Chapter 11
Participants' Income Levels

Abstract This chapter discusses the impact of the Grain for Green on the sources and level of income of farmers. While in many places agricultural incomes tended to dominate before the Grain for Green was introduced, by relieving farmers from agricultural work, the Grain for Green has had a considerable impacts on the economic structure and potential sources of income. With the Grain for Green the income structure diversified, to include agriculture, Grain for Green subsidies, the sale of Grain for Green-sponsored forest products, off-farm work in the villages of residence, and migration. In terms of the incomes from Grain for Green-induced land use changes, a distinction has to be made between economic trees, ecological trees, and grassland. Researchers agree that economic trees bring higher profits to the farmers, but even among economic trees, not all trees bring profits comparable to crops, once the subsidies are excluded from the calculation. Most researchers have looked at the benefits per hectare rather than the benefits per person-day.

Keywords Total incomes • Economic restructuring • Agricultural production • Sale of forest products • Off-farm work • Migration • Household composition • Income inequality

Introduction

In China the majority of the rural poor are concentrated in resource deficient, remote, upland or mountainous, and sometimes minority-inhabited areas in the north, northwest and southwest. Although these poor have land use rights, in many cases the land itself is of such low quality that it is not possible to produce sufficient food for subsistence. Since the Grain for Green program targets low productivity lands in mountainous areas, it was implemented primarily among the rural poor, and consequently is expected to have a positive impact on China's efforts to reduce poverty. In this chapter we examine changes in the levels of income among the households that participated in the GfG. It is reasonable to expect that the generous subsidies, the labor freed from agricultural production, and the new opportunities given by the GfG and other programs in the targeted areas would promote the development of the local economies. The research, however, has produced conflicting conclusions.

C.O. Delang, Z. Yuan, *China's Grain for Green Program*,
DOI 10.1007/978-3-319-11505-4_11

The first section discusses changes in participants' total income and in income composition. Most researchers have found that participants' incomes have increased. However, the studies reviewed in this first section the participants to the non-participants. This is not sufficient, because increased incomes and asset values are not necessarily attributable solely to the GfG program; it is very likely that the incomes of non-participants also increased, and that the increased income of GfG participants is not entirely attributable to the GfG. The second section addresses this issue, by comparing incomes of participants to those of non-participants.

Changes in Total Incomes

In 2000, Uchida et al. (2005) carried out a survey among 144 participating households from 16 randomly selected villages in Ningxia and Guizhou Provinces, and found that average household real net income increased after participating in the GfG program.[1] In Ningxia, from 1999 to 2000 the average real net household income increased 75 %, from Yuan 2,694 to 4,728. During the same period in Guizhou, it increased by 8 %, from Yuan 3,691 to 3,969. However, judging from the income structure change from 1995 to 2000 (Fig. 11.1), it seems that most of the increase from 1999 to 2000 was due to GfG payment. The differences in program payments, which themselves reflect differences in land holdings and participation in the program, explain most of the inter-provincial differences in income increases (Uchida et al. 2005).

Peng et al. (2007) looked at participants' net income in Zhangye City, a 41,924 km^2 prefectural-level administrative area at the center of the Hexi Corridor in western Gansu Province.[2] In 2001, it had a population of 1.26 million, of which about 1 million people (81.7 %) were involved in agriculture. Implementation of the GfG project in Zhangye began in 2002, and during the next 2 years, 286 km^2 of agricultural lands were converted into forestlands. Peng et al. (2007) assessed the costs and benefits to peasants engaged in the project to determine whether peasants benefited from participating in the project. Peng et al. (2007) found that the GfG had a positive impact overall on participants' net income in Zhangye city after 3 years of implementation. Except for new GfG participants in 2004, the net income of participating households was positive and increased over time (Table 11.1). The loss in 2004 might have been caused by a sudden policy change from expansion to forest/grassland maintenance (as discussed in Chap. 3).

The composition of total income shows the importance of the GfG in this particular region: between 2002 and 2004 household income was made up primarily of government subsidies (49.15 %) and migrant workers' income (40.10 %). Other

[1] The researchers collected information on households' on-farm production activities on a plot by plot basis. For each plot, respondents reported the crop(s) grown, yield, total output and inputs in 1999 before the program started. The survey also asked for detailed information on each household's total asset holdings and other income-earning activities from both on- and off-farm enterprises after the program began (Uchida et al. 2005).

[2] The survey was carried out in 2004 and included 313 randomly selected households from 13 villages.

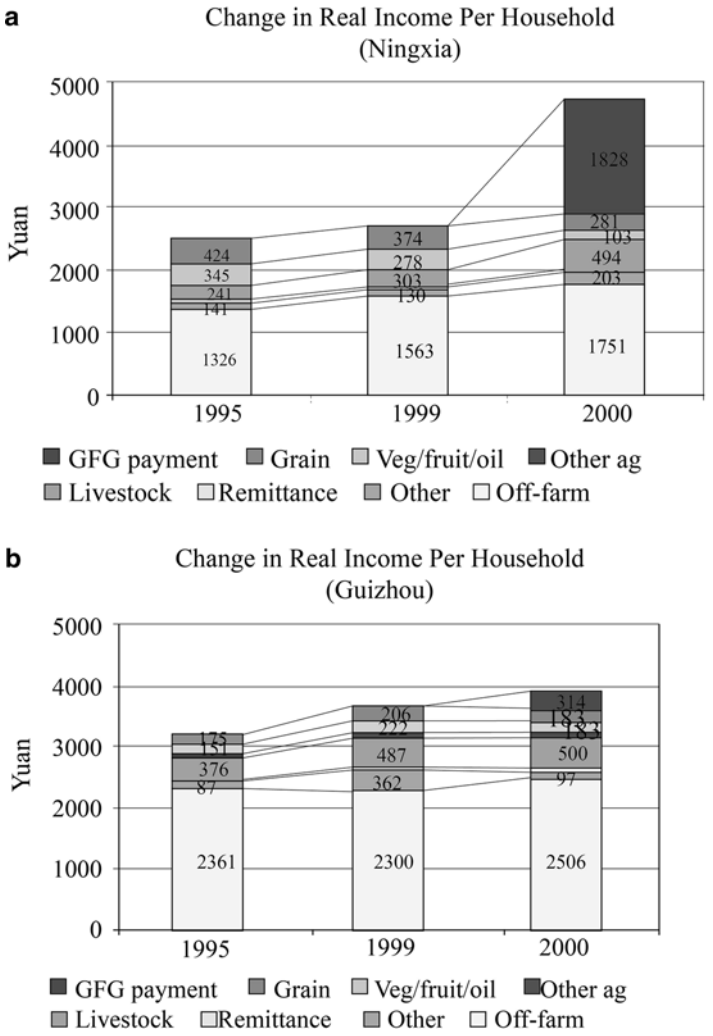

Fig. 11.1 Changes in real income per capita of farm households participating in GFG in Ningxia and Guizhou provinces, 1995–2000 (Note: Data have been adjusted for inflation. Source: Uchida et al. 2005)

Table 11.1 Net household income derived from the implementation of the GfG project in Zhangye City (2002–2004)

	Net income (million Yuan)		
Year of participation	2002	2003	2004
2002	34.03	47.36	51.53
2003		11.68	55.40
2004			–9.21

Source: Peng et al. (2007)

Table 11.2 Average per capita income in 17 counties in Hebei, Shanxi, and Inner Mongolia

	Per capita net income (Yuan)			
Year	Total	Per capita program-generated income	Per capita household production-generated income	Percentage of program- to production-generated income
1998	1,481.32	0.00	1,481.32	0
1999	1,548.55	0.00	1,548.55	0
2000	1,549.73	27.33	1,522.39	1.80
2001	1,623.01	63.44	1,559.57	4.07
2002	2,136.81	217.74	1,919.07	11.35
2003	2,692.85	544.18	2,148.67	25.33

Source: Zhang and Liu (2005)

sources of income included income from other local jobs (9.29 %), income from planting grass and breeding livestock (1.27 %), and seedling fees (0.19 %). It is likely that migration increased as the GfG freed labor from agricultural production, so it seems that the GfG helped transforming the local economy (Peng et al. 2007).

