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To cite this article: Chen-Xia Hu , Bo-Jie Fu , Li-Ding Chen & Hubert Gulinck (2006) Farmer's attitudes towards the Grain-for-Green programme in the Loess hilly area, China: A case study in two small catchments, *International Journal of Sustainable Development & World Ecology*, 13:3, 211-220, DOI: [10.1080/13504500609469673](https://doi.org/10.1080/13504500609469673)

To link to this article: <http://dx.doi.org/10.1080/13504500609469673>

Published online: 20 Sep 2010.

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Farmer’s attitudes towards the Grain-for-Green programme in the Loess hilly area, China: A case study in two small catchments

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Key words: Farmer’s attitudes, Grain-for-Green, the Loess plateau, China

SUMMARY

In 1999, the Chinese government initiated a massive conservation programme, the ‘Grain-for-Green’ programme, to reduce soil erosion and to improve the eco-environmental status in western China through the set-aside of sloping agricultural lands and their conversion to forest and pasture. The attitudes and perceptions of farmers towards Grain-for-Green are little known, but will eventually dictate the direction and, ultimately, the success of the project. This paper interprets surveys concerning attitudes towards environmental protection, in general, and the Grain-for-Green programme, in particular, in two small catchments in the Loess hilly area. Participatory Rural Assessment techniques are used as survey instruments and logistic regression analysis is used to analyze farmers’ attitudes towards environmental conservation and Grain-for-Green. Most respondents are positive about environmental protection and Grain-for-Green in general. However, marked differences are evident between the two small catchments: the level of farmers’ environmental protection consciousness in Anjiapo catchment is higher than that in Danangou catchment. Respondents in Anjiapo catchment expressed more support for the programme than respondents in Danangou catchment. Environmental care by farmers may not be sustainable should the programme come to an end. The results provide a useful insight into the interests and concerns of farmers, which might lead to a more positive attitude in officials in the future.

INTRODUCTION

As the most serious soil and water loss area in the world, over 60% of the land in the Loess plateau in China has suffered soil erosion, with an average annual soil loss of 2000–2500 t/km² (Shi and Shao 2000). In the most hilly parts of the plateau, this

reaches 5000–10000 Mg/km²/year as a result of irrational land use and poor vegetation cover, a loss that has seriously depleted land resources and degraded the eco-environment of the area (BREST-CAS 1992; Chen and Luk 1989; Fu 1989;

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Fu and Gulinck 1994; Fu and Chen 2000; Chen and Messing 2003). Hence, the Loess plateau is a target area in the Grain-for-Green programme. The major goal of this project is to reduce soil and water erosion through increasing forest coverage or permanent cover of steep, sloping cultivated land.

Historically, deforestation is the main cause of water and soil erosion in the basin of the Yellow and Yangtze Rivers. Records show that the annual soil loss in these basins can be as high as 4 billion tons as a result of deforestation and cultivation of hillside agricultural lands (World Wildlife Fund 2004). Many environmental experts believe that deforestation and water loss were major causes of the devastating floods in China in 1998. Because of the floods and further soil erosion, China's government initiated a nationwide cropland set-aside programme, known as the Grain-for-Green programme, in 1999 (Uchida *et al.* 2004). The strategy involves conversion of 15 million ha of low-yield farmland to forest and afforestation of another 17 million ha of barren mountains and other land (Feng and Yang 2004). The central government compensates participants for the loss of access to the land by giving subsidies of grain and money. The Grain-for-Green policy has been tested in Gansu, Shaanxi and Sichuan Provinces since 1999 and had been expanded to 25 provinces by the end of 2002 (Tao *et al.* 2004). The scale of the programme makes this one of the world's largest conservation projects (World Wildlife Fund 2004). The project not only plays a vital role in contributing to ecological security and sustainable development in China, it is also a pilot project in the fight against climate change.

A successful environmental conservation project has to take into account biophysical suitability, economic feasibility and social acceptability. There is ample evidence to suggest that the attitudes and perceptions of farmers towards Grain-for-Green will determine the direction and, ultimately, the success of the project. However, the local farmers' support for Grain-for-Green depends mainly on their perceptions of costs and benefits of converting cultivated land, against the background of socioeconomic and demographic considerations. Post-programme land-use decisions of participating farmers will be one of the biggest concerns in such a project (Cooper and Osborn 1998; Johnson *et al.* 1997; Uchida *et al.* 2004). Study and analysis

of farmers' attitudes will not only offer guidance for management decisions and baseline data to assess the efficiency of new policies, but will also be useful to avoid conflicts that may exist between government and local farmers.

