Chapter 13
Sustainability of the Grain for Green Program

Abstract In this chapter, we examine the sustainability of the Grain for Green. The Grain for Green was originally scheduled to end in 2007, but was extended, and the subsidies are now set to end beginning in 2015 for the land that was first set aside, and later for other land. The question is whether the farmers will continue with the Grain for Green-induced land use changes, or will revert back to the pre-Grain for Green land uses once the subsidies end. There are constraints on cutting the trees, in particular a quota system, whereby the farmers need to obtain permission from the Forestry Bureau to fell their trees. Nevertheless, if the income from tree products do not compare favorably to those from cash crops, when the subsidies end there will be considerable pressures on the forest. The hope is that the rural economies have sufficiently transformed (through the Grain for Green and other programs), and that off-farm opportunities abound, so that farmers no longer need to revert their least productive land to pre-Grain for Green land uses. One issue that complicates assessments of sustainability is the fact that most studies were done during the first years after the program was implemented, when the monetary benefits from the economic trees could not yet be fully ascertained. However, some studies did try to estimate future changes in prices, and predict farmers' adaptation to such changes.

Keywords Future incomes • Changes in taxation levels • Changes in interest rates • Farmers' attitudes • Property rights • Program sustainability

Introduction

At the time of implementation, government financial transfers made the Grain for Green program very profitable for farmers because, in many cases, subsidies were higher than incomes from farming the set-aside land. Subsidies were essential if farmers were to join the program voluntarily, since during the first few years farmers could make little money from the sale of tree products (such as fruits) or from thinning the trees. However, the GfG, like many other reforestation and rural development programs in the developing world, has a limited budget and a finite time line, and subsidies will eventually end. The GfG is very costly, with a projected investment of no less than Yuan 431.8 billion by 2016. Originally, it was set to last for 8 years for ecological trees, 5 years for economic trees, and 2 years for

C.O. Delang, Z. Yuan, *China's Grain for Green Program*,
DOI 10.1007/978-3-319-11505-4_13

grassland, with the program beginning to be phased out beginning in 2007. In 2007, however, the government renewed the GfG program payments and the program is now scheduled to begin being phased-out in 2015. The GfG has been renewed once, but it is unclear whether the government will continue program payments after this second period ends. What is clear is that subsidies cannot continue forever, and that if deforestation resumes once the payments end, the reforestation program can be said to have failed. With every reforestation program, however, there is the question of whether it is sustainable (i.e. whether the land use/land cover introduced by the program will continue after payments end).

Evidence from similar land set-aside programs in other parts of the world suggests that once payments cease, a large amount of land may return to its pre-program use (Uchida et al. 2005). This is the case, for example, of the Conservation Reserve Program (CRP) in the United States, where a relatively high number of farmers revert their land back to cultivation after subsidies end (USDA 2000). The objectives of the CRP do not include poverty alleviation, and the CRP is not intended to lead to economic diversification of the targeted areas. Since the GfG includes these objectives, it is hoped that it will be more sustainable than the CRP. Available evidence suggests, however, that officials in China should be concerned about the long-term sustainability of the GfG.

Farmers may chose not revert the land to pre-GfG land uses for three reasons. First, they may earn more from the economic or ecological trees than they would earn from growing food crops. Second, the GfG (together with other programs undertaken by the Chinese government) may has been successful in transforming the local economy, and there are now better (in farmers' views) off-farm opportunities locally. Third, they may have migrated to cities, either in their province of origin or in other provinces, with better opportunities than their place of origin, and have now settled in those cities. Thus, it is fair to say that the sustainability of the GfG also depends on the broader economic development of China, and on how successfully the farmers can diversify their livelihood (Hori and Kojima 2008).

This chapter looks at how sustainable the GfG can be expected to be, that is, whether farmers are likely to revert the converted land back to pre-GfG land uses once the subsidies end, or whether the conditions have been put in place for GfG-land uses to be maintained, not only because of legal restrictions on tree felling,[1] but also because the farmers chose to continue the land-use practices introduced by the GfG. We first examine the economic benefits from plants and how these compare to food and cash crops, given expected (or potential) changes in prices, taxation, subsidies, and interest rates. This addresses the question of how well future expected profits from tree products compare to profits from pre-GfG land use. By the time the subsidies end, the land use/land cover changes introduced through the GfG should ideally generate an income that is comparable (or superior) to alternative, more

[1] As mentioned in Chap. 1, there is a quota system for felling trees. If farmers cut trees without the necessary permit, they have to pay a fine or face imprisonment. Also, in most rural villages there are other programs (Zhang et al. 2006), and if people illegally fell trees the subsidies they receive from other programs may also end.

destructive, uses of the land, which existed before GfG conversion. If higher incomes do not materialize, there is a risk that farmers still living in rural areas will convert the land to pre-GfG land uses. We then turn to farmers' attitudes. These are important, because economic issues are only some of the factors farmers take into consideration when deciding which crops to grow or which ventures to undertake. Finally, we look at property rights of land, plants, and forest products. Researchers have found that considerations of property rights play an important role in farmers' decisions regarding what to do with the land.