This case may be rather extreme and may be so because the region was comparatively poor. Zhang and Liu (2005), for example, found that the GfG had a much smaller impact; they looked at the contribution the GfG made to total incomes in 17 counties in Hebei, Shanxi, and Inner Mongolia from 1998 to 2003 (the data were collected in 2003 and 2004).[3] Panel data and a fixed-effect model were used to assess the immediate/near-term impact of the program on the incomes of rural households. Though missing survey participants in six counties led to an unbalanced panel, statistical tests confirm that the unbalanced panel does not significantly alter the ultimate results. Zhang and Liu (2005) found that converting farmland to forestland had a positive impact on households' incomes. However, program-generated income increased relatively slowly, from 1.80 % of production-generated income in 2000, to 25 % in 2003, still well below the levels described by Peng et al. (2007) (Table 11.2).

Zhang and Liu's results (2005) paralleled those of Xu et al. (2010), who used a 2003 household survey to examine implementation and impact of China's GfG Program.[4] Using a treatment effects approach to evaluate program impact, they found evidence of

[3] Liu and Zhang (2006) use data obtained from a unique panel survey conducted by the MOF in 17 counties of North China from 1998 to 2003, supplemented with village and county-level survey data. The 17 counties were randomly selected from 68 program-targeted counties in Hebei, Shanxi, and Inner Mongolia. A total of 188 households were sampled from the selected villages with a total of 927 observations.

[4] The 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 in which the GfG 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 (Xu et al. 2010).

positive impact on cropping, husbandry, and total income, though the results were not robust enough to support government claims of huge gains (Xu et al. 2010).

The high reliance of GfG subsidies found by Uchida et al. (2005) was not confirmed by Shi and Wang (2011). Shi and Wang (2011) conducted a long-period economic assessment that aimed to identify changes in the income structure of rural households 10 years after the project began. The fieldwork for that research was done in Mizhi County (in the northern part of Shaanxi Province).[5] The county covers 1,212 km^2 with an altitude ranging from 843 to 1,252 m, and is semi-arid with a middle temperate, continental climate. From an economic point of view Mizhi County is predominantly agropastoral, with more than 80 % of its total area being cropland, and its farmers raising a great number of goats. The county has 15 townships with 396 administrative villages and a population of more than 200,000, of which 180,000 are rural residents.

The GfG was implemented in all 15 townships of Mizhi County beginning in 1999. According to the Mizhi County Forestry Bureau, a total of 931.2 ha of croplands and degraded slope lands were converted to forestlands. This resulted in a dramatic increase in its farmers' per-capita net income. Statistical analysis showed that 9 % of the farm households increased their net incomes less than twofold, 69 % of the farm households increased their net incomes two to five fold, and 19 % increased their net incomes six to nine fold (Fig. 11.2 and Table 11.3). The per capita net income for farmers in Mizhi County increased by 317 % between 1998

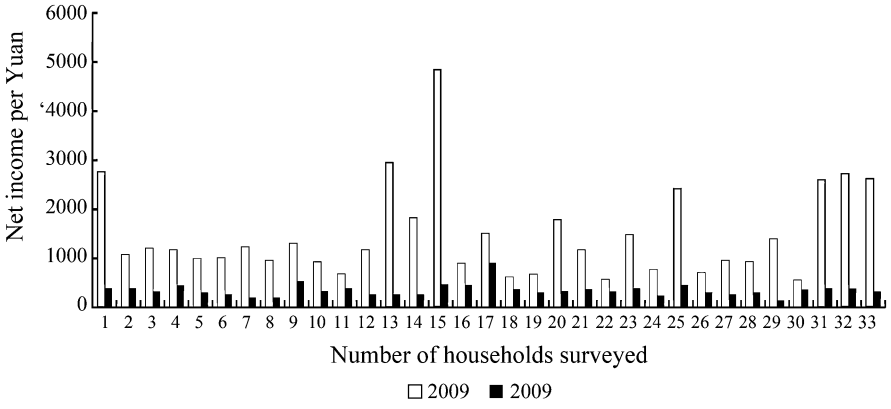

Fig. 11.2 Net income of farm households before and after implementation of the GfG project (Source: Shi and Wang 2011)

[5]A questionnaire survey was adopted to investigate farm households in 2010. Villages were randomly chosen from each district in proportion to its area size. In total there were 33 valid samples. The study also employed other approaches to obtain data, including face-to-face interviews and informal discussions with local leaders/officials, group debate with local people and comments in official records about environmental policy. Based on Bossel (1999) social sustainability indicators, the social impact of the GfG project was assessed using the coordination coefficient in systems.

Table 11.3 Overall net income and net income from crop planting of households before and after the GfG

Before the GfG		10 years after the GfG	
Net income (Yuan)	**Percentage**	**Net income (Yuan)**	**Percentage**
1,000–2,000	9.0	2,000–5,000	22.0
2,000–4,000	75.6	5,000–10,000	37.4
4,000–7,000	15.4	10,000–20,000	40.6
Net income from crop planting (Yuan)		**Net income from crop planting (Yuan)**	
1,000–2,000	9.0	1,000–5,000	13.0
2,000–4,000	15.0	5,000–7,000	50.0
4,000–7,000	76.0	7,000–10,000	28.0
		>10,000	9.0

Source: Shi and Wang (2011)

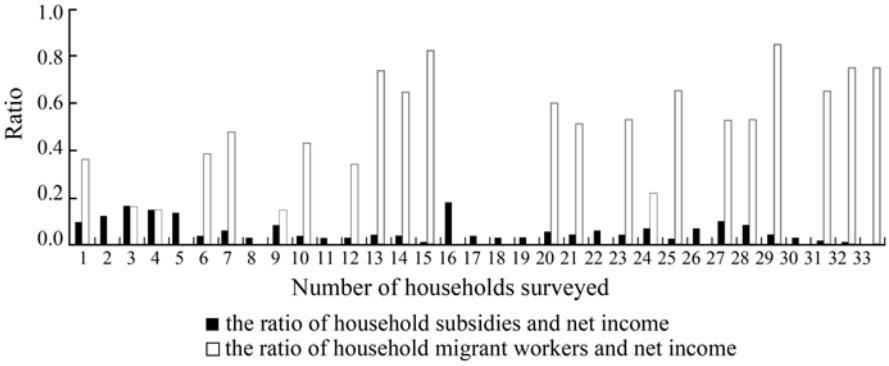

Fig. 11.3 Proportions of government subsidies and incomes of the farm household members as migrant workers to the net incomes of the farm households (Source: Shi and Wang 2011)

and 2008, reaching Yuan 3,368 in 2008 (Anonymous 1998, 2002). The possible sources of the net income increases were:

1. Expanded animal husbandry and orchards;
2. Increased income of farmers from labor service outside their hometowns;
3. Increased prices of agro-products such as potatoes and other major farm produce.

Shi and Wang (2011) found that after losing cropland, a high proportion of the farm households had members who migrated to work in urban areas or became involved in other economic sectors locally. Hence, the incomes of migrant workers made the greatest contribution to household incomes (Fig. 11.3), far outpacing household subsidies. Almost 50 % of the farm households received more than 50 % of their net incomes from migrant workers.

Table 11.4 Composition and structural change of household incomes over time (unit: Yuan in 1994 constant price)

	Quantity					Percentage	
Year	Total	Agriculture	Off-farm	Subsidy	Other	Agriculture	Off-farm
Shaanxi							
1999	3,848.0	2,413.7	1,108.3	326.0		0.63	0.29
2000	4,375.6	2,533.4	1,320.9	521.3		0.58	0.30
2001	4,501.7	2,566.9	1,426.7	508.1		0.57	0.32
2002	5,187.8	2,653.5	1,714.6	819.8		0.51	0.33
2003	5,400.5	2,458.7	1,739.8	1,201.9		0.46	0.32
2004	6,091.3	2,688.0	1,863.7	1,539.5		0.44	0.31
2005	7,290.6	2,388.5	2,764.4	1,854.1	283.6	0.33	0.38
2006	8,205.9	2,819.3	3,163.5	1,928.8	294.3	0.34	0.39
2007	9,294.7	3,130.5	4,178.6	1,493.8	491.9	0.34	0.45
2008	9,825.4	2,880.7	4,589.9	1,783.6	571.2	0.29	0.47
Sichuan							
1999	4,951.2	3,108.2	1,762.4	80.5		0.63	0.36
2000	5,580.3	3,217.5	2,111.0	251.8		0.58	0.38
2001	5,948.2	3,286.7	2,380.0	281.5		0.55	0.40
2002	6,591.0	3,439.6	2,747.9	403.5		0.52	0.42
2003	7,196.1	3,616.9	3,053.4	525.8		0.50	0.42
2004	7,709.0	3,881.8	3,261.4	565.8		0.50	0.42
2005	7,570.0	3,427.4	3,163.3	723.4	255.9	0.45	0.42
2006	8,540.3	3,847.2	3,651.6	767.0	274.4	0.45	0.43
2007	11,571.5	5,070.5	5,616.2	594.8	290.0	0.44	0.49
2008	12,445.6	5,316.8	6,157.8	554.4	416.6	0.43	0.49