The objectives of this paper are: (1) to explore the attitudes of farmers towards environmental conservation in general and towards Grain-for-Green in particular in the Loess plateau in China; (2) to analyze factors that influence farmers' attitudes; and (3) to detect sustainability of Grain-for-Green actions in the Loess plateau.

MATERIALS AND METHODS

Descriptions of the study areas

In order to examine patterns of farmers' attitudes towards environmental conservation and Grain-for-Green, we selected two small catchments to illustrate different types of countryside and rural economy settings in the Loess hilly area.

The Danangou catchment is located in An'sai County, Yan'an, Shaanxi Province in the central area of the Loess plateau, covering an area of about 3.5 km². It is approximately 5 km north of An'sai County. There are two villages with approximately 240 inhabitants in 50 families (2003). Most of them obtain their major income from off-farm work, thanks to prospering sectors in An'sai, such as the oil industry, transportation, quarrying, the service industry and tourism. In addition, farmers have more time to do off-farm work than before because nearly two-thirds of previously cultivated land is now under forestry.

The Anjiapo catchment, covering an area of 3.84 km², is situated 3 km from Dingxi, Gansu Province in the western part of the Loess plateau. There are three villages with approximately 314 inhabitants in 75 families (2003). Most of them depend essentially on subsistence agriculture because there are limited employment opportunities and the average land holding per household is adequate. As it is ranked as a poor county, there are few industries, except for the textile and potato processing industries in Dingxi. Some farmers obtain part of their income from off-farm work, mainly in the building industry.

Physically, the catchments are similar. They are part of the Loess hilly area, with a semi-arid climate and severe soil erosion.

Data collection

The data were collected from June to August 2004 by means of interviews. A face-to-face survey was conducted using the Participatory Rural Assessment (PRA) technique. The interview survey included a mixture of closed-response and open-ended questions. The closed-response questions were designed to collect information about the farmer's environmental consciousness and attitudes to the Grain-for-Green programme. These questions are presented in boxes 1 and 2. A few open-ended questions were included to elicit more extensive discussion of some of the issues faced in

the programme in China, such as types of trees preferred by the farmers, opinions on management methods and sustainability of the project. A series of supplementary questions were included in the interviews to collect the necessary socioeconomic information at the individual respondent level because some socioeconomic factors, such as age and educational attainment, could significantly shape the attitudes of local farmers. This information was used as independent variable in the logistic regression analysis. The survey in Danangou catchment involved a sample of 45 randomly selected households. The

BOX 1 Fixed-response questions presented to farmers to assess their opinions on environmental conservation

A. Do you know how utilization of chemical fertilizer and insecticides affect agricultural production?
1. Advantageous 2. Both advantageous and disadvantageous 3. Disadvantageous

B. Which use do you consider more favorable for barren land?
1. Plant trees 2. Plant crops

C. Which use do you consider most possible to reclaim sloping cropland?
1. Grain-for-Green 2. Terracing of land on slopes 3. Maintain present status

D. Do you know about sustainable development?
1. Yes 2. No

E. Do you think that it is important to protect the environment?
1. Yes 2. No

F. Did you consider the environmental consequences of your agricultural activities?
1. Yes 2. No

BOX 2 Fixed-response questions presented to farmers to assess their opinion about Grain-for-Green

A. Do you know about Grain-for-Green?
1. Yes 2. No

B. Do you know the objectives of Grain-for-Green?
1. Yes 2. No

C. Do you support this programme?
1. Yes 2. No

D. Would you like redeveloping forest and pasture yourself?
1. Yes 2. No

E. Do you think that the duration of subsidy payments is reasonable?
1. Yes, but worry about policy change 2. Too short

F. Will you reconvert land into cropland once programme payments stop?
1. Yes 2. No

survey in Anjiapo catchment was of a sample of 30 randomly selected households.

Data processing and analysis

Binary logistic regression models were undertaken to identify which factors have influenced the farmers' responses towards environmental conservation and Grain-for-Green. The model χ^2 values reported show the significance of the final logistic regression model. The farmers' responses to the fixed-response questions were recorded as positive and negative responses, which were used to develop the necessary dependent variables in the estimation of logistic regression models.