Present and Future Income from Plants

Some researchers have expressed doubts about the stability of GfG-related incomes. For example, Xu et al. (2010) argues that the future value and shorter-term income-generating capacity from ecological trees and economic trees (orchards) planted under the GfG do not look promising. For ecological forests, this is due to low survival and slow growth rates of ecological trees in many regions, as a result of low rainfall levels and unsuitable abiotic conditions for timber trees (especially in the arid northwest provinces of Gansu and Shaanxi), uncertainties about the future of China's forest sector reforms, and the potential oversupply of timber due to large-scale plantations in the south. For economic forests, the fast expansion of the GfG has led to many different regions in China planting similar orchard crops, raising concerns about future oversupply and price stability (Xu et al. 2010).

However, other researchers have argued that the incomes from economic trees should compare positively to those of food and cash crops. Xie et al. (2006) looked at the opportunity cost of the converted land, and how it compared to the profits that can be generated post-conversion (the analysis is on 20 to 30 households that participated in the GfG in four counties in Qinghai and Shaanxi Provinces). The authors provided output and prices forecasts until 2018 for agricultural food crops, cash crops, and timber products (at different discount rates and output prices), to simulate the future incomes from different land uses. They found that the potential revenues from converted land are relatively attractive, leaving little concern about the sustainability of the program after the government subsidies expire.

Zhou et al. (2007) addressed the same issue, setting out to compare the economic returns (per hectare and labor input) of different tree species to those of food and cash crops in Liping County, Guizhou Province. Liping County is 4,441 km^2 large, with an elevation that ranges from 600 to 1,500 m. Its landscape is dominated by mountains and hills. The physical properties of the county, as well as its isolation, contribute to the poverty of the county; peasant net income per capita was approximately US$153, lower than the national average of US$183.13 (Tang 2000).[2] Liping's economy is closely tied to its agricultural and forestry production. The

[2] The county's population in the year 2000 was 489,000, with 82 % of the population minorities. Administratively, there are 25 towns/townships and 403 villages. In 2001 there were 244 villages

implementation of the GfG program led to a decrease in both crop yields and timber output, thereby reducing peasant household income. For this reason, financial subsidies were a critical factor for the successful implementation of the GfG program.

Zhou et al. (2007) looked at two issues. First, they compared the incomes of GfG-introduced trees and traditional food and cash crops, then examined the importance of subsidies for the successful implementation of the GfG. Second, they looked at the long-term potential incomes from these trees, and how well the incomes will compare to food and cash crops once their full potential profits are generated. Their analysis was based on two peasant household surveys conducted in 2003 and 2004.[3]

With the first issue, Zhou et al. (2007) confirmed the importance of subsidies to alleviate the losses that peasants incur when replacing food and cash crops with economic or ecological trees. Common food and cash crops planted on the slope land in Liping County are sweet potatoes and potatoes, which generate a net income of US$247.70 per hectare per year. On the other hand, trees do not produce any income during the first years, while planting trees involves higher costs during the seeding and planting stage. The study reported that, given tree plantation costs during the first year, the net land productivity and the net labor productivity was negative for most tree species, except for orange and bamboo plantation.

Government subsidies were US$415.60 per hectare per year, much higher than the opportunity cost of planting crops on sloping agricultural land (Zhou et al. 2007). Without the financial subsidies, the peasants would have lost money in carrying out the conversion of agricultural land to forest land. However, when taking the program subsidies into account, the economic situation of the surveyed peasants was drastically different, with the net economic return per hectare becoming positive for every tree species planted (Zhou et al. 2007). With the subsidies, the net economic return of the slope land, which is often low-quality marginal agricultural land, reached as much as US$588 per ha for orange trees, US$513 per ha for bamboo, and US$503 per ha for oil tea seed. With the financial subsidies, the area-weighted net economic return of land use for all tree species was US$385 per ha, which was higher than the value of grain production (US$326 per ha) and cash crops production (US$288 per ha). Considering income per person-day, with government subsidies, the highest net labor return was US$6.50 per day for Masson pine, which can be compared to a return of US$0.82 per day for sweet potatoes, and US$0.90 per day for rice. Masson pine and oil tea seed plantations do not require large labor inputs and therefore enjoy high gross labor productivity (Zhou et al. 2007).

---

with a total population of 226,000, in which peasant annual net income per capita was below US$145 (Zhou et al. 2007).

