Green Times Publishing. Available at www.greentimes.com (accessed April 22, 2005).

Cooper, Joseph C., and Tim Osborn. 1998. "The Effect of Rental Rates on the Extension of Conservation Reserve Program Contracts." *American Journal of Agricultural Economics* 80 (1): 184–94.

Du, Jishan, and Jintao Xu. 2003. "A Socio-Economic Evaluation of the Sloped Land Conversion Program." [In Chinese.] Working paper. Center for Chinese Agricultural Policy, IGSNRR, CAS, Beijing.

Economic Daily. 2007. "State Forest Administration Issues *Report on the Overall Development of the Sloping Land Conversion Program*." February 4, 2007.

Heimlich, Ralph. 2003. "Land Retirement." In *Agricultural Resources and Environmental Indicators*, ed. Ralph Heimlich and William Anderson, Chap. 6.2. Washington, DC: Economic Research Service, U.S. Department of Agriculture.

Huang, Jikun. 2000. "Land Degradation in China: Erosion and Salinity Component." CCAP Working Paper WP-00-E17. Beijing: Center for Chinese Agricultural Policy.

Hyde, William, Brian Belcher, and Jintao Xu, eds. 2003. *China's Forests: Global Lessons from Market Reforms*. Washington, DC: Resources for the Future.

Jiang, Gaoming. 2003. "More Emphasis on Plantation Than Conservation: Ecological Protection Is Not Equal to Tree Plantation." [In Chinese.] *China Youth Daily*, Sept. 24.

Kung, James Kai-Sing. 1995. "Equal Entitlement versus Tenure Security under a Regime of Collective Property Rights: Peasants' Preference for Institutions in Post-Reform Chinese Agriculture." *Journal of Comparative Economics* 21 (1): 82–111.

Liu, Shouying, Michael Carter, and Yang Yao. 1998. "Dimensions and Diversity of Property Rights in Rural China: Dilemmas on the Road to Further Reform." *World Development* 26 (10): 1789–1806.

Lu, Feng. 1998. "Grain versus Food: A Hidden Issue in China's Food Policy Debate." *World Development* 26 (9): 1641–52.

———. 1999. "Three Grain Surpluses: Evolution of China's Grain Price and Marketing Policies (1978–1999)." Presented at the International Agricultural Trade Research Consortium, China's Agricultural Trade and Policy: Issues, Analysis, and Global Issues. San Francisco, California, June 25–26.

Maddala, G. S. 1983. *Limited-Dependent and Qualitative Variables in Econometrics*. New York: Cambridge University Press.

Pagiola, Stafano, Natasha Landell-Mills, and Joshua Bishop. 2002. "Making Market-Based Mechanisms Work for Forests and People." In *Selling Forest Environmental Services: Market-Based Mechanisms for Conservation and Development*, ed. Stafano Pagiola, Joshua Bishop, and Natasha Landell-Mills. London: Earthscan.

Park, Albert, Sangui Wang, and Guobao Wu. 2002. "Regional Poverty Targeting in China." *Journal of Public Economics* 86 (1): 123–53.

Rozelle, Scott, Loren Brandt, Li Guo, and Jikun Huang. 2002. "Land Rights in China: Fact, Fiction, and Issues." *China Journal* 47:67–97.

State Forestry Administration (SFA). 2003. *Plan for Sloping Land Conversion Program (2001–2010)*. [In Chinese.]. Beijing: State Forestry Administration.

Uchida, Emi, Jintao Xu, and Scott Rozelle. 2005. "Grain for Green: Cost-Effectiveness and Sustainability of China's Conservation Set-Aside Program." *Land Economics* 81 (2): 247–64.

Uchida, Emi, Jintao Xu, Zhigang Xu, and Scott Rozelle. 2007. "Are the Poor Benefiting from China's Land Conservation Program?" *Environment and Development Economics* 12 (4): 593–620.

Wooldridge, Jeffrey M. 2002. *Econometric Analysis of Cross-Section and Panel Data*. Cambridge, MA: MIT Press.

World Bank. 2001a. China: Air, Land, and Water: Environmental Priorities for a New Millennium. Washington, DC: World Bank.

———. 2001b. China: Overcoming Rural Poverty. Washington, DC: World Bank.

World Wildlife Fund. 2003. *Report Suggests China's "Grain-to-Green" Plan is Fundamental to Managing Water and Soil Erosion*. Available at www.wwfchina.org/english/loca.php?loca=159 (accessed March 31, 2003).

Xu, Jintao, and Yiying Cao. 2001. "The Socioeconomic Impacts and Sustainability of the SLCP." In *Implementing the Natural Forest Protection Program and the Sloping Land Conversion Program: Lessons and Policy Recommendations*, ed. Jintao Xu, Eugenia Katsigris, and Thomas A. White, CCICED-WCFGTF (China Council for International Cooperation on Environment and Development, Western China Forests and Grassland Task Force). Beijing: China Forestry Publishing House.

Xu, Jintao, Eugenia Katsigris, and Thomas A. White, eds. 2001. *Implementing the Natural Forest Protection Program and the Sloping Land Conversion Program: Lessons and Policy Implications*. CCICED-WCFGTF (China Council for International Cooperation on Environment and Development, Western China Forests and Grassland Task Force). Beijing: China Forestry Publishing House.

Xu, Zhigang, Michael Bennett, Ran Tao, and Jintao Xu. 2004. "China's Sloping Land Conversion Program Four Years On: Current Situation, Pending Issues." *International Forestry Review* 6 (3–4): 317–27.

ZGTJNJ (China Statistical Yearbook). 2001. Beijing: China Statistical Press.

Zhong, Funing. 2001. "The Political Economy of the Chinese Grain Marketing System." Technical Report ACIAR Project 9721, Working Papers, APSEM. Canberra: Australian National University.

Zuo, Ting. 2001. "Implementation of the SLCP." In *Implementing the Natural Forest Protection Program and the Sloping Land Conversion Program: Lessons and Policy Recommendations*, ed. Jintao Xu, Eugenia Katsigris, and Thomas A. White, CCICED-WCFGTF (China Council for International Cooperation on Environment and Development, Western China Forests and Grassland Task Force), Part 2, Chap. 3. Beijing: China Forestry Publishing House.