The independent variables used in the logistic regression analysis included: gender (GEN), age (AGE), education (EDU), household income (INC), source of income (SIC), household labour force (NHL), household scale (HS), area of cropland per person (ACP), and area of sloping cropland to be turned back into forest and pasture (ACF).

The logistic regression analysis was conducted by using SPSS version 10.0 at the $p < 0.05$ significance level.

RESULTS AND DISCUSSION

Demographic characteristics of respondents

Table 1 Main features of households in two small catchments

	Danangou	Anjiapo
Farmers interviewed	45	30
Mean persons/household	4	4
Mean labour/household	2.875	2.6
Mean income/household (Yuan)	8680.56	6428.57
Mean age of respondents	45	46
Mean level of education (years)	2.55	4.77
Female/male	22/23	19/11
Mean area of cropland per person (ha)	0.05	0.24
Proportion of participants in favour of Grain-for-Green	89%	67%
Area of retired cultivated land (ha)	24.13	5.2

A total of 75 respondents were interviewed in the household attitude surveys (Table 1). District differences remain between the two small catchments, in terms of income, level of education, area of cropland, number of participants, and extent of conversion to forest or pasture. Most farmers in Danangou catchment are employed in quarrying, transportation, building industries and planting vegetables and selling them; as a result, about 80% of cropland was returned to forest and pasture. Moreover, a highway from An'sai County to Jingbian County is being constructed and passes Danangou village at the outlet of the catchment, thus providing more employment opportunities for farmers. However, in Anjiapo catchment, little sloping cropland was converted into forest and pasture since most croplands were terraced. Although it is easy for farmers to access Dingxi city in the Anjiapo catchment, most farmers mainly depend on subsistence agriculture because of few alternative employment opportunities. Few farmers are able to obtain some income from off-farm work, such as the building industry or poultry raising, but opportunities are very limited compared with Danangou catchment. So, the average income of households in Danangou catchment is higher than that in Anjiapo catchment. Considering the level of education and the mean area of cropland, farmers in Anjiapo have a higher average literacy rate and average cropland holding per household than those in Danangou. However, in terms of the proportion of participants in Grain-for-Green and area of retired cultivated land are concerned, farmers in Danangou hold higher amounts than those in Anjiapo.

Attitudes towards environmental conservation

Although some differences existed in responses from the two small catchments, the overall findings of this study show that most farmers have positive attitudes towards environmental conservation (Table 2). Mean relative frequency in Table 2 refers to the farmers' attitudes towards environmental conservation in both catchment samples. Over 70% of the farmers believe that it is important to control soil erosion and conserve the environment (E). This response can be used to explain the farmers' responses to statement B, that most farmers support afforestation of barren lands. The area of

cropland per person is continuously decreasing as a result of population growth and Grain-for-Green, which led to over 75% of the farmers preferring land terracing on the slopes instead of reforestation of sloping cropland (C). The views of farmers in the two catchments differ in relation to the environmental effects of using chemical fertilizer or traditional agriculture (A and F). There are fewer farmers in Danangou catchment than in Anjiapo catchment who consider the environmental consequences of their inappropriate agricultural activities. About 90% of farmers are unfamiliar with the strategy of sustainable development (D). The low

level of education and limited propaganda on environmental knowledge and law may be principal reasons for the farmers' responses to statement D.

Attitudes towards Grain-for-Green

Perceptions about Grain-for-Green were examined using six attitude statements (see Box 2, Table 3). Although some variation occurred in the responses to statements A and B, over 60% of farmers were familiar with Grain-for-Green and related policies. Most farmers interviewed were in favour of Grain-for-Green (C and D). About 90% of farmers in

Table 2 Attitudes towards environmental conservation in general. A–F see Box 1

Attitude statements and response	Danangou		Anjiapo		Mean relative frequency
	Frequency	Relative frequency	Frequency	Relative frequency	
A Advantage	25	55.6	11	36.7	48.0
Both	20	44.4	19	63.3	52.0
Disadvantage	0	0	0	0	0
B Forest planting	34	75.6	15	50.0	54.7
Reclamation	11	24.4	15	50.0	45.3
C Grain-for-Green	10	22.2	3	10.0	17.3
Terrace cropping	34	75.6	25	83.3	78.7
Maintain present status	1	2.2	2	6.7	4.0
D Known	3	6.7	4	13.3	9.3
Unknown	42	93.3	26	86.7	90.7
E Importance	32	71.1	24	80.0	74.7
Unimportance	13	28.9	6	20.0	25.3
F Yes	15	33.3	16	53.3	41.3
No	30	66.7	14	46.7	58.7