[3] The social and economic data of for reforestation in Liping County are derived from statistical yearbooks from 1999 to 2004, development reports by Liping authorities, and publications on local agriculture and forestry. Zhou et al. (2007) conducted interviews with government officials in the Liping Forestry Bureau, other agencies, and farmers. The researchers interviewed 471 peasant households from 21 towns and 76 villages; survey information covered 1,192 peasants. The total reforested area of respondents was 629 ha, equivalent to 7.6 % of the total reforested area (4,334 ha) in Liping. Minorities accounted for 71.3 % of the 1,192 peasants sampled (Zhou et al. 2007).

Zhou et al. (2007) argued that the Liping case illustrates the importance of government financial subsidies. These subsidies have been essential in making the project economically feasible for peasants because, in the short run, before the revenue from economic and ecological trees are fully realized, net revenue generated from the tree plantation is lower than that from producing agricultural products. Meanwhile, since subsidies were also higher than the incomes from food crops, they were a major means of elevating farmers' income.

The second issue addressed by Zhou et al. (2007) is that of the economic returns of plantations once the trees provide their full economic potential. To do so, they calculated the average yearly revenue of planted forests with perpetual rotation using the following equation:

$$\bar{R} = \frac{\mathbf{1}}{T}\sum_{t=\mathbf{0}}^{T} R_t e^{-rt}$$

where $\bar{R}$ is the average annual revenue during a rotation period, R_τ is the revenue per hectare at time $\boldsymbol{t}$, $\boldsymbol{e}$ is the base of natural logarithms, $\boldsymbol{r}$ is the discount rate (Zhou et al. (2007) use a discount rate of 5 % based on Alig et al. (1997)), and $\boldsymbol{T}$ the rotation period (Zhou et al. (2007) use Pan et al. (2004), to estimate the rotation period of the tree species in the surveyed area). To calculate the yield per hectare and the unit price of forest products (such as lumber and fruits) during each rotation period, Zhou et al. (2007) used empirical estimated data provided by the local officials from the Liping forestry sectors.

They concluded that among all tree species, tea plantation will potentially provide the highest economic return of US$3,565 per ha per year (US$3,666 per ha with the subsidy for 5 years). This was more than ten times the income from rice. Other trees, such as chestnut, pear, and orange also had great potential for economic rewards. On the other hand, the economic returns of Sawtooth Oak and Oil Teaseed were found to be very low, and were not economically viable options (Table 13.1). Zhou et al. (2007) also calculated the area-weighted annual average potential net income for the sampled area. The calculated value was US$661 per ha (US$778 per ha with the subsidy for 5 years), as compared to US$385 per ha for 2003–2004, under the conditions prevalent at the time of the fieldwork. Zhou et al. (2007) concluded that the economic prospects of tree plantation over the long-term were expected to be much better than the short-term economic benefits. Hence, if the early 2000s market conditions hold, tree plantation through the GFG project will provide substantially higher incomes to Liping's peasants than food production (Zhou et al. 2007).

Future incomes will obviously be determined by changes in the prices of the products. However, there may also be other changes that will affect future incomes, in particular taxation levels and interest rates. This issue has been addressed by Liao and Zhang (2008), who carried out research among 40 randomly selected households in Zigui county (Hubei province) in 2000–2001.[4] With the help of a questionnaire,

[4] Liao and Zhang (2008) choose Zigui County, in the Three Gorges Region in the western Hubei province, as their study area because it is representative not only of Hubei province, but also of the

Table 13.1 Potential annual net income of trees in sample areas

Species	Area (ha)	Rotation Period (year)	Total year of subsidy (year)	Potential annual net income ($ per ha)	Potential annual net income with subsidies
Tea	7.77	25	5	3,565.03	3,666.09
Chestnut	1.78	25	5	1,719.81	1,784.33
Tuliptree and hackberry	4.69	21	5	1,279.89	1400.20
Pear	8.63	25	5	828.68	893.20
Masson Pine	51.37	25	8	752.57	853.63
Orange	5.19	25	5	678.79	743.31
Chinese fir	66.68	25	8	439.78	540.84
Wild pepper	0.82	25	5	473.02	537.54
Bamboo	31.31	11	8	255.26	484.94
Sawtooth oak	3.68	5	8	78.56	96.63
Oil teaseed	5.91	25	5	1.53	66.05

Source: Zhou et al. (2007)

Liao and Zhang (2008) asked about input costs, yield benefits, management regimes for five types of land use options, and characteristics of farmers and their participation in the GfG program. The land expectation value (LEV) method was used to examine the allocation of forest land among alternative options, based on the assumption of perpetual land use. LEV is estimate from the Faustmann model, a standard economic model to estimate land expectation values in forestry (Liao and Zhang 2008). The modified formula is

$$\mathbf{LEV} = \frac{\sum_{t=0}^{T} \left(R_\tau - C_\tau\right) \times (\mathbf{1} + \mathbf{r})^{T-\tau}}{\left(\mathbf{1} + r\right)^{T} - \mathbf{1}}$$

where R_τ denotes the revenue in the year $\boldsymbol{t}$; C_τ stands for the cost in the year $\boldsymbol{t}$ (including establishment cost C_0); $\boldsymbol{T}$ is the rotation age; and $\boldsymbol{r}$ is the interest rate.