Source: Yin and Liu (2011)
Note: "Other" means local welfare compensation and assistance to the poor and disabled

Yin and Liu (2011) compiled a unique longitudinal dataset from multiple rounds of surveys. The dataset covers ten consecutive years (1999–2008), containing a large but slightly fluctuating number of households, from 1,251 to 1,461, in six counties of two representative provinces in western China, Shaanxi and Sichuan. As shown in Table 11.4, while income from agriculture as a whole increased from 1999 to 2008, its pace of growth was much slower than that of off-farm and off-village income. In Shaanxi, total household income increased from Yuan 3,849 in 1999 to Yuan 9,825 in 2008 (Yin and Liu 2011). The greatest contribution to this increase was made from off-farm and/or off-village income, which rose from Yuan 1,108 to Yuan 4,590 during the same period. On the other hand, agricultural incomes only increased by Yuan 480. In Sichuan, the situation was similar. Total incomes increased from Yuan 4,951 in 1999 to Yuan 12,446 in 2008, with off-farm and off-village income jumping from Yuan 1,762 to Yuan 6,158, and agricultural income increasing more moderately, from Yuan 3,108 to Yuan 5,317. Overall, the share of agricultural income declined to only 29 % in Shaanxi, and from 63 to 43 % in Sichuan (Yin and Liu 2011).

Due to their larger percentage of participation and greater amount of land enrollment, households in Shaanxi benefitted tremendously from participating in the GfG. On average, a household there received an annual subsidy of up to Yuan 1,929 in 2006, accounting for almost 23.5 % of its total income in that year. In contrast, Sichuan had a modest increase in both enrolled households and enrolled cropland. Even though households received Yuan 70 per year more subsidy per mu, they did not benefit as much as their counterparts in Shaanxi. The highest level of subsidy was Yuan 767 in 2006, equivalent to almost 9 % of the total household income in that year (Yin and Liu 2011).

Some researchers, however, found that some areas had also experienced a decline, rather than an increase in household income due to the GfG. One such case was Dunhua County in the hinterland of the Changbai Mountains, northeast China, studied by Wang and Maclaren (2011).[6] They carried out a dichotomous logistic regression analysis to test for a relationship between perceived change in family income due to participation in the GfG, and a range of independent variables, including socioeconomic characteristics, land characteristics, and motivations for participation (Wang and Maclaren 2011).[7]

Wang and Maclaren (2011) found that, at the household level, 58 % of the families involved in afforestation felt that their income had declined after the GfG began. The impact of the program on the net income of participating households and sources of income are shown in Table 11.5. The average net income of households in three of the eight townships studied declined after the implementation of the GfG, but overall there was a growth of 13 %.[8] Farmers in Guandi Township experienced the largest absolute and percentage decline (74.2 %) in net income. There was no significant difference ($p > 0.05$) in net income between the plots set aside and those not set aside for the program. The single exception is Xianru Township, where net income from non-participating plots was more than double that from participating

[6] Dunhua County covers an area of 11,957 km^2 and has a total population of 480,000. According to the land use map of Dunhua County for the year 2000, forest lands covered 76.6 % of the territory, and farmlands 15.6 %. Slopes less than 5° accounted for 87 % of the total cropland area. Dunhua County has been the pilot site for several nationwide forest protection projects, including the NFPP (SFA 2005e). In 2000, the county was selected as a demonstration site for the GfG, and all of its 16 townships participate in the GfG program. Since 2000, 230,000 ha of land have been converted to forests (Wang and Maclaren 2011).

[7] Wang and Maclaren (2011) selected townships randomly. In each township, two villages were selected and within the two villages 20 respondents were chosen at random. The primary data came from 156 questionnaires and obtained information about income and changes in economic structure of the family before (1999) and after (2003) participating in the program, especially about economic crops, livestock raising and off-farm work. Besides the household survey, interviews with government officials of the Dunhua Forestry Bureau and other agencies were conducted to understand the historical and geographical context of society and the economy in Dunhua, and gain an overview of the progress of the program. Social and economic data of afforestation in Dunhua County were derived from statistical yearbooks, development reports by Dunhua governments, publications on local agriculture, soil, forest and historical development (Wang and Maclaren 2011).

[8] Incidentally, families who experienced a decrease in income were more likely to claim that the land conversion had been forced on them by government action. Peasant families with higher incomes and more economic resources to cope with change were associated with more positive perceptions of land use conversion (Wang and Maclaren 2011).

Table 11.5 Impact of the GFG on net household income and sources of income in Dunhua County

County		Net annual income per capita (Yuan)	Income change	Source of income (Percentage)			
				Agriculture	Off-farm	Livestock	Economic crop
Dashan	BP	2,804	−31 %	79.9	12.8	7.3	11.8
	AP	1,924		69.5	17.1	13.4	24.5
Emu	BP	1,980	9 %	79.8	8.3	11.9	17.3
	AP	2,156		62.7	17.4	19.9	22.7
Guandi	BP	2,482	−13 %	73.5	17.7	8.8	24.4
	AP	2,152		73	16.7	10.3	35.4
Heishi	BP	1,966	−15 %	73.2	12.2	14.6	2.1
	AP	1,664		59.4	15.7	24.9	3.5
Hongshi	BP	1,023	57 %	83.5	11.2	5.3	21.1
	AP	1,606		82.2	12.0	5.8	25.6
Huangnihe	BP	2,945	33 %	78.7	17.8	3.5	61.9
	AP	3,931		74.3	22	3.7	70.5
Shaheyan	BP	2,820	25 %	69.8	27.3	2.9	18.6
	AP	3,532		64.5	32.1	3.4	28.4
Xianru	BP	1,879	42 %	73.7	11.9	14.4	37.6
	AP	2,668		62.7	15.5	21.8	43.3
Average	BP	2,237	13 %	76.5	14.9	8.6	24.4
	AP	2,454		68.5	18.6	12.9	31.7

Source: Wang and Maclaren (2011)
Note: BP = before GfG (1999), AP = after GfG (2003)

plots (Wang and Maclaren 2011). Nevertheless, Wang and Maclaren (2011) show some level of restructuring of the local economy due to the introduction of the GfG.

Overall, household income is still dominated by agriculture, even though its importance declined after the GfG was introduced. Perhaps not surprisingly, incomes from agriculture overall dropped (though in some cases very little), since some agricultural land was retired (Table 11.5). On average, agricultural income accounted for about 76.5 % of total household income before the GfG was introduced and 68.5 % after. On the other hand, surprisingly, off-farm incomes increased only marginally, from 14.9 to 18.6 %, perhaps indicating that most of the opportunities available locally had already been taken and there was little migration outside the area. Livestock became an important player in some counties, such as Emu, Heishi and Xianru, although on average its contribution to total sources of income increased from 8.6 % to only 12.9 %. On the other hand, "economic crops" (the authors define them as "including tobacco, flax and other crops") increased considerably in a few counties. Dashan led the way, with economic crops more than doubling their contribution to households' total incomes. On average, the contribution of economic crops to total income also increased quite considerably, compared to the increase in other sources of income.

Table 11.6 Comparison of cropland and income per capita

Study Area	Province	Cropland per capita (ha)		Income per capita (Yuan)	
		Before the program	2000	Before the program	2000
Dingxi City	Gansu	0.336	0.227	2,022	1,487
Pengyang County	Ningxia	0.460	0.184	1,118	1,134
Heqing County	Yunnan	0.100	0.068	1,672	1,921
Dafang County	Guangzhou	0.149	0.040	1,484	1,197
Tianquan County	Sichuan	0.127	0.023	3,106	8,646

Source: Xu and Cao (2002)

The diversity of findings should not be surprising, given the social and environmental heterogeneity of China. Indeed, Xu and Cao (2002), compared five counties with different levels of cropland and income per capita, in five provinces, and found considerable variation in the consequences of the GfG program. In three cases out of five, household income increased following land retirement, in spite of less land being available (Table 11.6). In two cases, however, the income from farming dropped after the introduction of the GfG (although lower income in some counties may have been due to delayed delivery of grain and cash subsidies). Meanwhile, "income from non-farming activities increased across all the counties surveyed, suggesting that the potential for structural adjustment – reducing slope farming and exploring non-farming opportunities simultaneously – does exist, and these new activities should benefit local people and lead to sustained environmental improvement" (Yin et al. 2005: 27).

