ISSN: 1449-7433

Australian Centre for International Agricultural Research (ACIAR) Project: ADP/2007/055

Sustainable Land Use Change in China
Research Reports

Research Report No. 5

The Performance of the Bidding Trial for the Land Use Change Program in Sichuan Province, China

By
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February 2011

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Sustainable Land Use Change in China Research Reports are published by the Crawford School of Economics and Government at the Australian National University, Canberra, ACT, 0200, Australia.

These reports present discussion and preliminary findings of the research project 'Sustainable Land Use Change in China'. This project is a collaborative project between the Australian National University, Victorian Department of Sustainability and Environment, China National Forestry Economics and Development Research Centre, Sichuan Department of Forestry and Peking University. This research project is funded by the Australian Centre for International Agricultural Research (ACIAR).

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Abstract

This research report presents the findings of a cost benefit analysis of bid proposals submitted under the Land Use Change (LUC) bidding scheme in Sichuan Province, China. Results shows that a bidding scheme can be both practically feasible and efficient in China. Almost all the bid proposals are found to result in a positive net social benefit, indicating the efficiency of the bidding scheme. A comparison between the LUC bidding scheme and the fixed payment afforestation program revealed that the bidding scheme is 15 per cent more cost effective than the fixed payment program. The cost saving potential of the bidding scheme can be further captured through expanding the scheme to enable a wider variety of land types and land management and conservation activities in order to ensure heterogeneity across bid proposals. Transaction costs can also be minimised if bids are proposed at township or county level instead of at farm household level. Issues that need to be addressed in future bidding schemes include better project publicity and information dissemination, building long-term incentives into the contract design, and the minimisation of potential anchoring effects in bidding design.

Introduction

The use of market-based mechanisms in ecological restoration has not been as widely explored in China as it has in the USA, Europe and Australia. Under the ACIAR funded research project "Improving the Efficiency of Land Use Change Programs in China", a trial application of a market-based instrument for distributing funds to farmers engaging in land use change for environmental improvement was conducted in Sichuan Province in South West China. The objective of this project was to provide a comprehensive analysis and understanding of whether the introduction of market-based instruments could improve the efficiency of land use change programs in China. Specifically, the feasibility of a bidding scheme, named the Land Use Change (LUC) bidding scheme for establishing conservation contracts between farmers and government was explored. The LUC bidding scheme involved farmers in Sichuan Province submitting bids to provide environmental goods and services through afforestation and related management activities on lands that were contracted to their households.

According to economic theory, auctioning conservation contracts is cost-effective and can help to save public expenditure on the provision of environmental goods and services. In an auction, bids are evaluated and ranked based on the bid price information and the potential environmental benefits that the nominated conservation activities will generate. In evaluating bids, previous auction schemes such as the US Conservation Reserve Program (CRP) and the Australian BushTender programme were limited to a cost-effectiveness approach: An environmental or biodiversity benefit index was used to reflect the agency's preferences for various environmental attributes and bids were evaluated on a cost per index unit basis. In contrast, the LUC bidding scheme involves an analysis of the net-benefit arising from competing farmer bids. The environmental impacts of farmers' proposed actions were predicted using a bio-physical model and converted to a monetary measure of benefits using implicit prices estimated using stated preference techniques. These benefit estimates were then compared against farmers' bids to supply them as estimates of costs using standard benefit-cost ratios. Thus the scheme captures the preferences and priorities of the members of society who will enjoy the environmental goods and services supplied by the farmers' actions as well as the costs of those actions.

This research report presents the findings of a trial application of the LUC bidding scheme and provides an assessment of its performance relative to the fixed payment scheme currently used in China. The results also have wider implications for ecological restoration programmes and land use policy in China.

This research report[1] is structured as following. The methods used in implementing the LUC bidding scheme are outlined in the next section. These include the case study approach, biophysical and environmental economic modeling as well as the application of the net benefit criteria through the benefit cost ratio (BC ratio) in ranking the bids. Section 3 presents the process and characteristics of the bidding

[1] The organizational logistics and implementation of the bidding trial along with the initial findings of the LUC bidding scheme application trial were presented in Research Report No. 4 of this Research Series (Xu *et al* 2011).

scheme with the results of the trial application being detailed in Section 4. In Section 5, the cost saving potentials of the bidding scheme and the feasibility of its implementation are discussed. Some preliminary conclusions are drawn in Section 6.

Method

The relative efficiency of the LUC bidding scheme was assessed through a comparison of the area of land use change that could be achieved under the bidding scheme with that generated through fixed payments under the current Conversion of Cropland to Forest and Grassland Program (CCFGP) given the same amount of government funding. The incentives structure for farmers to participate was examined and analysed under each policy scenario and the feasibility of introducing the bidding scheme in rural China was explored.

A case study approach was used. Four villages in two counties in Sichuan Province were selected for the trial application of the LUC bidding scheme. Specifically, the bidding was conducted at the farm household level in Dishui and Zhongba villages of Pengzhou County and in Shunhe and Wenshan villages of Hongya County. The geographical location of these villages and the socio-economic characteristics of participating farmers were detailed in Research Report 4 (Xu *et al* 2011). The insecurity of property rights and potential high transaction costs due to the small scale of the rural household economy in China suggest that the cost-efficiency of the trial would have been improved if it had been conducted at the township or county level. Moreover, a random sample of counties and villages from Sichuan Province would have provided more representative results. However, concerns of local officials about the potential discontent of farmers arising from different payment levels under the bidding scheme precluded this approach (Wang and Bennett 2009). Hence the trial application was conducted at a smaller scale in villages where farmers have more experience with the CCFGP.

Bid evaluation under the LUC scheme was carried out through an analysis of the net-benefit arising from alternative farmer bids. Bids that have net benefits greater than zero were ranked based on their benefit-cost ratio. The benefit-cost ratio for each bid was estimated using bid price information and the potential environmental benefits that the land use change activities nominated in the bid will generate. The calculation of potential environmental benefits involves two stages. First, a biophysical model was developed at the individual bid level to predict the environmental outcomes of each bid (Li *et al* 2010). Second, these environmental outcome predictions were converted to a monetary measure of benefits that can be compared against farmers' bids. The second step involved the estimation of the non-market values of each environmental attribute through a choice modelling (CM) approach (Wang *et al* 2010). Specifically, respondents' preferences for various environmental improvements possible under the ecological restoration program were elicited in an urban household survey and their choice behaviour modelled to infer their willingness to pay (WTP) for each environmental attribute.