The LEV assesses the gain or loss of shifting the farm lands to other land uses with changing interest rates, prices, wage rates, and tax rates.

upper reaches of the Yangtze river in terms of ecology, geographic factors, socio-economic conditions, and the significant number of orchard trees (specially citrus and chestnut), tea and pine plantations growing there. First, four villages were randomly drawn from a list of villages at the Forestry Administration in the county. Then from each village, ten households were randomly drawn from the village (Liao and Zhang 2008).

Table 13.2 Comparison LEV for five types of land use options with tax or without tax at different interest levels

Percent interest rate	Land use options	With tax		Without tax		Tax reduction only for pine tree by 50 %	
		LEV (Yuan/ha)	Optimal rotation (year)	LEV (Yuan/ha)	Optimal rotation (year)	LEV (Yuan/ha)	Optimal rotation (year)
4	Crops	26,396	1	47,480	1	26,396	1
	Pine tree	31,097	29	41,208	28	36,153	28
	Citrus	86,469	25	119,907	25	86,469	25
	Tea	67,134	28	128,080	28	67,134	28
	Chestnut	107,404	29	136,688	29	107,404	29
8	Crops	13,198	1	23,740	1	13,198	1
	Pine tree	7,632	23	10,548	22	9,089	22
	Citrus	24,213	27	38,436	27	24,213	27
	Tea	15,678	30	43,597	31	15,678	30
	Chestnut	40,880	31	53,589	30	40,880	31
12	Crops	8,799	1	15,827	1	8,799	1
	Pine tree	2,133	19	3,358	19	2,745	19
	Citrus	3,871	29	11,783	29	3,871	29
	Tea	−1,687	30	15,263	32	−1,687	30
	Chestnut	18,741	33	25,950	31	18,741	33

Source: Liao and Zhang (2008)
Note: The optimum rotation age is when the marginal value of holding the current stand is equal to the marginal cost of the land for renting plus the foregone interest payment for timber growth

Changes in Taxation Levels

Removing the tax would increase incomes from trees compared to food crops, especially with an interest rate of 8 % (as it was during the time of the fieldwork) or higher (Table 13.2). Nevertheless, pine trees would still generate a lower income than food crops at 2000–2001 price levels. Even with a reduction in tax by 50 % for pine trees, the trees would be able to compete with food crops only if the interest rate dropped to 4 %. When interest rates are higher, removing taxes has the greatest positive impact in generating higher incomes from trees instead of food crops.

Changes in Interest Rates

Liao and Zhang (2008) found that different land use options respond differently to interest rate changes (Table 13.2). All five land use options have greater LEVs with an interest rate of 4 %, followed by 8 %, and then 12 % (12 % giving the lowest LEV). Orchard trees and tea are more sensitive to interest rate changes than crops and pine trees. The possible explanation is that more investment is needed to establish orchards at the beginning of the production cycle. Pine plantations are less sensitive to interest rate changes, but shifting farmland to pine plantations can generate benefits only if the interest rate is low (4 %), possibly because the price of pine timber during the fieldwork period was low (350 Yuan/m^3 on average). Similarly, citrus and tea generate lower profits than crops with an interest rate of 12 %, but higher profits at lower interest rates. Compared to crops, only chestnuts have no economic loss, regardless of interest rate and taxation rate. In contrast to trees, crops are not as sensitive to interest rates because, unlike orchard trees and tea, crops do not require great investment at the beginning of the production cycle (Liao and Zhang 2008).

The data strongly suggest that credit markets are very important to farmers. If low interest rate loans are available, the financial returns of orchard trees are higher crops, even without government subsidies (Liao and Zhang 2008). This means that farmers might be willing to convert their farm land to orchard trees and tea without subsidies. The government could cut subsidies for orchard trees and tea, and farmers would still find them more profitable to grow than food crops. Since GfG subsidies cannot last forever, Liao and Zhang (2008) concluded that market-based approaches, such as developing credit markets and lowering interest rates for farmers, could facilitate implementation of the GfG and reduce its costs.