Comparison of Program Participants and Non-participants

Uchida et al. (2007) argued that only examining households that participated in the program is not sufficient, because an increased average income and asset value of the participating households is not necessarily attributable solely to the GfG program; it is very likely that the incomes of non-participants also increased, and that the increased income of GfG participants is not entirely attributable to the GfG. Participants' characteristics may also have contributed to income increases. Since officials did not implement the GfG program on the basis of a randomized experiment, it cannot be assumed that the selection bias was zero. To test the actual contribution of the GfG, and obtain a more unbiased estimate of the impact of the GfG program on income, asset holdings, and labor allocation, Uchida et al. (2007) set out to hold constant variables that may affect total incomes, but are unrelated to the GfG. To do this, they employed three approaches: propensity score matching

Table 11.7 Estimated effects of the GfG on changes in income, labor allocation and asset holdings using three approaches, 1999–2002

	PSM	*DD*	*DDM*
Dependent variable	Y(2002)	Y(2002)–Y(1999)	Y(2002)–Y(1999)
Income per capita (Yuan)	−11.36	88.19	−11.36
Crop income per capita (Yuan)	−172.21***	−114.34***	−167.14***
Other agricultural income per capita (Yuan)	171.99**	180.56*	168.02**
Livestock inventories	180.00***	180.00***	220.02***

Source: Uchida et al. (2007)

Notes: (1) The estimates are adjusted for inflation

(2) * significant at 10 %;** significant at 5 %; *** significant at 1 %

method (PSM), difference-in-differences (DD), and difference-in-differences matching method (DDM) (Uchida et al. 2007).[9]

The results of cross-sectional PSM analysis, which compares the matched participating and non-participating households with similar probability of participation, reveal that the GfG had some positive effects on participating households (Table 11.7). Although there is no statistically significant effect on the household's total income per capita, the PSM results suggest that the program had a significant positive impact on other agricultural incomes (from livestock activities), which increased by Yuan 172. In contrast, crop income dropped by the same amount. In addition, house value and livestock inventory values of the participating households increased by Yuan 486 and Yuan 180, respectively. The estimates for these variables were statistically significant (Uchida et al. 2007).

The results that show only a marginal (or negligible) impact on income are consistent with findings in Xu et al. (2003). Using DD analysis, Xu et al. (2003) found that there was a negative impact on cropping incomes and a positive impact on incomes from subsidies. In contrast to Uchida et al. (2007), however, Xu et al. (2003)

[9] Uchida et al. (2007) is based on surveys carried out in 2003, and commissioned by China's MOF as part of their effort to evaluate the nation's GfG program after the third year of implementation. By that time, this was the only existing dataset that included both participating and non-participating households. From the three provinces that had been participating in the GFG since 2000 (Sichuan, Shaanxi and Gansu provinces), two counties in each province and three townships in each County were randomly selected. In each township, two participating villages were selected, and within each village, ten households were randomly selected. There was at least one household participating in the program in every village. A total of 359 households were interviewed (Uchida et al. 2007). In two of the 36 villages, all of the households interviewed were participating households. In total, 75 % of the households interviewed participated in the GfG program. The household survey employed a sampling strategy designed to collect data on a random sample of households in the program area. Enumerators collected information on the household's production activities on a plot-by-plot basis, as well as detailed information on each household's total asset holdings, its demographic make-up, and other income earning activities from both on- and off-farm (Uchida et al. 2007).

used a model that was restricted and unadjusted for other variables and did not examine the impact of the conservation set-aside program on household assets or labor allocation. Using different versions of the propensity score matching method and survey data from 360 households for 1999 and 2003, Uchida et al. (2007) found that the GfG had only moderate success in achieving its poverty alleviation goals. They also did not find strong evidence to support the expected finding that participating households shifted their efforts into off-farm wage earning or self-employed activities, unlike what was found by others.

The findings from the DD analysis suggest that the program has had a significant impact on several income categories and several asset categories when comparing participating with non-participating households (Table 11.7). While crop income decreased (significantly) by Yuan 114, other non-crop agricultural income (from livestock enterprises) increased by Yuan 181, offsetting the decrease in crop income. Although the estimates are not statistically significant, the point estimates for fixed productive assets and livestock inventories were Yuan 683 and Yuan 161, respectively (Uchida et al. 2007). In findings largely consistent with the DD and PSM analyses, the DDM analysis results demonstrate that other agricultural incomes and the value of livestock inventories are higher for participating households (Table 11.7). Incomes from non-cropping agricultural activities increased by Yuan 168, while livestock inventories also increased, by Yuan 220. On the other hand, crop income declined by Yuan 167, as expected from a cropland set aside program, and confirmed by other studies (Uchida et al. 2007).

Using DD, PSM, and DDM approaches with different models, Uchida et al. (2007) found that there were positive, although somewhat nuanced, effects on participating households. The strongest finding was that participants increased their non-cropping incomes and asset bases to offset the fall in cropping incomes. Since Uchida et al. (2007) used cash accounting methods to measure assets, the higher direct income effects that might be associated with participation in the program could be offset by lower realized incomes from families who chose to increase their livestock holdings. In other words, if accrual accounting methods had been used, there would have been higher incomes. Moreover, 3 years is too short a time to assess the impact of a program on more fundamental structural transformations (Uchida et al. 2007).

Uchida et al. (2007) pointed out that a land retirement program, like the GfG program, had two effects on household labor: a substitution effect and an income effect. With a substitution effect a household retiring its cropland would shift the labor freed by the program into other productive activities, such as on-farm activities on the household's remaining cropland, off-farm wage jobs, or self-employment. But households may not shift all of the free time created by participating in the program into productive activities because of an income effect: a farmer could reallocate the time saved from the program into leisure. Hence, whether or not we could expect increases in off-farm labor is theoretically indeterminate (Uchida et al. 2007). Furthermore, a lack of increase in the incomes of participants may not necessarily indicate that the program failed, since the incomes of participants may have dropped if they had not participated in the program. Thus, assuming that participants' incomes must increase for the GfG to be considered successful is not necessarily correct.

As mentioned at the beginning of this section, we should expect that, after implementation of the program, both income levels and the income structure of participants and non-participants should change. This is because the opportunities available to households in the village or county change as additional money reaches the area or simply because, with the passage of time, prices of goods and opportunities change. Therefore, simply looking at socio-economic changes among participants, and assuming that all changes are due to the GfG, are likely to provide misleading information. More reliable results are obtained when the changes that occur during a given period of time among participants and non-participants living in close proximity are analyzed.

Accordingly, some studies compared changes among participants and non-participants. Xu, Bennett et al. (2004) compared the situation in Shaanxi, Gansu and Sichuan,[10] and found that, between 1999 and 2003, the growth rates in average net income varied greatly across regions. In Shaanxi, incomes of participants and non-participants exhibited a very similar growth rate; in Gansu, participant incomes showed a slower increase than that of non-participants; in Sichuan, participant incomes grew more rapidly than that of their non-participating counterparts. Overall, however, Xu et al. (2004) showed that the impact of the GfG on participants' income was statistically insignificant.

Table 11.8 presents the 1999 and 2002 components of total income for participant and non-participant households by province (Shaanxi, Gansu and Sichuan). Since such numbers could be the result of factors unrelated to the implementation of the GfG, they used a first-differences model explaining change in household per capita net income between 1999 and 2002, to more rigorously estimate program impact on income (Xu et al. 2010).

These numbers suggest that the GfG has indeed induced a restructuring of agricultural production, in which participants have shifted relatively more of their inputs from cropping into husbandry. In Shaanxi Province, growth rates for cropping income were 35 % for non-participants but only 12 % for participants (including subsidies received). In Gansu, cropping incomes dropped by 26 % and 32 % (including subsidies), respectively, while in Sichuan cropping income declined by 30 % for both groups (Xu et al. 2010).

Conversely, growth rates for husbandry were higher for participants than for non-participants. In Shaanxi, average household per capita husbandry income for participants increased by more than 1,055 %, compared to only 183 % for non-participants. In Gansu, participants' husbandry income grew by 1,783 %, compared with only 600 % for non-participants, and in Sichuan these numbers were 837 % and 500 %, respectively (Xu et al. 2010). However, changes in total income between participants and non-participants were less systematic across regions. Xu et al. (2010) estimated that in Shaanxi total income (including subsidies received) increased by 41 % and 42 % for participants and non-participants, respectively; for Gansu these numbers were 2.3 % and 12 %, respectively; and for Sichuan they were 26 % and 17 %, respectively (Xu et al. 2010).