The main parameters used to estimate the environmental benefits are outlined in Table 1. The implicit prices (IP) for the environmental attributes estimated in the CM study are reproduced in the table. Specially, the IP for air quality represents the per household value estimates of urban households in Shanghai and Chengdu for one

more day with good to excellent air quality per year. The IP for water quality shows the value for a reduction of one million tonnes of sediment discharge into the Yangtze River per year, and the IP for species gives the value of one more plant species being present as a result of the implementation of ecological restoration program in China.

Table 1 Main parameters used in environmental benefit estimation

	Shanghai	**Chengdu**
IP for air quality (yuan[2])	5.48	4.75
IP for water quality (yuan)	50.08	0
IP for species (yuan)	0.79	0.65
Urban population (million)	16.48	5.96
Household size (persons)	2.7	3.0
Extrapolation rate	0.75%	0.25%

These per household value estimates were then used to derive the aggregate value that urban households in Shanghai and Chengdu hold for the environmental changes generated by the proposed land management activities under the LUC bidding scheme.

The CM survey extrapolation rate is one of the key parameters used to estimate these aggregate values. The relatively low extrapolation rates recorded (less than one per cent of the population) can be explained by a number of factors. First, response rates in stated preference surveys are sometimes low because they involve scenarios that are unfamiliar to respondents (Loomis 1987). Second, given that China's urban population has a relatively low income level[3], environmental goods and services are still luxury goods to most urban households. Hence their interest in participating in a CM survey on environmental issues is limited. The derivation of the extrapolation rate for Shanghai is illustrated here. The survey was web-based and the sample was drawn from the panel of the survey company. There are altogether 10 million people in Shanghai who have internet access, and among them only 100,000 people (a fraction of 1 per cent) were registered in the panel who indicate an interest in social surveys. Within the panel only 75 per cent were interested in taking this specific CM survey. This gives an overall extrapolation rate of 0.75 per cent.

The biophysical models predict environmental outcome attribute levels resulting from land use changes undertaken at the single farm level (Li *et al* 2010). The calculation of the environmental benefits generated by each bid is demonstrated in the following formula:

$$V_n^i = IP_{n,sh} \times Q_n^i \times {P_{sh}}/{HS_{sh}} \times E_{sh} + IP_{n,cd} \times Q_n^i \times {P_{cd}}/{HS_{cd}} \times E_{cd} \qquad (1)$$

Where V_n^i denotes the environmental benefits from attribute *n*, for farm *i*,

IP_n is the implicit price for attribute *n* for Shanghai (sh) and Chengdu (cd),

Q_n^i is the quantity change for attribute *n*, for farm *i*,

P is the population for Shanghai (sh) and Chengdu (cd),

HS is the household size in Shanghai (sh) and Chengdu (cd); and,

E is the extrapolation rate in Shanghai (sh) and Chengdu (cd).

[2] 1 yuan is equivalent to 0.15 US dollars.

[3] The average disposable income is 28838 yuan (USD 4325.7) in Shanghai and 18659 yuan (USD 2798.9) in Chengdu (Shanghai Statistics Bureau 2010; Chengdu Statistics Bureau 2010).

As the soil erosion reduction model predicts the quantity of reduction in soil erosion for each bid, the IP derived from the CM study (i.e. IP for soil erosion reduction per ton) can be used directly in Equation (1) to calculate the environmental benefits from water quality improvements. The calculation of environmental benefits from air quality improvement is based on a modified formula expressed in Equation (2). The IP for air quality represents the per household value estimates for one more day with good to excellent air quality per year. According to scientific research (Li, R., personal communication, 2009) conducted in Sichuan Province, a total area of 1.2 million hectares of afforestation across the province will bring about 35 more days with good to excellent air quality per year. Hence the quantity change for each farm can be expressed as:

$$Q^i_{AIR} = 35 / 1{,}200{,}000 * A^i * D^i_{AIR} \qquad (2)$$

Where A^i is the area of land use change on farm *i*, and

D^i_{AIR} is the divergence factor[4] for farm *i* that differentiates the impact of farm *i* LUC activities on air quality improvements from the regional average.

The Q^i_{AIR} thus derived can then be used in Equation (1) to derive the environmental values for air quality improvement arising from LUC activities nominated in each bid. The calculation of biodiversity benefits has a similar approach. As the impact of individual farm level LUC on biodiversity will be minimal, it is not feasible for the biophysical model to predict changes in species resulting from LUC activities at the farm level. The approach taken therefore is to apportion the likely impact on biodiversity of the overall change in land use over the project area amongst the participating farmers. Thus the average per mu[5] impact on biodiversity is the total number of species gain - estimated at 30 - divided by the total number of mu involved in the LUC. This quantity change is then substituted into equation (1) to derive the environmental values for biodiversity conservation achieved under each bid.

Bids that have positive net benefits were then ranked on the basis of their benefit-cost ratios, with the highest benefit-cost ratio providers of environmental goods and services being identified and selected for contract until the available government funding was exhausted. The total area of afforested land included in the LUC bidding scheme was used as a proxy for the potential environmental benefits arising from the land use change achieved under the bidding scheme. The efficiency of the LUC bidding scheme was then assessed through a comparison of these potential environmental benefits with those achieved through direct government funding provided consistent with the current Conversion of Cropland to Forest and Grassland Program (CCFGP) or Natural Forest Protection Program (NFPP) funding system.

Finally, the incentives structure for land improvement providers was analysed. A post-bidding survey was conducted to find out the key factors that affect farmers' decisions to participate in the bidding trial. The post-bidding survey covered 194 farm households, of which 152 households were bidders and 42 households did not

[4] Details of the divergence factor can be found in Li *et al* 2010.
[5] 1 mu is equivalent to 0.667 hectares.

participate in the bidding scheme. The key factors that may influence farmers' choices include their socio-economic conditions, experiences with previous CCFGP programs, perceptions of the bidding scheme such as distrust and uncertainty about the scheme, and environmental attitudes. Issues of interest also included the influence of information dissemination on farmers' participation choices and the role of technical assistance from county forest bureaus. Whether farmers are able to develop their own bids was another issue to note during the bidding process. For instance, while farmers may be able to develop a bid price for afforestation and management options, they may find the concept of quoting on the basis of their opportunity costs confusing. Based on these analyses, the feasibility of introducing the bidding scheme for land improvements activities in rural China is explored.

The Process and Characteristics of Bidding

Under the LUC bidding scheme, farm households were invited to submit proposals to carry out afforestation and related management activities during 2009-2012 on three types of lands that were contracted to them from the village collectives: barren lands, degraded cultivated lands and logging sites. An overall approach to afforestation and associated management activities was developed by local technical staff. This included the setting of standards such as tree species that could be selected, planting densities and times for maintenance to ensure the environmental values of the area would be protected. Within these overall settings, farm households were able to propose specific afforestation and management activities that suit them best.