Subsidies

The provision of government subsidies is sufficient to motivate farmers to shift their farm lands to other uses. Table 13.3 demonstrates that the government-initiated subsidy program facilitates shifts in land cover. When subsidies for citrus, tea, chestnut, and pine are delivered to farmers for 5 years, all four land use options generate higher land values than crops, no matter how much the interest rate changes. Under these circumstances, farmers who are land value maximizers could be willing to shift their agricultural lands to planting pine, orchard trees and tea (Liao and Zhang 2008).

Overall, over 90 % of farmers who were actively involved in the GfG program were satisfied with the program and were willing to shift their farms to forest lands. Still, farmers preferred orchard trees and tea to pine trees because the former generated higher returns than pine trees with the same subsidies (Liao and Zhang 2008). For these reasons, it would be efficient for the government to cut subsidies for economic trees and use the savings to increase subsidies for ecological trees, matching the subsidies to the economic benefits that can be obtained from each species.

Liao and Zhang (2008) suggested that, if the government carried out a cost-benefit analysis of different land uses, including the environmental benefits generated from land conversion, it would be able to determine which land use option was best for each region. Moreover, the authors argue that multiple incentive programs should be developed jointly. For example, whereas the agricultural tax in China has

Table 13.3 Comparison of LEV for five types of land use options, with or without subsidy at different interest levels

Percent interest rate	Land use option	Without subsidy LEV (Yuan/ha)	Without subsidy Optimal rotation (year)	With subsidy LEV (Yuan/ha)	With subsidy Optimal rotation (year)
4	Crops	26,396	1	26,396	1
	Pine tree	31,097	29	60,142	24
	Citrus	86,469	25	111,508	24
	Tea	67,134	28	89,742	26
	Chestnut	107,404	29	130,478	27
8	Crops	13,198	1	13,198	1
	Pine tree	7,632	23	26,549	18
	Citrus	24,213	27	40,161	25
	Tea	15,678	30	30,467	29
	Chestnut	40,880	31	56,256	29
12	Crops	8,799	1	8,799	1
	Pine tree	2,133	19	16,989	18
	Citrus	3,871	29	16,856	27
	Tea	−1,687	30	10,750	30
	Chestnut	18,741	33	31,554	30

Source: Liao and Zhang (2008)
Note: Subsidy for pine trees and cash trees for 5 years (Yuan 3,450/ha per year)

been cut gradually, the timber tax is still high. If this tax was cut to the same level as the tax rate for agricultural crops (10 %), the LEV of pine plantations could catch up with that of crops, since prices of pine timber will probably increase by 30 %, given the implementation of the Natural Forest Protection Program (NFPP) since 1998 (Liao and Zhang 2008).

Farmers' Attitudes

Regardless of the actual profits that farmers may make from the production of trees, tree products or crops, farmers' attitudes are equally important. Farmers not only look at total profits or price stability, but also consider a range of non-economic issues and may choose to continue growing trees even if the production of food or cash crops would be more profitable. Shi and Wang (2011) looked at farmers' attitudes towards the GfG adapting Bossel's orientation theory (1999). Shi and Wang (2011) designed seven orientors (Table 13.4), and collected data by asking farmers in Mizhi County, Shaanxi province yes-or-no questions. For each measure, the coordination coefficient U was calculated based on the number of "yes". The higher degree of U, the more positive the farmers' replies. "Security" (measured by farmers' net income) scores the lowest, which indicates that many farmers believe the

Table 13.4 Social coordination coefficients of the indicators in Mizhi County

Orientor	Question	U
Existence	"Does the GfG project affect the grain supply to your family?"	0.75
Project efficiency	"Have you converted all 25-degree-and-over sloped farmland to forest?"	0.99
Living choice	"Will you support the GfG project when food subsidy is cut off at the project end?"	0.85
Security	"Does the GfG project increase your net income?"	0.70
Adaptability	"Does grain subsidy make up for your loss in the GfG project?"	0.85
Coexistence	"Does the GfG project enhance your environmental consciousness?"	0.99
Psychological satisfaction	"Are you satisfied with the vegetation coverage after the implementation of the GfG project?"	0.96
Coordination Degree		0.87

Source: Shi and Wang (2011)

GfG did not increase their net income (Table 13.4). Similarly, many farmers found that their households' grain supply was not affected by the GfG (as measured by the indicator "Existence", whose U is 0.75). The other orientors' U range from 0.85 to 0.99, indicating farmers' positive attitudes. In particular, the orientor "Living choice", related to the issue of sustainability, has a U of 0.85, indicating that most farmers plan to continue with the land use/cover changes introduced by the GfG. The GfG has also improved farmers' environmental consciousness ("Coexistence", with a U of 0.99), which is likely to have a positive impact on its sustainability. Overall, Shi and Wang (2011) concluded that the GfG project had positive impacts in Mizhi County and the land uses/land cover changes brought about by the GfG will continue after the subsidies end.