[10] It is worth mentioning that, while the sample provinces in Uchida et al. (2005) and Xu et al. (2004) overlap, they studied different counties.

Table 11.8 Per capita net income of participant and non-participant households, 1999 and 2002

	Non-participant Households				Participant Households			
	1999		2002		1999		2002	
Income Component	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Shaanxi								
Total without subsidy	940	777	1,335	930	986	1,077	1,325	1,874
Total with subsidy							1,394	1,877
Cropping without subsidy	465	521	626	429	420	672	401	622
Cropping with subsidy							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							1,317	942
Cropping without subsidy	484	350	360	246	589	523	370	320
Cropping with subsidy							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		1,195	1,961	1,524
Total with subsidy							2,067	1,151
Cropping without subsidy	721	938	506	633	829	931	472	590
Cropping with subsidy							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: Xu et al. (2010)
Note: All units are in 1999 Yuan, adjusted using the Rural Consumer Price Index

Yao et al. (2010) suggested that, in addition to the participation status and household characteristics, the impact of the GfG on income growth and labor transfer was determined by local economic development, program extent, and political leadership; further, the impact on income could vary from sector to sector. In other words, implementing the GfG could result in quite different outcomes for farming and animal husbandry, and thus total income, in different areas; it was likely that the program made a greater impact where a better developed economy, a larger program range, and stronger political leadership existed. This was one of the first studies that attempted to incorporate both internal and external variables, in studying the program's implementation and assessing its impact on rural economies (Yao et al. 2010).

To test these propositions, Yao et al. (2010) selected three counties in the Loess Plateau region: Wuqi (Yan'an municipality, Shaanxi province), Dingbian (Yulin municipality, Shaanxi province), and Huachi (Qingyang municipality, Gansu province), then looked at the changes that had occurred between 1999 and 2006. The rationale for this selection was as follows. First, these three counties represented the typical ecological conditions found in the region, where land degradation and soil erosion were so severe that there had been a great need for farmland retirement and conversion. Second, their adjacent locations and similar landscapes as well as program implementation schedules (they all initiated farmland conversion in the late 1990s, which was virtually completed by 2005) were conducive to comparisons. Third, while these counties are adjacent, they belong to different jurisdictions, which better reflect the variations in program execution, political setting, and economic development (Yao et al. 2010).

Situated in the northeast of Yan'an municipality, Wuqi has a total population of 127,369, with 109,470 rural residents. Unlike its neighbors, the county, which has been extremely poor, has enjoyed preferential treatment by the central government for two reasons. First, it has major oil and gas reserves. Second, it occupies a significant place in contemporary Chinese history as the end point of the Red Army's Long March (Wuqi GfG office 2007). This attention, since the mid-1980s, has enabled Wuqi's economy to grow rapidly. In 2005, the county's GDP was Yuan 2.1 billion, and its own revenue reached Yuan 0.7 billion. In recent years, Wuqi has become one of the richest counties in western China (Wuqi Statistics Bureau 2006).

Before 1998, Wuqi had 123,700 ha of cultivated land, or 3.40 ha per household, and a large number of the rural households also raised goats – the number of goats peaked at 280,000. As a consequence of extensive farming and open grazing, the county's land and vegetation were heavily degraded, causing severe water runoff and soil erosion. In response, Wuqi began retiring croplands on steep slopes and converting them to forest and grass coverage in 1998. Taking advantage of the GfG, Wuqi's land set-aside and conversion expanded tremendously in 1999. Croplands were cut back to 10,000 ha, and open grazing was banned in favor of raising goats in pens and vegetation recovery (Wuqi Statistics Bureau 2006, in Yao et al. 2010). By 2006, over 97,000 ha of converted cropland had passed the national survival, growth, and stocking inspections (Wuqi GfG Office 2007, in Yao et al. 2010).

Lying in the transitional zone between the Loess Plateau and the Erdos Desert, Dingbian is located in the west part of Yulin. Over 87 % of its population of 315,851 lives in rural areas (Dingbian Statistics Bureau 2006). On the other hand, Huachi is located in the eastern part of Gansu province, and 86 % of its 130,175 population is rural (Huachi Statistics Bureau 2006). As with Wuqi, both counties are endowed with rich petroleum and gas resources, as well as extensive farming and open grazing. Dingbian and Huachi, however, have not been allowed to develop their natural resources. Instead, the national company Changqing Petro Co., holds exclusive rights to exploration. While the GDP of Dingbian and Huachi in 2005 was close to Yuan 3 billion and Yuan 4.6 billion, respectively, higher than that of Wuqi, much of the profits from oil and gas extraction were retained by the oil company, and did not significantly benefit the local treasury.

Consequently, the total budget for Dingbian and Huanchi counties was less than Yuan 60 million in 2005 (Dingbian Statistics Bureau 2006; Huachi Statistics Bureau 2006, in Yao et al. 2010).

The total amount of cropland retired through the GfG by 2006 was 10,966 ha for Huachi and 21,905 ha for Dingbian, suggesting a much smaller extent of program implementation, given their total cropland holding in 1997 of 57,265 ha and 83,333 ha, respectively. Further, extensive farming and open grazing in these two counties were still the norm rather than the exception. Their local investment in land retirement was negligible, and incidences of delayed delivery and deduction of farmers' subsidies occurred (Dingbian GFG office 2007; Huachi GfG Office 2007 Compared to Wuqi, Dingbian and Huachi lacked political leadership, local investment, and extensive participation (Yao et al. 2010).

In August 2007, Yao et al. (2010) conducted a survey of 200 randomly chosen households in each of the three counties, including basic household characteristics, production, consumption, income, and farmland retirement and conversion. The data revealed that there was little difference in the number of laborers, the average amount of education in years, and the average age of household head between participating and non-participating households. On the other hand, noticeable differences existed in family size, cultivated land, and years of schooling of household heads (Yao et al. 2010).

Dividing income into discrete categories that included farming, animal husbandry, off-farm work,[11] and other sources, enabled Yao et al. (2010) to look into the gains and losses experienced by different sectors. They then used the DD model to detect the program's impact. Table 11.9 compares per capita income of the participant and the non-participant household groups in Wuqi in 1999 and 2006. Except for participating households' income from animal husbandry, all categories of income increased during the period under consideration. Both non-participants and participants saw their incomes from crop production increase, but non-participants saw their incomes increase by more: in 1999 the difference between non-participating households and participating households was Yuan 1,859, while in 2006 the difference had dropped to Yuan 1,136. Even though the amount of cultivated land of participating households was reduced, their improved productive efficiency seems to have reduced the income gap from crop production with non-participating households (Yao et al. 2010). Income from animal husbandry increased both for non-participating and participating households, but more so for participating ones. Similarly, income from off-farm employment increased for both participants and non-participants, but comparatively more for participating households. As mentioned, unlike other studies, Yao et al. (2010) found that even before the GfG was introduced in the region, participating households engaged more in off-farm incomes than non-participating households. Finally, other incomes increased by a similar amount for both groups. Overall, the income of participating households was much higher before implementation of the GfG, and remained equally higher in 2006 (Yao et al. 2010). These findings, again, differ from those of other studies.

[11] Off-farm employment includes (a) employment in local non-agricultural activities and (b) off-village employment as migratory workers.