Information sessions and the bidding process itself were conducted through villagers' meetings in the four pilot villages. Details of the bidding trial, including pricing and enrolment rules, were provided to participants during the information sessions. Table 2 shows the bidding characteristics. The bidding documentation which included a form for proposed afforestation and management activities by the farmers and a bid form with cost information, were distributed to interested farmers. There was question time after these information sessions. The bidding trial was then carried out immediately after the villagers' meetings in each village. Local technical staff and research team members were present during these sessions in case farmers needed further information on the technicalities of afforestation and management or on bid formulation. The farmers made minimal requests for assistance as they were relatively familiar with the type of activities that suited them best and with the estimation of the costs of such activities. In each of the villages, the bidding lasted for half a day to one whole day. In one of the villages, Pengzhou, farm households submitted their bids immediately after the villagers' meeting. In other villages, farmers lodged their bids the next day.

Table 2 Bidding Characteristics

Issue	**Characteristics**
Type of bidding	Single-round, sealed bid
Budget limit	Predetermined, concealed
Pricing rule	Discriminatory pricing
Activities contracted	Determined in advance and outlined in the afforestation and management plan
Reserve price	Not considered
Joint bids	Allowed

A cost benefit analysis was conducted for each bid proposal. Those that had a negative net benefit were initially discarded. The remaining bids were then ranked on the basis of their benefit-cost ratios and selected within the limit of the budget made available by the government for each village. In three of the pilot villages – the exception being Dishui Village in Pengzhou County - almost all submitted bids[6] were successful as the bid total in each village was within the government budget limit. An official notification letter was sent by the local governments to successful bidders specifying the time and venue for farmers to sign the written contract with county forest bureaus. Farmers were required to bring their land lease contracts to prove that the period of their lease covered the whole project cycle from 2009-2012. This ensured that participating farmers had the necessary property rights to undertake the land contract and were able to make decisions on the use of the specified lands.

Contracts were signed between the county forest bureaus and successful farm households in August 2009. Based on the contract, government payments are to be made in three instalments, with the second and third payments conditional on verification of compliance. This provides incentives for compliance for the duration of the contract. Initial payments were disbursed immediately after the contracts were signed to ensure that farmers could start planting in the autumn season. During the course of the contract, compliance will be monitored by local forest bureaus with facilitation by the Sichuan Forestry Department. The outcome of the bidding trial and the performance so far are discussed in the following section.

Results

Table 3 provides summary statistics of participation in the LUC bidding scheme. A total of 364 bids were received from 303 farm households in the four pilot villages covering a total land area of 5205.4 mu. There was a wide range of bids in terms of the land area nominated and the bid prices. Bid areas ranged from 0.5 mu to 280 mu, with bid prices ranging from 20 yuan (USD 3) per mu to 1500 yuan (USD 225) per mu. The total bid price covered by these bids amounted to 1.07 million yuan (USD 160,500).

[6] One bid in Zhongba Village had a benefit-cost ratio of less than 1.0 and so was excluded.

Table 3 Summary of the bidding trial results

	Hong Ya County		Peng Zhou County		Total/ average
	Caoyutan Township, Wenshan Village	**Caoyutan Township, Shunhe Village**	**Cifeng Township, Dishui Village**	**Xiaoyudong Township, Zhongba Village**	
Number of bidding households	79	66	90	68	303
Number of nominated sites	80	67	93	124	364
Total bid area (mu)	985	330.7	3226.5	663.2	5205.4
Total bid price (1,000 yuan)	150.2	28	737.6	149.7	1065.5
Average bid price (yuan/ mu)	152.4	84.5	228.6	225.7	172.8
Successful bid area (mu)	985	330.7	1336	661.2	3312.9
Allocated funds (1,000 yuan)	150.2	28	250.3	149.4	577.9
Minimum area nominated (mu)	1	0.5	1.0	0.5	NA
Maximum area nominated (mu)	35	30	280	50	NA
Minimum bid price (yuan/mu)	126	49.2	154	20	NA
Maximum bid price (yuan/mu)	315	210	324	1500	NA

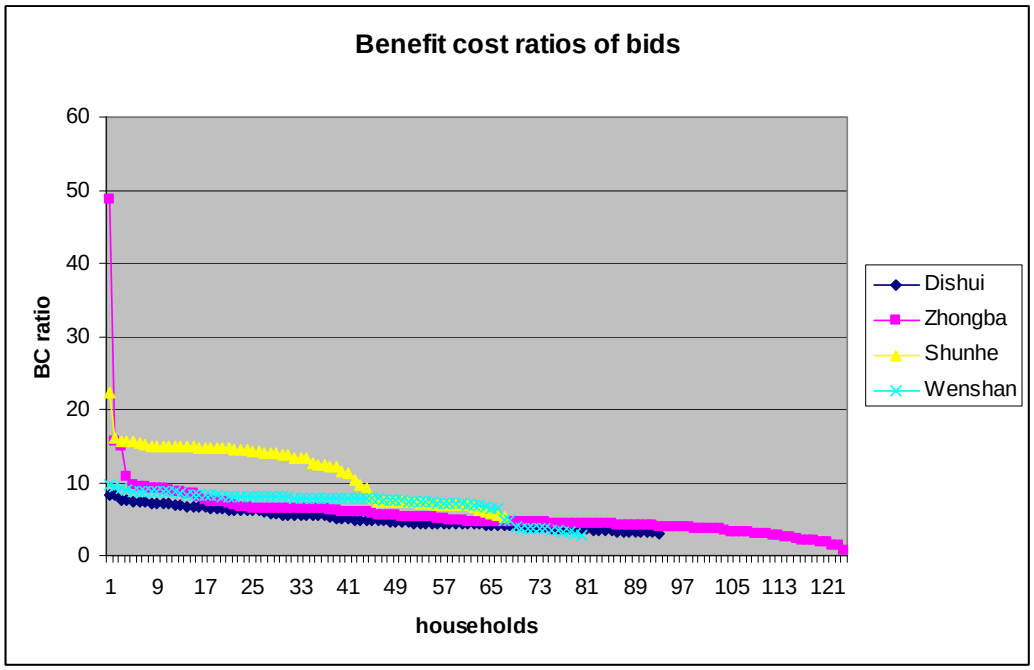
The bids were assessed and ranked in terms of their benefit-cost ratio. Almost all the bid proposals have benefit cost ratio greater than 1.0 (see Table 4), implying that community well being would be enhanced by funding the nominated activities outlined in the bids. All bids in Wenshan and Shunhe Village in Hongya and Zhongba Village in Pengzhou (except one with a benefit-cost ratio of less than 1.0) were successful. The total bid area in these three villages was relatively small and the total bid price in each of these villages was within the government budget constraints. In Dishui Village of Pengzhou County where the total bid area was much larger (around 3226.5 mu), only 1336 mu of land use change was funded from the limited government budget allocated for ecological restoration. This amounts to 50 successful bids out of the 93 bids collected from this village. Across the four villages, a total of 320 of these bid proposals were allocated contracts. This means that 3312.9 mu of land will be afforested and managed under the scheme at a cost of 577,900 yuan across the four villages over a three-year period from 2009 to 2012.