In order to examine sustainability and forecast the farm household's post-contract land-use decisions, Uchida et al. (2005) directly asked households in Ningxia and Guizhou Province what they intended to do after program payments stopped (Fig. 13.1).[5] The central government required that 80 % of the land be planted with ecological trees and 20 % with economic trees. While the actual implementation in Guizhou Province was consistent with the government's requirement, the survey shows that more than 50 % of households stated that they would have preferred to plant economic trees. Uchida et al. (2005) argued that, because of the high proportion of ecological trees with limited economic benefits, there could be a greater danger of reconversion in the future when program payments cease. Thirty four percent of the participating farmers in Guizhou Province said that, if the government were to stop the payments after 5 years, they would shift their land back to cropping. Similarly, 29 % of the sample farmers in Ningxia Province stated that they had the same intentions (Uchida et al. 2005). On the other hand, Zhang et al. (2008b) found that 26 % of farmers in Ningxia planned to reconvert their land "for sure" and another 20.9 % "probably". The pressure to reconvert the land may be more serious

[5] Uchida et al. (2005) is based on a sample of 144 participating households from 16 randomly selected villages in Ningxia and Guizhou Provinces.

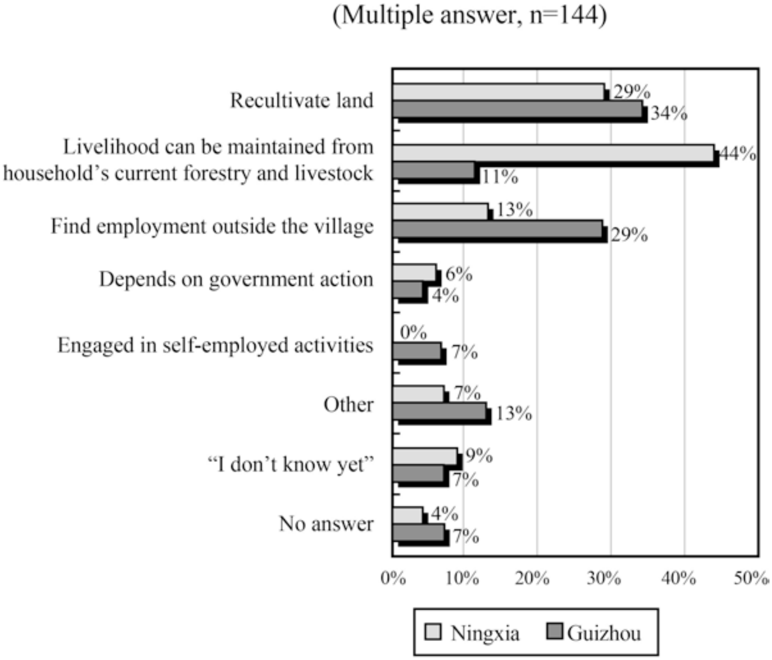

Fig. 13.1 Summary of opinions of farm households about reconversion plans if GFG program payments stopped in Ningxia and Guizhou after 5 years, 2000 (Source: Uchida et al. 2005)

in Guizhou Province because the average land holdings per household is lower, and farmers may need to reconvert land back to agricultural production if they cannot find (or retain) alternative sources of income off-farm. In Ningxia Province 44 % of the farmers said that they believed their new mix of forestry and livestock enterprises would sustain their livelihood after the Grain for Green program. In contrast, only 11 % of the farmers in Guizhou Province replied that they would be able to do so. Not surprisingly, more farmers in Guizhou Province (29 %) replied that if payment were to stop, they would also seek off-farm jobs outside the village (versus 13 % in Ningxia Province). Hence, if the program encourages or pressures farmers to shift into activities that can provide them with incomes even after the program subsidies end, there is likely to be fewer pressures to return the set-aside land back to cultivation (Uchida et al. 2005).

Uchida et al. (2005) argued that the differences between the two provinces regarding the need for alternative off-farm jobs may also reflect the different economic environments that exist in the two provinces. First, as mentioned above, the average holdings of land per household in the sample are lower in Guizhou than in Ningxia. Although in both provinces more than 50 % of the sown area of households was set aside under the GfG, the amount of land remaining under cultivation is less, on average, for farmers in Guizhou Province. Therefore, those farmers have a greater need to find alternative sources of income outside the land-intensive agricultural sector. If the opportunities for off-farm employment dwindle after the program ends, it is plausible that farmers would revert the land to pre-GfG uses (Uchida et al. 2005).