Table 3 Attitudes towards Grain-for-Green. A–F see Box 1

Attitude statements and response	Danangou		Anjiapo		Mean relative frequency
	Frequency	Relative frequency	Frequency	Relative frequency	
A Yes	23	51.1	24	80.0	62.7
No	22	48.9	6	20.0	37.3
B Known	30	66.7	19	63.3	65.3
Unknown	15	33.3	11	36.7	34.7
C Support	28	62.2	27	90.0	73.3
Oppose	17	37.8	3	10.0	26.7
D Agree	36	80.0	22	73.3	77.3
Disagree	9	20.0	8	26.7	22.7
E Reasonable	16	35.6	8	26.7	32.0
Shorter	29	64.4	22	73.3	68.0
F Yes	33	73.3	12	40.0	60.0
No	12	26.7	18	60.0	40.0

Anjiapo catchment and about 62% of farmers in Danangou catchment agree that Grain-for-Green is necessary for the prevention of soil erosion. Farmers in both catchments have similar views about the duration required for subsidies provided by the government (E). They believe that short-term subsidies will not benefit them because it takes a long time for forest and pasture to be redeveloped. Statement F was used to assess the sustainability of Grain-for-Green by assessing farmers' attitudes towards land-use decisions when the subsidies end. About 60% of farmers said that they would consider turning forest and pasture back to cropland when subsidies ended because they could not support their families from the remaining cropland and other resources with only 5 to 8 years of government subsidies. However, there are clear differences in farmers' attitude in the two catchments towards statement F. Over 70% of farmers in Danangou catchment would convert their land back to agricultural activities if the government were to stop subsidies after 5 years or 8 years, because they worry about employment opportunities and insufficient family income. Only 40% of farmers in Anjiapo catchment would return to the status before Grain-for-Green. Compared with Anjiapo catchment, the pressure to reconvert land is higher in Danangou catchment because the average land holding per household is low and farmers need to find off-farm alternative income sources. If

the area of cultivated land decreases due to reforestation, there will be a rapid increase in unemployed labour. To alleviate employment pressure, people should be encouraged to migrate to more economically developed areas. But, in face-to-face discussions between village leaders and farmers, it was found that most are unskilled. As a result, the strengthening of an education programme to improve the skills of the workforce is imperative (Ye et al. 2003). On the other hand, to guarantee that farmers have sufficient grain, sloping land between 10 and 25 degrees should be converted into terraces.

Factors affecting attitudes towards environmental conservation and Grain-for-Green

Although some variations exist, the analysis of farmers' attitudes towards environmental conservation and Grain-for-Green reveals that the majority are positive. This is encouraging. Complementary logistic regression analyses were carried out to identify the factors that influence farmers' attitudes towards environmental conservation and Grain-for-Green. The preliminary logistic regression analysis was undertaken using SPSS Version 10.0 at the $p < 0.05$ significance level (Tables 4 and 5). The results indicate that the effect of nine variables on farmers' attitudes varies.

Table 4 Results of logistic regression analysis for the factors that influenced farmers' attitudes towards environmental conservation. A–F see Box 1

			Final logistic model		
Statements		Influencing factors	χ^2	df	p value
A	Danangou	ACP, ACF	12.574	2	0.002
	Anjiapo	EDU, GEN	1.241	1	0.045
B	Danangou	AGE, GEN, EDU, HS, ACP	16.393	7	0.022
	Anjiapo	EDU	3.643	1	0.056
C	Danangou	EDU, GEN, AGE	9.730	2	0.008
	Anjiapo	GEN, HS, NHL, INC, SIC, ACP, ACF	19.505	7	0.007
D	Danangou	AGE, EDU, SIC, ACP	22.044	5	0.001
	Anjiapo	AGE, INC	23.560	4	< 0.001
E	Danangou	SIC	9.118	1	0.003
	Anjiapo	GEN, EDU, HS, NHL, INC, ACP	30.024	7	< 0.001
F	Danangou	GEN	4.960	2	0.084
	Anjiapo	AGE, GEN, HS, NHL, INC, ACP, ACF	41.455	10	< 0.001