Table 4 Benefit-cost ratio of bids

	Wenshan Village	**Shunhe Village**	**Dishui Village**	**Zhongba Village**
Highest BC ratio	9.7	22.4	8.3	48.6
Lowest BC ratio	2.8	5.2	2.9	0.6
Average BC ratio	7.2	11.6	5.1	5.7
Coefficient of variation	0.24	0.33	0.27	0.80

Figure 1 below shows the benefit-cost ratios of all the nominated bids across the four pilot villages. The benefit-cost ratios vary the most in Zhongba Village, with the lowest ratio being less than 1.0 while the highest was 48.6. Variation is also evident in Shunhe Village, while less so in both Dishui and Wenshan villages. Economic theory of conservation auctions suggests that the greater the heterogeneity in the costs and benefits of the landholders, the greater are the potential gains from introducing trade relative to a uniform subsidy. This indicates that the greatest potential for efficiency gains is in Zhongba Village, followed by Shunhe Village where heterogeneity across bidding households is significant. Even though the majority of bids were accepted, these efficiency gains of the bidding scheme relative to a fixed payment arrangement are experienced through the lower overall costs of achieving more targeted environmental improvements. Even more efficiency gains could have been achieved if only those bids with higher benefit-cost ratios had been selected.

Figure 1 Benefit cost ratio of bids across the pilot villages



The analysis to this point has assumed that the activities proposed in farmers' bids will have a 100 per cent success rate in producing the predicted environmental benefits. A sensitivity analysis was conducted to find out the impact on the benefit-cost ratios of the various factors that may affect this success rate. These factors include the survival rate of plantings, the extent of maintenance after the 3-year project period, and weather conditions that may increase the risks of forest fires and pests as well as growth rates.. The probability of successful delivery of environmental improvements resulting from land use change was assumed to vary between 50 per cent and 75 per cent. Table 5 shows that across this range of probabilities, the BC ratios of bid proposals across Wenshan, Shunhe and Dishui villages are still greater than 1.0. However, there are five bids in Zhongba Village that would produce benefit-cost ratios lower than 1.0 if the probability of success was 50 per cent. This number drops to two when the probability of success rises to 75 per cent.

Table 5 Sensitivity analysis of BC ratio

Probability of success		Wenshan Village	Shunhe Village	Dishui Village	Zhongba Village
50%	Highest BC ratio	4.8	11.2	4.2	24.3
	Lowest BC ratio	1.4	2.6	1.5	0.3
	Average BC ratio	3.6	5.8	2.5	2.8
75%	Highest BC ratio	7.3	16.8	6.2	36.5
	Lowest BC ratio	2.1	3.9	2.2	0.4
	Average BC ratio	5.4	8.7	3.8	4.2

Figures 2 to 5 provide an overview of budget allocation based on benefit-cost ratios across the pilot villages. As stated earlier, bids were selected and government funds allocated from the highest benefit-cost ratio bid to the lowest. Apart from bids coming from Dishui Village in Pengzhou County, most farmers were allocated contracts, with BC ratio ranging from 48.6 to 1.3. However, only 50 out of the 93 bid proposals from Dishui Village farmers were funded, not because of benefit-cost ratios less than one but due to government budget constraints. The lowest benefit-cost ratio of the selected bid proposal in Dishui was around 4.6. This indicates that there is greater cost saving potential if government funds could be re-allocated between townships or even counties to take further advantage of differentials in benefit-cost ratios between household level bids. More bid proposals would have been selected in Dishui Village if bid proposals were selected at the county or provincial level.

Figure 2 Budget allocation based on BC ratio (Wenshan)

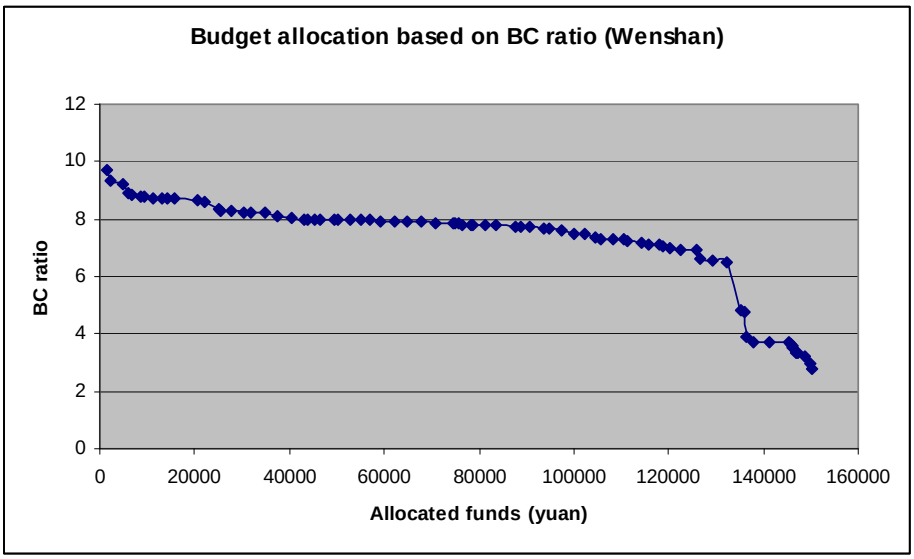


Figure 3 Budget allocation based on BC ratio (Shunhe)

