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2 Executive summary

The efficiency of public environmental payment programs is a prominent policy issue not only for the Chinese Government but also for the Australian and other governments worldwide. This project aimed to investigate the potential of policy alternatives to help improve the efficiency of the various land use change policies that are currently financed by the Chinese Government, with a budget totalling CNY 700 billion (US\$ 90.6 billion). The overall objective of the research was to provide a comprehensive analysis and understanding of whether the introduction of market-based instruments (MBIs) would improve the efficiency of the key land use change programs in China. Specifically, the feasibility of a bidding scheme for conservation contracts to allocate government ecological funds was explored in four case study villages of two counties in Sichuan Province, Southwest China.

The case study trial results suggest that a bidding scheme under which farmers offer land use changes in return for a financial payment nominated by them can be both practically feasible and more economically efficient in China. The bidding scheme was found to be very well received by local farmers and most farmers indicate that they would participate in future bidding schemes. There is potential to increase the efficiency gains of government funding in ecological restoration through the introduction of a competitive bidding process. The bidding scheme was found to improve the environmental targeting of ecological restoration compared to the currently used fixed payment programs. A comparison between the bidding scheme and the fixed payment Conversion of Cropland to Forest and Grassland Program (CCFGP) revealed that the bidding scheme is 15 per cent more cost effective than the CCFGP. However, the magnitude of this cost saving potential of the bidding scheme is limited by the small geographical coverage of the pilot project due to the lack of heterogeneity across the land plots included in the bids.

The bidding scheme carried out under this project is one of the first trialled in a developing country context. It demonstrates how MBIs can be used to improve the efficiency and effectiveness of natural resource management in China and has implications for policy development in this area both in China and in other developing countries. It is anticipated that MBIs such as the bidding scheme can be more widely used in natural resource management in China in the coming years. The bidding scheme was also found to bring a number of community 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.

Findings of this project suggest that future bidding schemes could be conducted so that budget allocation occurs at the township or county level in order to increase the extent of efficiency gains from reduced transaction costs and greater level of heterogeneity. Long-term incentive structure needs to be built into the bidding schemes to ensure the sustainability of the provision of environmental goods and services. Further, institutional barriers especially at the local level need to be tackled in order for the bidding scheme to be implemented successfully. Lastly, more in-depth research relating to auction design and contract design need to be incorporated into future bidding schemes in China.

3 Background

Worldwide payments made by governments to stimulate land use change are often determined by political or budgetary considerations, rather than economic evaluation of the benefits and costs involved. Research under the previous ACIAR funded project entitled “Sustainable Land Use Change in North West Provinces of China” (ADP/2002/021) identified a number of problems associated with the Conversion of Cropland to Forest and Grassland Program (CCFGP), one of the world’s largest government initiatives to provide environmental goods and services. In particular, better environmental targeting and improved cost-effectiveness of the Program were found to be possible and desirable. Under the CCFGP, payments are made on the broad basis of opportunity cost of land converted instead of recognising the potential environmental benefits arising. There are only two levels of payments across the country to differentiate crop productivity, and hence opportunity cost, between the North and South. While the payment was found to be important in some counties in initiating land use changes, it was found to be less so in other counties. This suggests that the CCFGP should target areas where the payment is most needed. More resources should be diverted to these areas in order to maximise the environmental benefits of the Program. A single rate of payment of the Program in North China was found to be inefficient in achieving sustainable land use changes in Program areas.

This is a feature shared with other forest management and environmental services programs in China, including the Forest Ecosystem Compensation Program (FECP) and the Natural Forest Protection Program (NFPP), with a total budget of CNY 700 billion (US\$ 90.6 billion). Direct public subsidisation of the land use change programs in China, which use the “command and control” type approach, was found to be inefficient also in a number of other studies (Qu 2002; Liu 2002). Problems with this type of approach include difficulties in quantifying ecological benefits, and the single rate of compensation that fails to reflect the different levels of ecological function and agricultural potential in different locations. These problems severely undermine the cost-effectiveness of the key land use change programs currently undertaken in China. It is therefore of great policy significance for the Chinese Government to improve the efficiency of the use of these government funds. The intensity of environmental degradation resulting from current land use, growing public finance constraints and an increasing frustration with governmental inefficiencies require more innovative policies to secure land use change.

The more innovative policies need to address the main problems associated with the current payment scheme for land use change in China. There are two main problems associated with the current payment scheme. First, the design of a payment scheme requires clear objectives and evaluation procedures. The implementation of the CCFGP demonstrates how the lack of clear, measurable objectives and means to evaluate progress toward meeting objectives can lead to unintended uses of funds. The Program typically has been paying to restore vegetation cover on the assumption that forests and grass will be beneficial, rather than to reward measurable environmental services. The second problem of the current payment scheme is asymmetric information. According to Latacz-Lohmann and Van der Hamsvoort (1997), farmers know better than the program administrator about how participation in conservation actions would affect their production plans and profits, while environmental experts hold information about the significance of environmental assets that exist on farm land. Furthermore, landholders may not have information about government priorities and may not understand how this information might influence subsequent land use contracts (Latacz-Lohmann and Van der Hamsvoort 1997). Hence, flat-rate Pigouvian taxes and subsidies may not fully correct market failure when information asymmetry is evident. Other forms of contract design or governance arrangements are therefore needed.