Gender (GEN), age (AGE), education (EDU), income (INC), source of income (SIC), the number in household labour force (NHL), household scale (HS), area of cropland per person (ACP), the area of sloping cropland to be returned to forest and pasture (ACF)

Table 5 Results of logistic regression analysis for factors that influenced farmers' attitudes towards Grain-for-Green. A–F see Box 1, Influencing factors see Table 4

Statements			Final logistic model		
			χ^2	df	p value
A	Danangou	AGE, GEN, EDU	8.562	3	0.036
	Anjiapo	AGE, EDU	18.778	2	< 0.001
B	Danangou	AGE, GEN, NHL, INC	26.187	7	< 0.001
	Anjiapo	GEN, EDU, HS, SIC, ACP, ACF	39.429	6	< 0.001
C	Danangou	AGE, GEN, HS, NHL, SIC, ACP, ACF	59.667	9	< 0.001
	Anjiapo	GEN, HS, INC, SIC, ACP	19.505	7	0.007
D	Danangou	GEN, EDU, HS, NHL, INC	14.724	7	0.040
	Anjiapo	AGE, EDU	10.641	4	0.031
E	Danangou	HS	2.793	1	0.095
	Anjiapo	AGE, GEN, SIC, ACF	13.105	5	0.022
F	Danangou	EDU, INC	9.985	4	0.041
	Anjiapo	GEN, HS, NHL, SIC, ACF	40.381	8	< 0.001

Education was found to be a significant predictor affecting the attitude of farmers. Support for environmental conservation and Grain-for-Green was proportionally correlated with the number of years of education. Those farmers with higher household literacy rates in Anjiapo catchment hold more favorable attitudes towards environmental conservation projects. This is consistent with studies in other countries on attitudes towards nature conservation and wildlife (Bandara and Tisdell 2003; Mehta and Heinen 2001; Heinen 1993). Education is, therefore, often considered to be a primary step in improving people's environmental or nature conservation consciousness (Parry and Campbell 1992; Gillingham and Lee 1999; White *et al.* 2001; Bandara and Tisdell 2003). However, at present, the educational opportunities for farmers are limited as a result of a low level of social and economic development and of the vulnerable natural environment in the Loess plateau. Measures should be taken by the government to improve the level of education of farmers, which can indirectly increase farmers' income, promote success of Grain-for-Green and also accelerate sustainable socioeconomic development in the Loess plateau.

Age was an important factor positively correlated with the responses of farmers, although only weakly correlated with the level of education. Most of the younger interviewees have a higher education level than the older people. However, one interesting finding in our study is that older people hold more favorable attitudes towards environmental conservation. This is inconsistent with the situation found

in other studies about conservation, where younger people with a high education possess better environmental consciousness (Hadker *et al.* 1997; Bandara and Tisdell 2003; Mehta and Heinen 2001). One plausible explanation could be that schooling has little impact on younger people's awareness about contemporary conservation issues in rural areas of China. On the other hand, it could be that the older people have realised the importance of environmental conservation after consecutive bad experiences of severe soil loss and environmental disasters.

Gender is also a significant factor to influence farmers' opinions about environmental conservation. Results show that, in both catchments, more men than women hold favorable attitudes towards environmental conservation and Grain-for-Green. Gender was significantly associated with the level of education. One explanation for this situation may be that men have a higher number of years of schooling and more opportunities to participate in social and educational activities than women, because of the traditional idea that a boy is more important than a girl.

The size of households was found to be significantly and positively correlated with the number in the household labour force and the household income. However, the results indicate that big families with more labour units tend to have more negative attitudes towards Grain-for-Green. Also, richer farmers hold more favorable opinions than poor farmers towards conservation and Grain-for-Green in Anjiapo catchment.

Source of income can also be an important predictor of farmers' attitudes to Grain-for-Green. Farmers who rely on off-farm work hold more favorable opinions because a basic livelihood for those who depend on subsistence agriculture cannot be guaranteed if they lose farmland. This is less a concern for farmers who rely on off-farm work.

In addition, the results indicate that farmers' attitude towards Grain-for-Green is influenced by the area of cropland per person (ACP) and the area of slope cropland to be returned (ASC). In both catchments, farmers with more croplands are more likely to express negative attitudes towards environmental conservation in general but hold positive attitudes to Grain-for-Green. However, farmers that possess more reverted croplands hold favorable attitudes towards conservation and Grain-for-Green. This is because farmers with more cropland rely principally on subsistence agriculture and extensive land management. They seldom consider environment conservation and environment consequences caused by their improper agricultural activities used to gain more grain. Considering their positive attitudes to Grain-for-Green, the main explanation could be that farmers can receive more grain in compensation from Grain-for-Green than they lose in agricultural returns, and also have more time to do off-farm work than before.