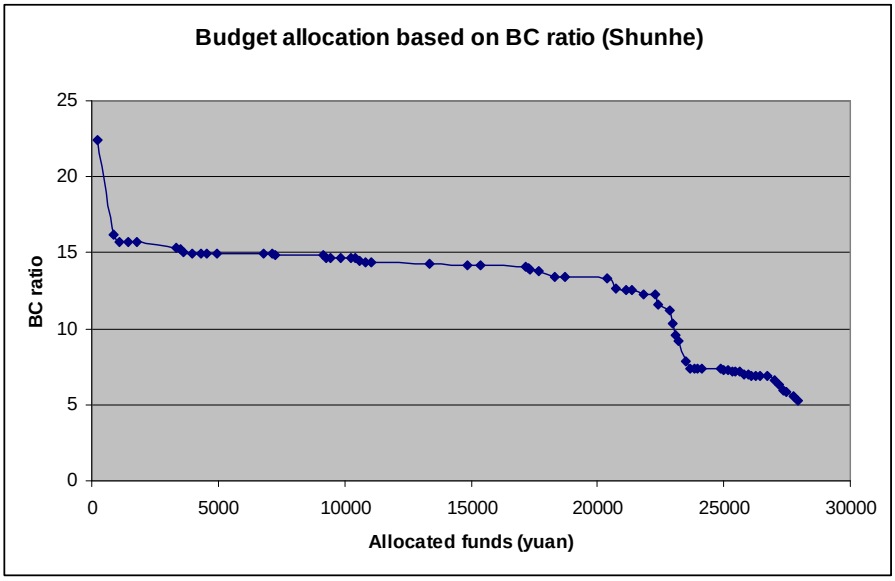


Figure 4 Budget allocation based on BC ratio (Dishui)

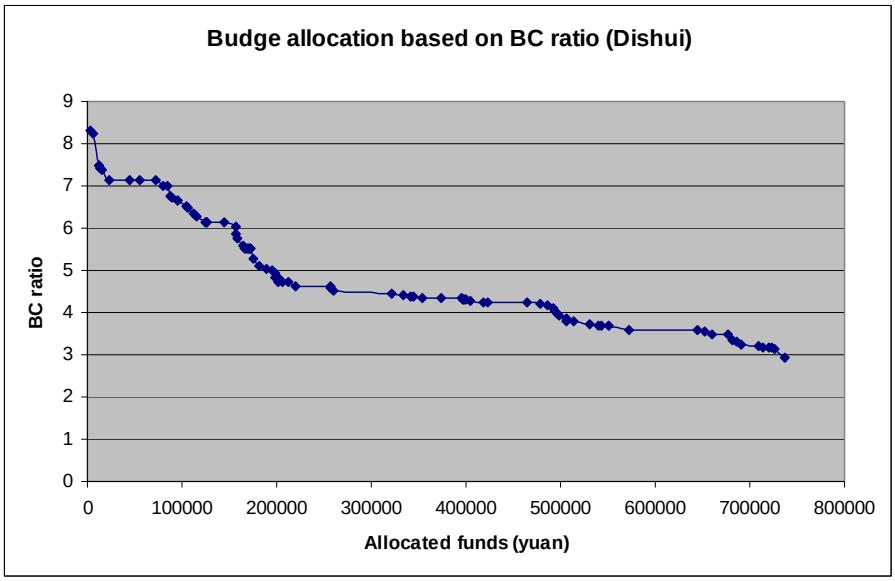
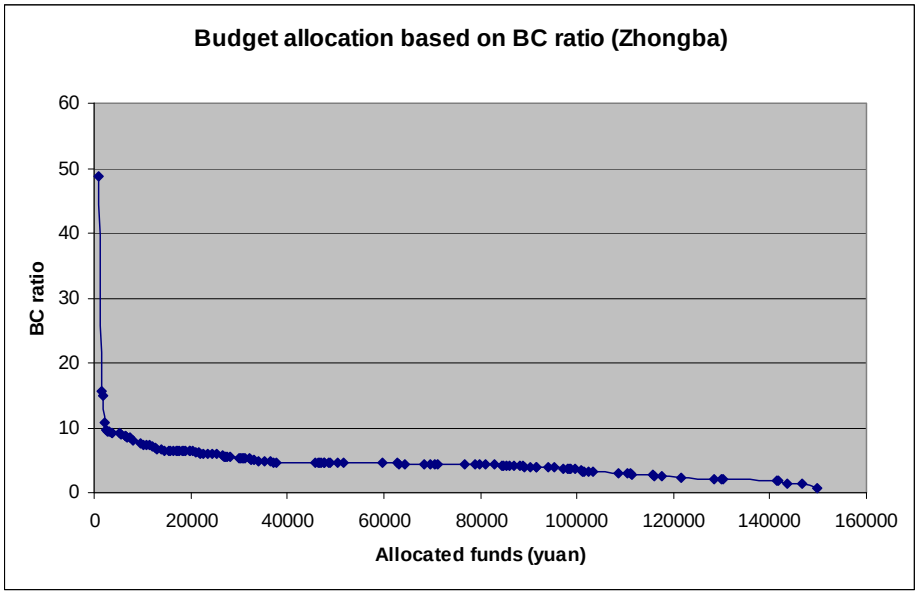


Figure 5 Budget allocation based on BC ratio (Zhongba)



The marginal cost (supply) curves for the four pilot villages (see Figures 6 to 9) illustrate the costs of generating additional units of environmental benefits. The horizontal axis depicts the total environmental benefits (measured in monetary terms) supplied when the bids received are assembled in ascending unit price order. The supply curve for environmental benefits in Wenshan Village is relatively flat over much of the quantity of environmental benefits provided, with unit price ranging from 130 yuan to 160 yuan. The supply curve then becomes relatively inelastic as the accumulated quantity of environmental benefits exceeds 1 million yuan. At this point the unit price required for the supply of an additional unit yuan of environmental benefits rises steeply. In Shunhe Village, the unit price remains below 100 yuan up to cumulative benefit of 300,000 yuan. In both Dishui and Zhongba villages in Pengzhou County, the supply curves remain flat until the cumulative environmental benefits reach 600,000 yuan, with unit price ranging from 150 to 300 yuan per mu. Thereafter, the price for an additional unit of environmental benefits increases rapidly.

Some initial conclusions can be drawn from these supply curves. First, the cost for the provision of environmental benefits is higher in Pengzhou County compared to that in Hongya County in general. If government funds are to be allocated across the counties in Sichuan Province, then Hongya County should be favoured over Pengzhou County on the basis of economic efficiency, at least for the levels of land use change considered in this project. Second, the slopes of the marginal cost curves for the provision of environmental benefits in the pilot villages suggest that setting a fixed price payment would be inefficient.