Table 11.9 Per capita average income of surveyed households in Wuqi, 1999 and 2006

	Non-participating households		Participating households		Between group income difference	
Type of income[a]	1999	2006	1999	2006	1999	2006
Crop production income	5,591	5,788	3,733	4,653	1,859**	1,136
Animal husbandry income	1,162	1,948	3,575	1,409	−2,413**	539
Off-farm income	2,475	2,916	10,404	13,785	−7,930	−10,869***
Other income	0	5,411	61	6,778	−61	−1,367
Total income	9,228	16,064	17,773	26,625	−8,544***	−10,561***

Source: Yao et al. (2010)

Notes: (1) These statistics are rounded mean values, so they may not add up to the total exactly
(2) ***, ** represent significance levels of 1 % and 5 %, respectively

[a]Crop production income comes from producing corn, potatoes, and other minor crops; animal husbandry income comes from raising livestock, predominantly goats; off-farm income is comes from off-farm employment, mainly construction and service work in local towns as well as large cities; other income is derived from sources such as family properties and government subsidies; total income is the gross income from all sources (Yao et al. 2010)

Table 11.10 Per capita average income of surveyed households in Huachi and Dingbian, 1999 and 2006

	Non-participating households		Participating households		Between group income difference	
	1999	2006	1999	2006	1999	2006
Crop production income	2,176	4,511	2,475	4,615	−299	−104
Animal husbandry income	2,371	1,591	1,358	1,265	1,012	326
Off-farm income	6,409	5,568	6,642	9,912	−234	−4,344
Other income	1,459	1,708	487	535	972***	1,172*
Total income	12,414	13,379	11,962	16,327	1,452	−2,948

Source: Yao et al. (2010)

Notes: (1) These statistics are rounded mean values, so they may not add up to the total exactly
(2) ***, * represent significance levels of 1 % and 10 %, respectively

Similar results have been found among the households surveyed in Huachi and Dingbian (Table 11.10); however, crop production incomes were slightly higher for participating households than for non-participating households in 1999, while in 2006 they were about the same. Since participating households had a considerable amount of farmland set aside, as in the case of Wuqi, we can conclude that they were able to considerably increase the productivity of their remaining land.

Differences can also be observed in incomes from animal husbandry. While in Wuqi the income from this activity for participating households had more than halved, in Huachi and Dingbian it dropped only marginally. Remarkably, in these two counties income from animal husbandry also dropped for non-participating households, unlike in Wuqi. Off-farm incomes dropped for non-participating farmers, perhaps

Table 11.11 Regression results of income and off-farm employment based on the model with specific variables for regional variation

	Crop production income	Animal husbandry income	Off-farm income	Other income	Off-farm employment	Total income
Status of participation	131.11	−2,445.52	3,170.06	382.16	0.09	5,397.04
Economic condition	619.27	202.64	187.94	−269.32	0.25	286.52
Program extent	170.25	73.69	62.95	−145.46	0.12	175.97
Political leadership	251.33	68.18	55.18	−50.79	0.07	91.63
Education of household head	83.55	191.92	522.17	138.29	0.02	1,059.97
Family size	8.37	507.66	191.12	1,309.85	0.14	1,867.99
Number of laborers	190.59	258.93	−1,792.95	−498.13	0.07	1,376.97
Non-agricultural employment	187.41	−606.91	9,191.11	126.79	*NA*	11,046.1
Per capita cultivated land	984.56	−159.15	−328.14	252.31	−0.02	231.62
R^2	0.58	0.40	0.25	0.20	0.48	0.15

Source: Yao et al. (2010)
NA: The non-agricultural employment variable is not included in the off-farm employment transfer model

because they concentrated more of their labor on crop production. Like the situation in Wuqi, however, off-farm incomes increased for farmers in Huachi and Dingbian. The result was that incomes increased only marginally for non-participating households, but they increased considerably for participating ones. Unlike in Wuqi, in 1999 participating households had slightly lower incomes than non-participating households. By 2006, however, as in Wuqi, non-participating households had been able to reverse the situation and had higher incomes than participating ones.

Table 11.11 shows the econometric relationship between various sources of income (first column) after the implementation of the GfG, and different variables (first row). The data reveal the following: First, all of the variables have a positive effect on the crop production income regression. Compared to non-participating households, crop production income of participating households increased by Yuan 131.1, which is not a large amount but is significant at the 99 % level. A better-developed local economy, a larger program, and stronger political leadership, respectively, result in an increase in the households' crop production income by Yuan 619.3, 170.2, and 251.3 at the 99 % significance level. Together, these add up to a significant increase (Yuan 1,240), partially confirming what Yao et al. (2010) hypothesized: variations in local programmatic, economic, and political conditions all affect crop production income. The head of household's education level also has a significant influence on crop production income, with each additional year of schooling leading to an increase of Yuan 83.6. Other variables, like the number of

household laborers, per capita cultivated area, and non-agricultural employment, also led to a significant increase in crop production income (Yao et al. 2010).

Second, the regression of animal husbandry income reveals that participation status is negatively associated with the income at the 95 % significance level. Animal husbandry income of participating households is decreased by Yuan 2,445.5, in comparison to that of non-participating households (Yao et al. 2010). Here, program extent, economic development, and political leadership do not matter much. Variables like years of schooling for household head, family size, and number of household laborers have a positive but statistically insignificant effect. Likewise, per capita cultivated area and local non-agricultural employment have a negative but statistically insignificant effect (Yao et al. 2010).

Third, the off-farm income is positively related to the participation status and household head's years of schooling at the 90 % significance level. Participation allowed a household's off-farm income to increase by Yuan 3,170.1, and one additional year of schooling for the household head led to an increase of Yuan 522.2. Local economic development, program extent, and political leadership caused household off-farm income to increase respectively, by Yuan 187.9, 62.9, and 55.2. These effects are all significant at the 99 % level (Yao et al. 2010). Additionally, non-agricultural employment had a positive effect at the 99 % significance level. One more family member employed in the nonagricultural sector resulted in the household's off-farm income increasing by Yuan 9,191.1. In contrast, family size, number of household laborers, and per capita cultivated area did not have strong correlations with off-farm income. As to income from other sources, the regression has only one significant variable, family size, suggesting that the larger the family, the greater the income. All the other variables have little effect (Yao et al. 2010).

Fourth, the regression of the number of off-farm employment revealed that participation had a positive effect on off-farm employment at the 95 % significance level. Other things being equal, participation caused 0.09 units of labor to shift out (Yao et al. 2010). Although there was a positive relation with years of schooling for household heads, this relation was statistically insignificant. While family size and number of household laborers had positive effects on off-farm employment, per capita cultivated area had a negative effect on off-farm employment. These results illustrate that the more surplus labor a family has, the more off-farm income it generates; and, the larger the per-person cultivated area, the less likely it is for the household to engage in intensive farming, making it more difficult to seek off-farm work (Yao et al. 2010). Local economic development has a positive relation with off-farm employment; a coefficient of 0.25 indicates that the condition is a key factor in labor transfer. Program extent has an effect of 0.12, and political leadership has an effect of 0.07. Together, these variables cause 0.45 units of labor to shift out of farming, which is more than four times greater than the coefficient of participation status alone. This has further confirmed the hypothesis of Yao et al. (2010): the realized transfer of surplus farming labor depends on both internal and external conditions, coupled with program participation (Yao et al. 2010).

Fifth, total income has a positive correlation with years of schooling for the household head, family size, number of laborers, and non-agricultural employment. The contribution of these variables is Yuan 1,056 from one more year of household head

education, Yuan 1,870 from one more person in the household, Yuan 1,377 from one more family laborer, and more substantially, Yuan 11,046 from one more non-agricultural job (Yao et al. 2010). Participation in the land conversion program results in an increase in total income by Yuan 5,397. In addition, local economic development, program extent, and political leadership are positively correlated with total income. Their coefficients, respectively, are Yuan 287, Yuan 176, and Yuan 91.6 (Yao et al. 2010).

Yao et al. (2010) conclude that, while the GfG has had a significant positive impact on crop production income, the magnitude of this effect is small. In comparison, better local economic conditions, larger program extent, and stronger political leadership have had a much greater impact. These results suggest that cropland retirement does not necessarily cause a reduction in crop yield or income if the production mode can be sufficiently transformed by adopting better inputs and management practices. With regard to income from animal husbandry, however, participation has had a substantial negative effect that is almost ten times greater than the combined positive effects of local economic conditions, program extent, and political leadership. Clearly, animal husbandry was hit hard by the grazing and feeding constraints imposed by the GfG, even with local efforts to maintain its vitality (Yao et al. 2010).

Meanwhile, participation has had a large positive effect on both off-farm income and total income. In combination the results indicate that, although animal husbandry has been negatively affected, the program's impact on other sectors has been positive therefore more than offsetting the aggregate negative effects (Yao et al. 2010). The results of the off-farm employment and income regressions highlight the fact that participating in the program has accelerated the transfer of farming labor and has greatly stimulated income growth from off-farm opportunities. Moreover, these positive effects have been reinforced by better economic development, larger program extent, and stronger political leadership. These findings are new and they have provided further supporting evidence for Yao et al.'s (2010) claim that the socioeconomic effects of the program are indeed predicated on the program's local range and conditions, coupled with participation status.