Auctioning conservation contracts has emerged in recent years as a means of creating markets for public goods and to facilitate price discovery and allow resources to be allocated in a more efficient way (Stoneham *et al* 2003; Eigenraam *et al* 2007). Under the auction mechanism, the land to be converted could be identified through a competitive bidding scheme where land holders, in selected regions, are asked to bid for funds to undertake land improvement services. Theory suggests that auctioning conservation contracts is cost-effective and can help to reduce public spending on programs for provision of environmental goods and services. Because of competition, farmers have an incentive to reveal their true compliance costs. This reduces over-compensation and increases cost-effectiveness. Bids submitted by participating farmers are ranked on the basis of two key components. The first is the farmer's bid price, which normally comprises their compliance costs of the conservation contract, opportunity costs of their foregone benefits from previous land practices, and a risk premium in the case of output-based payment which will cover the farmer's losses arising from factors beyond farmers' control (such as droughts or pest invasions). The second component is the assessment of potential environmental outcomes from farmers' proposed conservation activities. Through the bidding scheme, the highest net benefit providers of environmental goods and services can thus be identified and selected into the conservation contracts.

Despite its theoretical advantages, an auction is a complex incentive mechanism which involves a higher risk of failure compared to a simple fixed-rate payment. Insufficient bidding competition and the risk of learning on the part of bidders, especially in a multi-round auction setting, are potential problems. In addition, high transaction cost might undermine the cost-effectiveness of auctions for conservation contracts. The transaction costs associated with bidding schemes might be higher than the fixed-rate payment scheme in some cases. Transaction costs for conservation auction programs include costs associated with designing the auction scheme, information dissemination, administration of contracts, compliance monitoring, environmental monitoring and evaluation of the scheme.

This research project aimed to assess the viability of a bidding scheme for access to government funds for land use conversion and ecological restoration in China. Four villages in two counties (Pengzhou and Hongya) in Sichuan Province were involved in the bidding trial. The efficiency of the bidding scheme was assessed through a comparison with the land use change achieved under the current "command and control" funding system. Co-investment from the Chinese Government for the implementation of the land use change programs in the localities was provided for the trial. This involved the actual government funding for the implementation of the land use change programs in the localities taking part in the project. This demonstrated the Chinese Government's commitment to move forward to a more decentralised and more market-oriented approach to land use management. Throughout the process more decision-making power were given to participating farmers.

This project also tried to tackle some of the above mentioned problems associated with auctions and bidding. The results from the research are readily transferable across China (including North West China where land use change is also a priority). The research therefore addressed the highest priority of the Chinese partners and also embodied an emphasis on poverty reduction in western China through institutional reform and environmentally sustainable rural development. It was also aligned with priorities expressed in the ACIAR Annual Operational Plan (2007-08) for China, which involves the "sustainability aspects of agricultural production through policy and technical projects on better management of land and water resources in north-western China". Findings from this research have important implications for the future design of the full range of land use change programs in China, including the CCFGP.

4 Objectives

There were **four** main objectives to be achieved under this research project.

The primary objective of the research was to provide a comprehensive analysis and understanding of whether the introduction of market-based instruments will improve the efficiency of the key land use change programs in China. Specifically, the feasibility of a bidding scheme for conservation contracts in allocating government funds was explored. As a result, better policy outcomes can be delivered whereby environmental benefits are maximised for the lowest possible cost.

The second objective of this project was to enhance cooperation between resource management agencies and research bodies in China. Effective collaboration across government agencies at various levels and across sectors as well as between policy makers and research community is crucial in natural resource management. Through this project, such collaboration was strengthened to ensure more effective policy making process and the implementation of these policies.

The third objective of this project was to promote community participation. Through this project, more decision-making power was given to local communities in their land use decisions as consultations were held between local governments and participating households during project implementation. More local participation in policy making and resource management can bring further changes to the policy-making process for the implementation of the land use change programs in China. In addition, social awareness of the importance of environmental improvements was also raised. This is a key component to ensure the successful implementation of land use change programs at the grass-root level.

The last objective of this project was to continue capacity building in the partner country institutions. Through this project, the research capacity of key collaborators in China and their command of policy-making tools was further strengthened. The capacity of local township and village leaders as well as rural households was increased in the preparation of the bidding documents jointly. Land management knowledge was delivered and shared more widely amongst the rural households, and this will be beneficial to future land improvement activities.