Figure 6 Marginal cost curves for environmental benefits in Wenshan Village

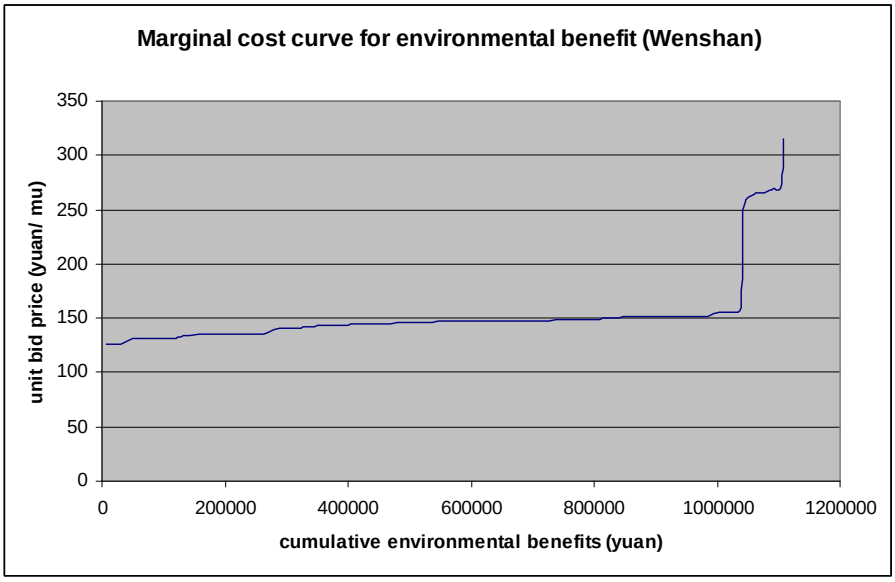


Figure 7 Marginal cost curves for environmental benefits in Shunhe Village

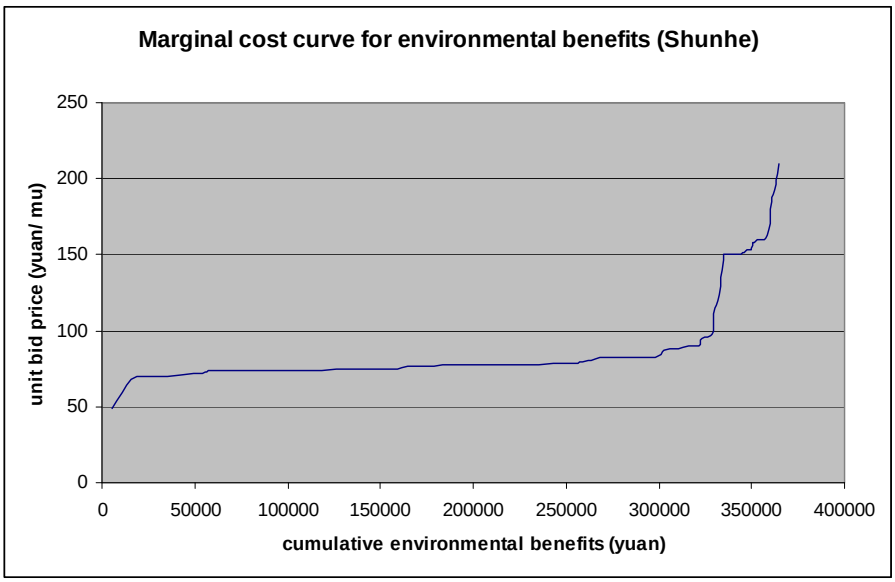


Figure 8 Marginal cost curves for environmental benefits in Dishui Village

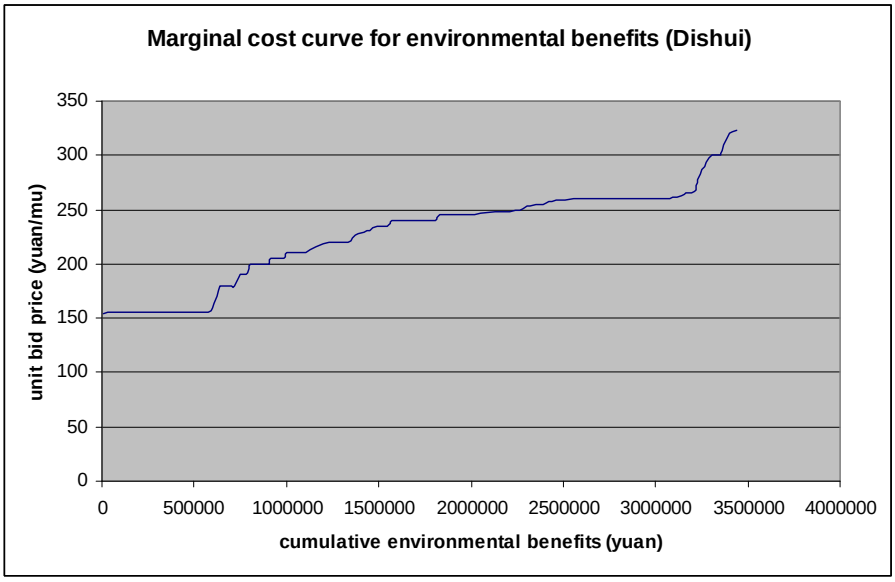
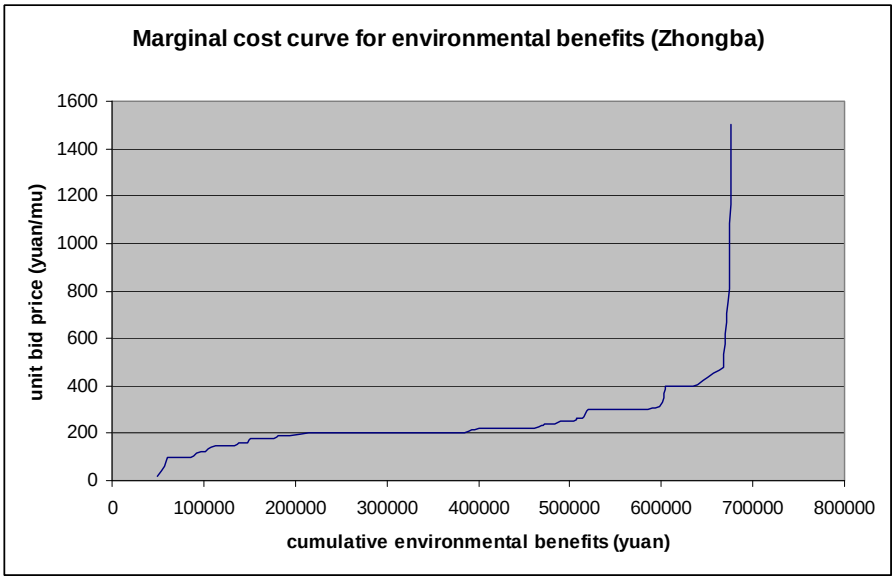