Yao et al. (2010) argue that while their findings regarding the program's negative effect on animal husbandry income for participants, and its positive effect on off-farm employment and total income, conform to what was previously reported (for example by Guo et al. 2005), confirming a positive effect on cropping income is new. This implies that cropland reduction will not inevitably cause a decline in crop yield, and thus income. Yao et al. (2010) propose that the significance of these effects is directly related to their sample features, including the selection of a representative study site, the coverage over a long period of time, the division of total income into specific categories, and the capture of specific regional variations. They conclude that the differences between their results and those of Xu et al. (2004) and Yi et al. (2006) lie in these factors.

Another study that compared participants and non-participants was carried out by Yin and Liu (2011) using a dataset that contained a large but slightly fluctuating number of households (from 1,251 to 1,461) in six counties of two representative provinces in western China – Shaanxi and Sichuan – over ten consecutive years (1999–2008). Table 11.12 disaggregates the net revenues from grain and livestock

Table 11.12 Total and off-farm incomes for the two different groups of households in Sichuan (unit: Yuan in 1994 constant price)

	Total Income		Grain Production		Livestock Production		Off-farm Income	
Year	Participants	Non-participants	Participants	Non-participants	Participants	Non-participants	Participants	Non-participants
1999	5,124.9	4,940.9	1,141.2	1,201.8	1,197.6	1,594.4	2,107.9	1,742.1
2000	6,334.0	5,302.1	1,147.8	1,222.7	1,705.8	1,639.5	2,397.4	2,005.3
2001	6,541.8	5,666.2	1,128.7	1,230.9	1,653.6	1,723.6	2,647.8	2,252.8
2002	7,050.6	6,202.2	1,144.5	1,294.5	1,680.5	1,880.0	3,078.7	2,468.2
2003	7,525.1	6,682.6	1,239.1	1,323.1	1,801.2	1,983.4	3,266.3	2,721.0
2004	8,136.2	6,991.6	1,266.9	1,402.8	1,988.6	2,143.5	3,580.1	2,726.1
2005	7,890.9	6,990.5	1,051.1	1,114.4	1,603.7	1,890.3	3,720.8	2,874.5
2006	8,907.6	7,866.2	1,117.3	1,191.3	1,839.9	2,243.1	4,294.6	3,249.5
2007	11,654.9	11,418.8	996.5	1,264.0	3,168.1	3,983.1	6,124.9	5,505.4
2008	12,127.3	12,965.8	907.2	1,180.6	3,022.7	3,819.6	6,555.1	6,606.0

Source: Yin and Liu (2011)

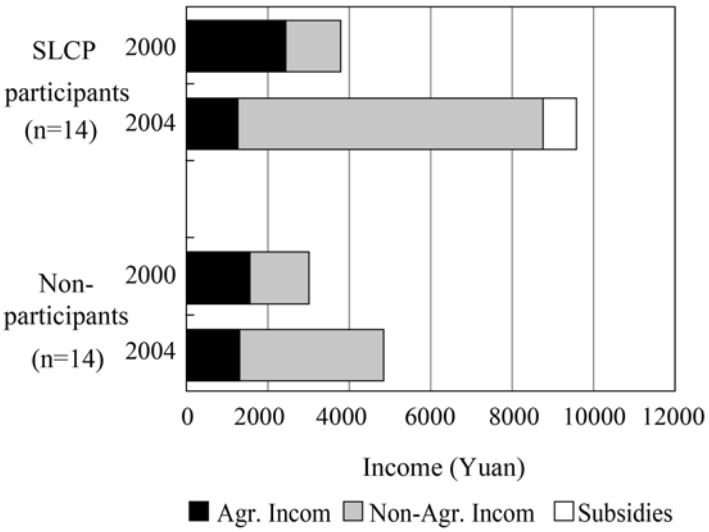

Fig. 11.4 Income of participating and non- participating households in GfG, 2000 and 2004 (Source: Hori and Kojima 2008)

production in Sichuan for participating and non-participating households. Compared to participants, non-participants were able to maintain a slightly higher level of net revenue from grain and livestock production, although during the last 2 years of the survey (2007–2008) this difference increased. Still, off-farm incomes were much higher among participants, as expected, since participants were in some measure liberated from farm work. Overall, the higher on-farm income of participants and off-farm income of non-participants were approximately equivalent, and the difference in total income fluctuated around Yuan 1,000 in favor of participants.

Hori and Kojima (2008) addressed the differences between participants and non-participants in Mizhi County, Yulin City, Shaanxi Province, using a dataset of 27 participant and non-participant households from 2000 to 2004. They found that there were few differences in total incomes of participants and non-participants in 2000, with GfG participants earning slightly more than non-participants. These differences grew considerably by 2004, however (Fig. 11.4). Among participants, agricultural incomes declined about 50 % between 2000 and 2004, but non-agricultural incomes increased more than five-fold, jumping from Yuan 1,448 in 2000 to Yuan 7,559 in 2004. Non-agricultural incomes consisted mainly of incomes from migrant workers. The number of migrant workers among GfG participants increased considerably (Table 11.13). Overall, including GfG subsidies, incomes more than doubled from 2000 to 2004, with the income by migrant workers making up more than 70 % of nonagricultural income for both types of households in 2004. More than 50 % of villagers were working in Yulin City district. This can be attributed to the economic growth that occurred in Yulin thanks to the "Go West" campaign, which began in 1999 and can be said to have had a positive impact on

Table 11.13 Variety of migrant workers

Year	GfG participants	Non-participants	Manual labor	Others
Before 1998	2	4	5	1
1998	1	1	0	2
1999	2	0	1	1
2000	0	1	1	0
2001	0	2	2	0
2002	5	1	3	3
2003	12	1	5	8
2004	2	0	1	1
Total	**24**	**10**	**18**	**16**

Source: Hori and Kojima (2008)
Note: Data represent the result of interviews with householders, Unit: person

local migrant workers, thereby contributing to the success of the GfG. Nevertheless, the authors point out that Yulin is rich in mineral resources while most Chinese rural areas have fewer local opportunities, thus lower non-agricultural incomes. Meanwhile, among non-participants, while agricultural incomes decreased very slightly, nonagricultural incomes did not increase as much as those of GfG participants (Fig. 11.4). The result is that, while in 2000 GfG participants earned only slightly more than non-participants, by 2004 they earned twice as much.

Roles of Household Members and Importance of Household Composition

Household composition, in particular the ages of household members, is important in determining the opportunities available to them beyond the village, and therefore the ways in which households adapt to reforestation programs. Liang et al. (2012) looked at the ways in which household composition determined the impact of the GfG program on household activities and livelihood in Zhouzhi County, one of the poorest counties in Shaanxi province, with Yuan 3,023 average per capita income in 2005. The county has a total area of 2,949 km^2, most of which is located in the Qinling Mountains, a natural boundary between northern and southern China. In 2002, Zhouzhi County introduced the GfG in the mountain towns.

Liang et al. (2012) is based on interviews and questionnaire surveys that used multiple level cluster sampling, conducted in April 2008.[12] Liang et al. (2012) first

[12]At the household level, cluster sampling was used for the questionnaire survey in 20 villages from the four selected towns. 1,078 questionnaires were completed, covering both participating and non-participating households with a variety of detailed information on demographic characteristics, production and consumption activities, income and other livelihood, as well as some basic information on each family member. In particular, the questionnaire addressed households' assets that did not change much even after participation in the program (Liang et al. 2012).

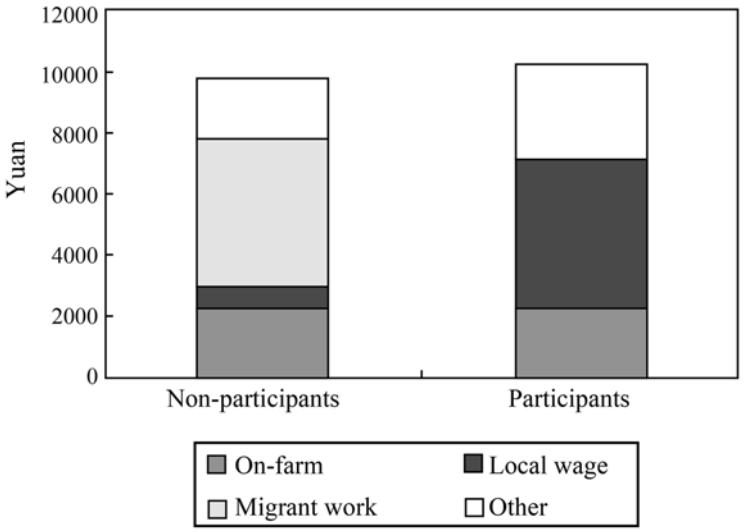

Fig. 11.5 Mean household income portfolios in 2007 of households with children but no elderly (Source: Liang et al. 2012)

divided household members into three groups by age: children (<15 years old), adults (15–65), and elderly (>65). Due to mandatory education laws and a traditional emphasis on education, children are primarily in school. In order to test different policy effects dependent on various types of household composition, Liang et al. (2012) adopted the calculation formula of Uchida et al. (2007) to estimate household income.