Rather than comparing two provinces, Wang and MacLaren (2011) looked at the availability of land among farmers in one individual county (Dunhua County, Jilin Province, in 2003), and at how much land they converted out of the total land they owned. They found that 16 % of the farmers would choose to return the afforested and reforested land to agriculture after the program subsidies end. However, the survey shows a big difference between those who converted only some of their land, and those who converted all their land; 88.2 % of those who converted all their land claimed they wanted to reconvert afforested land to pre-GfG land uses after the program ends, compared to only 7.2 % of those who did not convert all their land. Although the surveys showed that farmers recognized the importance of the GfG and supported the aims of the project, they did not necessarily accept the personal costs associated with the project, such as the adverse impact that losing all of their croplands had on their livelihood, especially when their main source of income was farming (Wang and Maclaren 2011). Cao et al. (2009b) also found that while 63.8 % of the households in his fieldwork area in northern Shaanxi Province supported the GfG, 37.2 % planned to return to cultivating the converted forested areas and grassland, once the project's subsidies end in 2018.

One way to discern the likelihood of returning retired cropland to cultivation when the GfG subsidies end is to compare the wage rates for agricultural production and off-farm employment. Yin and Liu (2007) argued that these rates can be derived by dividing the net revenues from agricultural and off-farm employment by the corresponding labor times. That study revealed that the wage rates of participating households from off-farm opportunities were universally higher than those from agriculture for the years 2006–2008 (Fig. 13.2). It therefore can be inferred that rural laborers will prefer off-farm work. On the other hand, Fig. 13.2 also shows that the difference is decreasing. Yin and Liu (2007) argued that if this trend continues, it is likely that more rural laborers will revert to farming. Uchida et al. (2005) offer a counter-argument, contending that people will not return to farm work even if the

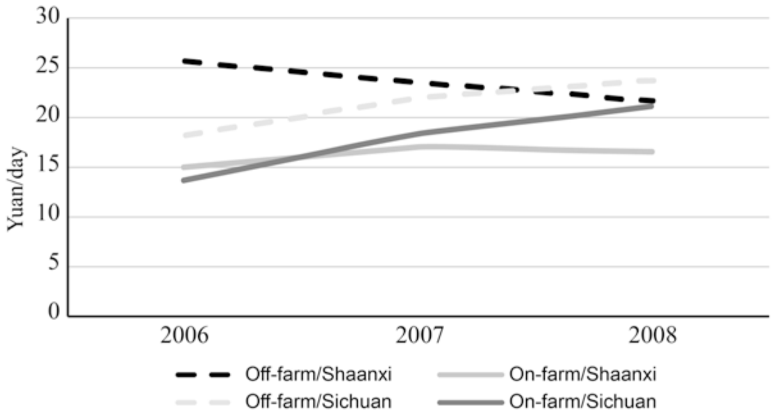

Fig. 13.2 Estimated wage rates of different jobs for participants (Source: Yin and Liu 2007)

differences between on-farm and off-farm incomes decline, because when the farmers shift their land away from crop cultivation to other productive uses, they gradually increase the opportunity cost of reconversion.

Property Rights of Land and Trees

Uchida et al. (2005: 78) point out that the CCICED (2002) raised concern that "uncertainty over the lack of property rights and the future responsibility for management of the trees may mean that farmers do not have strong incentives to maintain their forest plots in the long term. […] Incentives to preserve natural resources and to invest in trees and other land improvements for future benefits will be hindered without well-established property rights, because the future benefits may not accrue to those who manage them. The uncertainty over the property rights of the trees planted under the program also may discourage the participating farmers from managing the trees, thereby diminishing the long-term environmental benefit of the program."

Grosjean and Kontoleon (2009) reached similar conclusions in their two-province study of farmers' choices when the GfG ends. Surveys were carried out in Ningxia Province, situated in northwest China into the middle reaches of the Yellow River, and Guizhou Province, located in the southwest on the reaches of the Yangtze River. These provinces were selected because they were among the first where the GfG was implemented, and because their particularly poor economic and ecological conditions relative to the rest of China were envisaged to provide particularly important information for the sustainability of the GfG (Grosjean and Kontoleon 2009).[6]

In order to assess the viability of the program in its current form, Grosjean and Kontoleon (2009) analyzed responses to contingent behavior questions over household land and labor allocation intentions after the program ends, under three plausible and mutually exclusive alternative post-GfG scenarios: (1) the program will be renewed in its current form; (2) the program will be terminated; or (3) a different and new program will be introduced. The first two choices were naturally confined to GfG participants alone and were focused on both labor and land allocation intentions of participating households. For the third scenario they used a choice experiment in which both participants and non-participants were asked to select their preferred policy option from a range of hypothetical land set-aside policies (Grosjean and Kontoleon 2009).