Figure 9 Marginal cost curves for environmental benefits in Zhongba Village



Discussions and Policy Implications

Cost-effectiveness of the bidding scheme

The cost-effectiveness of the LUC bidding scheme is assessed by comparing the outcomes of the scheme with those that would have been achieved under the fixed payment arrangements of the CCFGP. A strict counterfactual comparison between the two schemes cannot be made as the different selection processes used in the two

schemes would result in different land plots being accepted with different afforestation and management activities. However, a comparison can be made of the amount of government spending under the LUC scheme with that would have been allocated under the fixed payment CCFGP to achieve the same area of afforestation and associated management activities, ignoring the diversity of outcomes that may come from any given area of land. It can be argued that the LUC bidding scheme will perform better than the CCFGP in terms of environmental performance for two reasons. First, bid proposals under the bidding scheme were ranked and selected based on their benefit-cost ratios, that embody a biophysical model that relates activity to environmental performance. This ensures that environmental improvements are specifically targeted. This can be contrasted with the CCFGP approach which is more based on the views and opinions of local officials who may be involved in rent seeking behaviour. Second, payments are to be made only upon regular monitoring of compliance under the bidding scheme. This will help to ensure the successful delivery of environmental outcome as farmers have the incentive for better maintenance of the forests. The expected environmental outperformance of the LUC bidding scheme implies that the cost saving potential of the scheme is rather conservative using the above approach which takes into account only the cost aspects of the two schemes.

Table 6 Cost saving potential of the LUC bidding scheme

	Wenshan Village	**Shunhe Village**	**Dishui Village**	**Zhongba Village**	**Total/ average**
Successful bid area (mu)	985	330.7	1336	661.2	3312.9
Allocated funds under LUC scheme (1,000 yuan)	150.2	28	250.3	149.4	577.9
Allocated funds under CCFGP (1,000 yuan)	197.0	66.1	267.2	132.2	662.5
Cost saving (1,000 yuan)	46.8	38.1	16.9	-17.2	84.6

As Table 6 shows, it costs 577,900 yuan under the LUC bidding scheme to carry out afforestation and management activities on 3312.9 mu of land in the pilot villages. If the same area had been submitted under the CCFGP it would have cost 662,500 yuan. This is a 15 per cent cost premium for the fixed payment scheme compared to the LUC bidding scheme. The overall bidding payment represented an average cost of 172.8 yuan per mu, compared with a cost of 200 yuan per mu under the CCFGP scheme.

The negative cost saving shown for Zhongba Village in Table 6 arises because the availability of funds meant that bid proposals with relatively low benefit-cost ratios were selected and allocated contracts[7]. This occurred because the total area covered by bid proposals was much smaller than expected. Hence the authorities in the pilot villages (except Dishui Village) did not set any limit to their budget. All bids were accepted. This undermines the potential gain of the bidding scheme across the pilot villages. This is especially the case for Zhongba Village, where the sensitivity analysis shows that a 50 per cent probability of successful delivery of environmental outcomes would result in five bids having BC ratio lower than 1.0.

[7] Note that the existence of a negative cost saving does not necessarily imply that the CCFGP scheme is more economically efficient. The environmental benefits secured by the better targeted LUC scheme may outweigh its cost disadvantage.

The cost saving potential of the bidding scheme is also undermined by the bid proposals being submitted at the farm household level. The bidding scheme could have been carried out at the township or county level. This would have reduced the transaction costs of the LUC scheme when implemented at the small scale of the rural household. It would also have ensured the heterogeneity of environmental benefits across the bid proposals. Because of the small scale of rural households, land plots in the same villages have very similar physical conditions such as topography, climate, and tree species suitable for planting in the area. These may differ greatly across townships and counties. However, concerns amongst local officials regarding the prospect of discontent amongst the farmers because of different payment levels under the bidding scheme precluded this approach (Wang and Bennett 2009).

The implementation of the bidding scheme at the farm household level did increase transaction costs compared to the CCFGP according to officials from Sichuan Department of Forestry and county forest bureaus. The institutional structure used to administer this bidding scheme spreads across three levels of government:

- provincial government (Sichuan Department of Forestry) to coordinate the bidding scheme and provide overall guidance;
- local government (county forest bureaus) to organise various activities under the scheme and coordinate funding; and,
- village committee to implement the bidding activities at the field level.

There was also a number of technical extension support groups involved at these levels. This implies that it may be difficult to coordinate changes in mechanisms across a complex institutional structure. Because of the low level of knowledge and understanding of the mechanism among the local officials, there were extra costs incurred in assisting them to design, develop and implement the bidding scheme, and in assisting landholders formulate their proposals. High transaction costs also include applying the biophysical model, collecting biophysical data, organising village meetings for information dissemination, etc. It is estimated that transaction costs for the bidding scheme are one third higher than the administrative costs associated with the afforestation under the CCFGP. Hence, the magnitude of the cost saving potential of the bidding scheme will not be as significant if the potentially higher transaction costs are taken into account.

However, studies show that once the initial costs of design had been incurred, the operational costs of running a tender are similar to those of a grant scheme (Bryan et al, 2005; Gole et al 2005). The skills and knowledge obtained from the LUC bidding scheme would considerably reduce the cost of implementing another bidding scheme in the region, especially if the focus remains on afforestation and associated management activities for the purpose of ecological restoration. Officials from Sichuan Department of Forestry and local forest bureaus also confirmed that the transaction costs of the bidding scheme are likely to fall with further implementation similarly to the pattern of transaction costs witnessed in the beginning phase of the CCFGP. They believe that once the start-up administrative costs of the new mechanism have been incurred, it will be easier for a future similar bidding scheme to be put in place. The initial scheme has helped to build up local knowledge and capacity. Participating farm households considered that their transaction costs were also higher under the LUC scheme compared to the CCFGP, but they also said that the initial phase of the CCFGP was as difficult as the bidding scheme's. In addition,

the scale of the current bidding scheme is small, so the increase in transaction costs for the improvements in capital efficiency appears higher. With the expansion of the bidding trial, the increase in transaction costs may no longer be significant.

Feasibility of the bidding scheme in China

Information gathered from the post-bidding survey provides some insights into the feasibility of implementing the bidding scheme in China. Issues of interests include the incentives for farmers to participate in the bidding scheme, farmers' perceptions of the bidding scheme such as distrust and uncertainty about the scheme and their environmental attitudes, the influence of information dissemination on farmers' choices of participation, and whether farmers will be able to develop their own bids.