Local farmers' attitudes to environmental conservation projects depend mainly on their perceptions of losses and benefits. This study found that the official compensation scheme is another main factor influencing farmers' attitudes towards Grain-for-Green. According to a document issued on March 29, 2002 by the State Forestry Administration Bureau, the State Development Planning Commission and the Ministry of Finance, farmers will receive 1500 kg of grain per year per hectare in the upper and middle reaches of the Yellow River. The government provides subsidies of 300 Yuan per farmer per year per hectare of forest or pasture (SFAB 2000; Feng and Yang 2004). To avoid rapid income loss due to forest and pasture restoration, it was suggested that fruit and other commercially valuable trees be planted, where natural conditions allow. The government will also provide seedlings, while farmers will be responsible for taking care of the restored forests and pastures and will retain all profits from planting trees and grass on cultivated land. However, subsidies are only available for 5 years for 'commercial trees' and 8 years for

'ecological woodland'. The data show that the majority of farmers considered that government subsidies are the principal driving force in their support for Grain-for-Green. They can receive more subsidized grain by using less labour and energy than before the Grain-for-Green programme, and income of participating farmers has increased due to the programme subsidies.

Although the majority of farmers in both catchments hold favorable attitudes towards Grain-for-Green, farmers in Anjiapo catchment were more positive than farmers in Danangou catchment. This difference may, on one hand, be attributed to the Anjiapo catchment area being representative for a soil and water conservation project for a long time so that farmers have acquired deep understanding about the importance of the nature conservation programme. On the other hand, because Anjiapo catchment has more terraced croplands and fewer sloping croplands, the programme's effects are less pronounced. Moreover, Anjiapo offers fewer opportunities for off-farm work, by participating in the Green-for-Grain programme, most farmers anticipate gaining subsidized government grain and being able to take more time off from farming in order to take work outside Dingxi.

However, from interviews with the local farmers, it was found that the current compensation scheme managed by the Forestry Department and local administration is not being effectively carried out. Some farmers have received only 2 years' cash subsidies and half of the compensating grain for restored forests and pastures. Also, about 85% of farmers said that they have no decision rights in the selection of land parcel, area and tree types to be planted. A major conflict between local farmers and the management department concerns the selection of tree types for planting, which has undermined participating farmers' enthusiasm for Grain-for-Green. Unless the State authorities seriously address these matters, it may not be easy to change the negative attitudes of farmers towards Grain-for-Green.

The key concern of the Grain-for-Green programme lies in its long-term sustainability. Uchida and colleagues (2004) believe that there are two strategies for promoting the sustainability of the programme's environmental benefits. One is the government continuation of subsidies to households. The responses of farmers to statement E support this. Alternatively, during the time between

the start of Grain-for-Green and the time when programme payments cease, households can take advantage of profit from the additional labor that they gain as a result of access to the programme. The survey shows that realization of the goal, which encourages farmers to shift into off-farm activities, can provide them with more income, but needs more than 5 or 8 years of aid. It is possible that the optimal choice for farmers would be to return to cultivation if they could not find off-farm employment once subsidies end. Therefore, the question of how to guarantee farmers a basic living after 5 or 8 years of government subsidies is still open (Ye *et al.* 2003). Lack of action could lead to the failure of the Grain-for-Green project and further threaten ecological security in China, even worldwide, if this question is not resolved.

Since 1999, China's government has carried out one of the largest conservation projects, Grain-for-

Green, in the developing world in order to control water and soil loss. China has invested billions of dollars for afforestation and to provide compensation for participating farmers. As stressed by Uchida and colleagues (2004), the success of such programmes in the developing world depends on their ability to reduce erosion and sustain income of participating farmers by means of a cost-effective and sustainable change.

ACKNOWLEDGEMENTS

This article was supported by the National Natural Science Foundation of China (40321101) and was partially funded by the bilateral Flanders-China project (BIL0209). Thanks are expressed to the members of the project team and Yang Qiu, Peng Zhao and Yin Zhang for field assistance.

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