For the first scenario, where the program is renewed, 63 % of farmers said they would sign up for the program and maintain or increase reforested land, while 42 % said they would decrease their on-farm labor activities. For the second scenario, where the program is terminated, only 38 % of farmers said they would continue to maintain

[6] Both household and village level data were collected via in-person interviews with the head or spouse of randomly selected households (without replacement) and with village leaders. Household data were collected for both GfG participants and non-participants. In total, 286 households in 44 villages were surveyed (Grosjean and Kontoleon 2009).

their reforested lands, while 67 % said that they would increase their on-farm labor activities (Grosjean and Kontoleon 2009). These results, in addition to the analysis derived from the third scenario, were used to reach the following conclusions:

First, the GfG should address the root causes of households' inefficient allocation of resources, in particular uncertain property rights and high costs of labor mobility, in dealing with the underlying problem of an oversupply of farm labor. Second, in cases where the GfG is renewed, Grosjean and Kontoleon (2009) recommend providing better forestry training to participating households along with more autonomy in managing their trees. Third, in the event that subsidies are not renewed, farmers will tend not to reconvert their reforested lands, provided that the commercial value of the reforested trees is high. Fourth, secure property rights were also shown to be important in the post-GfG scenario when subsidies are terminated. Since subsidies will end sooner or later, offering farmers secure property rights seems to be an important issue. Fourth, in the scenario where a new program is offered, Grosjean and Kontoleon (2009) found that the likelihood of enrollment would be affected, not just by the level of subsidies, by the accessibility and attraction of off-farm employment (e.g. creating employment centers, reducing local travel costs, enhancing education, and the level of the off-farm wages), and by wider institutional reforms that would include land tenure, land renting, and land management.

Making a somewhat similar argument to that of Grosjean and Kontoleon (2009), Groom et al. (2010, in Grosjean and Kontoleon 2009) found that, almost 10 years after the GfG started, market and institutional constraints (primarily incomplete property rights and high transactions costs) still constituted serious impediments to the reallocation of labor toward off-farm activities, and thus remained important contributors to the vicious cycle of inefficient production processes, poverty, and environmental degradation.

Land tenure and exchange rights have been shown to be essential determinants of agricultural and labor allocation choices in China. In particular, insecure land rights may discourage households from committing to land quality investments (such as the maintenance of reforested trees) while they may also constrain household members from seeking more profitable off-farm employment opportunities due to the fear of losing unused land. Therefore, land tenure and exchange rights can be expected to have a significant impact on the likelihood of converting land to pre-GfG uses (Grosjean and Kontoleon 2009).

Conclusions

This chapter has reviewed the literature on various issues related to the sustainability of the GfG. Sustainability in this case relates to the question of whether households will maintain the land cover/land use changes introduced by the GfG, or whether they will revert to pre-GfG land uses once the subsidies end. When the program began, the economic returns of land

(continued)

and labor from reforestation were substantially lower than those generated by grain or cash crop production. That difference was covered by subsidies, and the ability to engage in work on other land, or off-farm, made the program attractive to many farmers. However, payments will eventually cease, and over the longer term farmers will revert their land back to pre-GfG uses if the incomes from trees are not competitive, or if there are insufficient off-farm opportunities.

Few studies tried to estimate the post-subsidies economic benefits from GfG land-use changes, but those that did concluded that in many cases (at least for economic trees) revenues from the new land uses were superior to those of pre-GfG land use. However, this chapter, like previous ones, has shown that researchers' findings display considerable variation. This is not surprising. It is unreasonable to expect that the same results will be found across all of China. China is a very diverse country, economically, socially and ecologically, and a program that was rather homogeneous throughout the country (and indeed has been criticised as such when, for example, promoting tree planting in arid areas) cannot be expected to fare similarly everywhere. Hence, some researchers found that a majority of households plan to maintain the new land use/land cover, while others have found that they will not. Most research presented is localised in a relatively small area, and the differences described may simply be due to local variations in environmental and socio-economic conditions.

While most studies focused on comparing the economic benefits of pre-GfG land uses to those of post-GfG land uses, it is also clear that the situation in many places have changed, so that comparison may be irrelevant. In particular, in many cases, as the previous chapters have also shown, the most productive members of many families have migrated out of the rural areas, and only aged people and children remain in the villages. For them, it might be difficult to grow food crops while it is possible to harvest economic trees. Thus, income is not the only consideration that may affect land use.

As the program is set to end starting in 2015, it is disconcerting that a nation-wide survey of the attitudes of farmers towards the GfG, as well as a comparison of the economic returns of economic and ecological trees to pre-GfG land uses, has not been undertaken recently. In our opinion, there is insufficient evidence to determine how sustainable the GfG will be, once the subsidies end. It is quite possible that unless a transition to post-GfG subsidies is properly planned, many of the positive impacts of the GfG will be lost, and a sizable proportion of the investment made (some Yuan 430 billion) will have been squandered