Survey results show that the bidding scheme was well accepted by farmers in the pilot area. Almost all participating farmers expressed their willingness to participate in future bidding schemes. Among the surveyed participants, 97 per cent indicated that they participated in the bidding scheme on a voluntary basis. Only three per cent of participants were asked by their village leaders to participate in the bidding scheme. Farmers participated in the bidding scheme for three main reasons. First, barren lands can be utilised under the bidding scheme while only degraded cultivation lands are eligible under the CCFGP. This will bring additional income to the farmers. Most of surveyed participants believe that their lands are better suited to growing trees rather than crops. Second, almost half (45 per cent) of surveyed participants believed that the subsidy under the bidding scheme would be higher than under the CCFGP. Third, some farmers consider that more technical assistance would be available under the bidding scheme. There is a small number of participants (about 11 per cent) who participated in the bidding scheme for other reasons including environmental conservation, sustainable land management, and increasing their income levels. Most participating farmers were able to develop the bids by themselves, with only 28 per cent receiving assistance to complete the bidding form from the village head or technical staff.

For those surveyed non-participants, almost all of them were willing to participate in the bidding scheme. They did not participate for various reasons. Among these non-participants, 26 per cent were not aware of the bidding trial. Other reasons for non-participation include that their lands were not suitable for forests, none of their lands were available for the bidding scheme, lack of labour force in the households and a combination of other reasons such as concerns about not having convenient transportation. The lack of information about the bidding scheme indicates problems associated with information dissemination during the organisation of the bidding scheme. More effort should be devoted to project publicity so that everyone who is eligible is aware of any future bidding scheme.

The potential social dispute that might arise from different payment levels was explored during the post-bidding survey to address the concern of local officials. Survey results showed that 82 per cent of the successful participants who compared payments with other successful landholders did not care if other land holders received higher payments through the bidding process, as they appreciated that each landholder had different costs. This demonstrates that even though China has long been an egalitarian society in which farmers share the costs and benefits of agricultural

production on an equal basis, farmers' perceptions and attitudes are changing as China moves into a more market-oriented open economy. On the basis of this finding, it is possible to scale up the bidding trial to expand it to a wider area in Sichuan Province. To reduce transaction costs and ensure heterogeneity across bids, future bidding trials could be conducted so that budget allocation occurs at the township or county level.

The long-term provision of the environmental goods and services generated through the conservation contracts under the bidding scheme is of great significance, given that the term of these conservation contracts is only three years. Two thirds of the surveyed participants confirmed that the bids they put forward reflected the costs they would incur during the first three years following plantation as stated in the contract. Only 21 per cent of participants were informed of avenues for accessing additional financial support from other sources following the expiration of the three-year contract. These findings present a challenge to the long-term sustainability of afforestation and associated management activities achieved under the bidding scheme. Continuous efforts and inputs will be required to maintain the forests established under the scheme. It is therefore of great policy significance to relate the contracts signed for the bidding scheme to other preferential forest policies such as the Forest Ecological Compensation Programme to protect long-term environmental gains.

The anchoring effects discussed in the reserve price literature (Reichelderfer and Boggess 1988) can limit the efficiency gains from conservation auctions as bidders act strategically instead of revealing their true costs in their bid proposals. This potential problem was explored in the context of the bidding scheme. According to the survey results, almost all the participants (99 per cent) being surveyed had previous experience with the CCFGP. More than half of them referred to the subsidy level provided through the CCFGP when formulating their bid price under the LUC bidding scheme and submitted bids that were higher than the subsidies they received from the CCFGP. Other bids offset these higher than CCFGP subsidy bids. About 90 per cent of participants considered input costs for production when formulating the bids, 34 per cent considered labour costs, and 31 per cent further considered foregone income sources. This implies that there might be a combination of strategic behaviour and rational thinking when the bids were formulated. Future bidding schemes in China need to be designed in a way to allow for testing of anchoring bias and to minimise this potential bias.

Conclusions

Even though conservation auctions have already been piloted and conducted in a number of countries for the past decade, experiences are rare in developing countries. The LUC bidding scheme presented in this report is one of the first pilots to be conducted in a developing country context. Results shows that a bidding scheme can be both practically feasible and efficient in China. There is potential to increase the efficiency gains of government funding in ecological restoration through a competitive bidding process. Cost benefit analysis of each bid shows that almost all the bid proposals result in a positive net social benefit, indicating the efficiency of the bidding scheme. Further, a comparison between the LUC bidding scheme and the fixed payment CCFGP revealed that the bidding scheme is 15 per cent more cost

effective than the CCFGP. However, if differential transaction costs are factored in, this potential gain may not be as significant.

The potential efficiency gain and the implications of the transaction costs involved need to be interpreted with caution. The magnitude of the cost saving potential of the bidding scheme is limited by the small geographical coverage of the pilot project. As bid proposals were submitted and selected at the village level under the bidding trial in four villages across two counties in Sichuan Province, there was a lack of heterogeneity across the land plots included. This undermines the potential efficiency gains available from a competitive bidding mechanism. The small scale of farm land involved also increased the per unit transaction costs. This indicates that future bidding scheme could be designed and implemented at a larger scale to enable a wider variety of land types and land management and conservation activities in order to ensure heterogeneity across bid proposals. Transaction costs can also be minimised if bids are proposed at township or county level instead of at farm household level. Furthermore, the post bidding survey results show that farmers perceived little difference in their costs of involvement with the bidding scheme compared with the CCFGP, and the design and development costs of the bidding scheme will decline in future bidding schemes.

An expansion of the bidding scheme looks to be feasible. At the inception of the LUC bidding scheme, local officials indicated concerns about the social disputes that might arise due to differential payments being made under the bidding scheme. Hence the bidding approach was piloted at a small scale. The post bidding survey results show that the bidding scheme was very well received by local farmers and almost all surveyed participants believe that they would participate in future bidding schemes. The majority of participating farmers were aware of the different subsidy levels they received under the bidding scheme, but did not mind the difference as they appreciated that different costs were experienced by different landholders with different projects. This finding provides further assurance to local officials that social conflict will not be an issue if the bidding scheme is expanded to a larger scale.

In addition to its cost saving potential and superior environmental targeting, the bidding scheme was found to bring a number of indirect social benefits. These included local capacity building for officials, technicians and farmers, building up the trust between officials and farmers, increased environmental awareness of local farmers, and more decision-making power being given to local farmers in land use management. Finally, the bidding scheme needs to be tested in a variety of landscapes and institutional settings before it can be widely applied in China. Issues that need to be addressed in future bidding trials include better project publicity and information dissemination, building long-term incentives into the contract design, and the minimisation of potential anchoring effects in bidding design.

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