The study found that: (1) participants who had children but no elderly had relatively more local wage income and less migratory wage income, due to lower propensity to migrate; (2) on-farm income was almost the same for the two groups (Fig. 11.5), because participants had less crop income but more forestry income after some of their land was converted; (3) participants had slightly more income than non-participants, since more often than not payments were more than the opportunity costs of the retired land; (4) notwithstanding overall significant positive effects on household local wage income, participating in the program had negative effects on migrating income; (5) local wage incomes were larger for participants than for non-participants. Non-participants earn a much larger share of household income from migration than from local wage work, while participants earned comparatively more from local wage work (Fig. 11.5); (6) estimation of income without payments showed that households with children but no elderly (H(C, A)) relied relatively more on payments from the GfG (Table 11.14). This can also shed light on which types of households will be most affected by cessations of payments from the program. The lower level of migration among GfG-participants may be caused by fewer opportunities for migration because of lower education levels and/or a weaker social network outside the locality. In other words, the GfG

Table 11.14 Estimated impact of the Grain for Green Program and household composition on income

	Total income[a]	On-farm income[b]	Income without payments[c]	Migrating wage-income[d]	Local wage-income[e]
Households with adults and elderly H(A,E)	−270.51	−123.5	−1,636.11	867.67	2,594.41
Households with only adults H(A)	−743.39	−347.76*	−1,862.29**	−276.77	2,354.03
Households with children and adults H(C,A)	−1,895.91**	−568.75**	−3,329.07***	−6,946.50***	5,859.25***
Households with children, adults and elderly H(C,A,E)	278.57	280.76	−1,304.99	−2,403.46	2,985.06

Source: Liang et al. (2012)

Notes: (1) [a,b,c]: Coefficients are estimated by OLS. [d,e]: Coefficients are estimated by Tobit
(2) *, **, *** indicate significance at 10 %, 5 % and 1 % levels, respectively

may not be able to promote migration as much as may be desirable, in spite of the financial incentives that people would have, because of social or structural constraints. It is quite possible that, without GfG subsidies, people would migrate even less, since there would be financial deterrents, such as loss of income from crop production (Liang et al. 2012).

Unlike areas where households can increase income from livestock activities and other types of assets after they participate in the GfG (as discussed, for example, by Uchida et al. 2007), Liang et al. (2012) found that villages' ecological policies were intensively implemented and households' activities were heavily restricted. For the H(C, A) group, which was heavily reliant on payments, if payments were removed from total income, participants could face a more serious income loss than other groups. Previous studies (Uchida et al. 2005; Xu et al. 2004) also found that, on average, increased income for participating farmers in Guizhou and Ningxia was due mainly to program payments (Liang et al. 2012). Other explanations for income loss from the program for the H(C, A) group are that the households were risk averse and took the subsidies as a risk-coping strategy, or a household over-anticipated the possibility of engaging in alternative, income-generating activities.

Income Inequality

Because the GfG primarily targeted the least-productive land and the poorest households, it should be expected that the program contributed to decreasing inequality in the communities where it was implemented. Yin and Liu (2011)

Table 11.15 Estimated Gini coefficients and their sources

Year	Yuan in 1994 constant prices					
	Gini Coefficient	Total Income	Agriculture	Off-farm Income	Subsidies	Other
Shaanxi						
1999	0.34	3,848.0	2,413.7	1,108.3	326.0	0.0
2000	0.34	4,375.6	2,533.4	1,320.9	521.3	0.0
2001	0.34	4,501.7	2,566.9	1,426.7	508.1	0.0
2002	0.34	5,187.8	2,653.5	1,714.6	819.8	0.0
2003	0.34	5,400.5	2,458.7	1,739.8	1,201.9	0.0
2004	0.34	6,091.3	2,688.0	1,863.7	1,539.5	0.0
2005	0.28	7,290.6	2,388.5	2,764.4	1,854.1	283.6
2006	0.29	8,205.9	2,819.3	3,163.5	1,928.8	294.3
2007	0.33	9,294.7	3,130.5	4,178.6	1,493.8	491.9
2008	0.39	9,825.4	2,880.7	4,589.9	1,783.6	571.2
Sichuan						
1999	0.34	4,951.2	3,108.2	1,762.4	80.5	0.0
2000	0.34	5,580.3	3,217.5	2,111.0	251.8	0.0
2001	0.35	5,948.2	3,286.7	2,380.0	281.5	0.0
2002	0.33	6,591.0	3,439.6	2,747.9	403.5	0.0
2003	0.33	7,196.1	3,616.9	3,053.4	525.8	0.0
2004	0.33	7,709.0	3,881.8	3,261.4	565.8	0.0
2005	0.31	7,570.0	3,427.4	3,163.3	723.4	255.9
2006	0.31	8,540.3	3,847.2	3,651.6	767.0	274.4
2007	0.37	11,571.5	5,070.5	5,616.2	594.8	290.0
2008	0.39	12,445.6	5,316.8	6,157.8	554.4	416.6

Source: Yin and Liu (2011)

looked at the GfG's impact on inequality among 1,251–1,461 households (depending on the year) in six counties of Shaanxi and Sichuan provinces between 1999 and 2008. In 1999, the Gini coefficient for the households studied was 0.34.[13] The Gini coefficient dropped slightly until 2005–2006, then rose to be higher in 2008 than in 1999. Based only on these figures, we can say that the GfG ended up increasing inequality. Nevertheless, interesting information can be gathered about the sources of income, in particular the limited importance of GfG subsidies, and the increasing importance of off-farm work. In Shaanxi, off-farm incomes increased fourfold from Yuan 1,108.3 in 1999 to Yuan 4,589.9 in 2008, while in Sichuan it increased more than threefold from Yuan 1,762.4 in 1999 to Yuan 6,157.8 in 2008. Meanwhile, on-farm incomes remained almost unchanged in Shaanxi, while in Sichuan they increased by about 70 % (Table 11.15) (Yin and Liu 2011). Thus, the

[13] The lower the Gini coefficient, the more equality there is. A Gini coefficient of 0 means that everybody has exactly the same income. A Gini coefficient of 1 means that all income is concentrated in one person.

greatest change is in off-farm employment. Not unexpectedly, those willing and able (or forced) to leave the countryside, or engage in non-farm work in the rural areas, are able to earn much higher incomes than they did on the farm, which increases inequality. It is unknown whether the migrants are participants or non-participants, and other studies have found that they may be both. It is possible, however, that by encouraging off-farm employment of farmers with the worse land, the GfG may have contributed to the poorest farmers becoming the "new rich", thus reversing the social structure in the villages. Some of the poorest households may now be among the richest, thanks to off-farm work. These may be interesting consequences of the GfG that could be further investigated.

Conclusions

This chapter has looked at the changes in income levels among GfG participants, and compared the changes to those of non-participants. The conclusions are mixed. In some cases, non-participants have seen their incomes increase more than participants while in other cases the opposite is true. However, it is useful to remember that if the incomes of participants failed to increase (or even declined) it does not necessarily mean that the GfG failed: it is possible that participants' incomes would have declined even more without the GfG. In some cases, GfG subsidies constituted a relatively large part of participants' total income (e.g. Uchida et al. 2005), which means that a cut in subsidies will lead to a considerable drop in their standard of living. In other cases (e.g. Yin and Liu 2011), the income from off-farm work formed the largest component of total income. This is not entirely surprising, since off-farm wages are usually considerably higher than income from agriculture, especially when practiced on marginal land. Nevertheless, here too there are some contradictory findings among researchers. Some researchers (e.g. Liang et al. 2012) have found that participants have higher incomes, while others (e.g. Yao et al. 2010) have learned that non-participants have higher incomes from off-farm work. Thus, there are strong indications that the GfG has had different impacts in different areas, either because of differences in leadership (as pointed out by Yao et al. 2010), because of different local opportunities for off-farm work, or because of uneven environmental and ecological conditions.