5 Methodology

5.1 Case study approach

To assess the feasibility of applying the bidding scheme in allocating government fund for ecological improvements in China, a case study approach was adopted which involved field experiments in Sichuan Province (see Figure 5.1) in south west China. Sichuan Province is of great agricultural and ecological significance in China. It is where the pilot phase of the CCFGP was implemented. In 2009, the Sichuan Government initiated a new ecological restoration program. This three-year program aims to encourage local farmers to plant ecological trees on barren land, harvested sites, degraded arable land and sloped lands in the Province. The bidding trial was conducted for the implementation of the new ecological restoration program. Two case study counties in Sichuan Province, Pengzhou and Hongya (see Figure 5.2), were involved in the trial. The efficiency of the 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 land improvement providers was examined and analysed in each policy scenario and the feasibility of introducing the bidding scheme for land improvements activities in the rural context of China explored.



Figure 5.1: Sichuan Province, China



Figure 5.2: Case study counties

The original design of the project was for the bids to be submitted at the township level. This design can be justified as follows. Compared to conservation contracting programs in other parts of the world, the most distinctive feature in China involves its land property right regime and the scale of lands for each household. The implementation of the auction mechanism would require clearly defined property rights for land holders. Unlike in the United States and Australia where private property rights of farmland owners are strong, all the land in China is owned by the state or the collectives represented by local governments. Farmers have only the use rights to the land and very often these rights are incomplete or insecure. This imposes risks for participating farmers if they entered into the bidding scheme as individuals because their payments would not be guaranteed. Moreover, landholders in China are normally small scale (Hyde et al 2003). This implies high transaction costs under the auction scheme and hence challenges the cost-effectiveness of the scheme. Taking these into consideration, it is likely to be more practical for local governments at the township or village level to enter into the bidding on behalf of small landholders. This would reduce transaction costs and also secure the property rights to the land entering into the long-term contracts.

Refinement of the bidding trial design led to the selection of two villages in each of Pengzhou and Hongya Counties as the initial pilot project area. This adjustment came as a result of further discussions with provincial and county forest bureau officials. According to local officials, rural China has long been an egalitarian society in which farmers share the costs and benefits of agricultural production on an equal basis. This remains much the same even after the rural land reform took place in the late 1970s with the introduction of a household responsibility system. Farmers' previous experience with ecological restoration programs or other agricultural schemes was always about being paid the same level of subsidies or other incentive packages. Hence there is a concern that social tension or disputes might arise from the introduction of the bidding scheme under which payments will be provided at different levels. As a result, a decision was made to conduct the pilot at a smaller scale and to expand to a wider area once it is proved to be workable in the local context.

Following extensive consultation with the project group and residents of Pengzhou County and Hongya County, Wenshan village and Shunhe village in Hongya County and Dishui village and Zhongba village in Pengzhou County were selected as the project sites. All farmers in the four villages were eligible to tender for the ecological afforestation project.

Based on previous research, it is known that education levels amongst potential tenderers can significantly influence project implementation. For example, reasonable levels of education can improve the level of project understanding amongst a village community. As can be seen from Table 5.1, 80 per cent of people in the four selected villages have graduated from junior high school. It was thought that this level of education would help ensure project participants understood the project objectives and operation. In addition, the off-farm employment rate is below 25 per cent, implying that there is a sufficient supply of labour to ensure project implementation.

Table 5.1 Social characteristics of the selected villages (2008)

		Hongya		Pengzhou	
		Wenshan	Shunhe	Dishui	Zhongba
Households		565	640	214	305
Population		1905	2195	842	1035
The amount of labor		1040	1560	460	662
Level of education	Primary and below (%)	20	30	13	30
	Junior school (%)	60	60	74	60
	High school and above (%)	20	10	13	10
Off-farm employment	Population	240	329	40	23
	Percentage	25.1	15	8.7	2.2
Per capita income (Yuan/Year)		6155	5658	3400	3860
Arable land (per capita)		0.03	0.23	0.82	0.1
Forest area (per capita)		16.12	2.1	9.14	6

5.2 Organisation of the bidding trial and procedures

The Australian National University (ANU) and the China National Forest Economic Development and Research Centre (FEDRC) provided overall technical and policy guidance to the research work conducted under the project and the implementation of the bidding trial. As research collaborators, Peking University and the Victorian Department of Sustainability and Environment played a key role in the design of the bidding documents used in the bidding trial based on the Australian and international experiences in this field, as well as providing technical inputs to the organisation and implementation of the bidding trial. As the bidding trial was conducted in Sichuan province, the Sichuan Department of Forestry was responsible for coordinating and organising most of the field work, with the assistance of the Sichuan Academy of Forestry and local forest bureaus. The following table provides an overview of the key steps and procedures of the bidding trial as well as the main methodologies applied for the work at each stage.

Table 5.2 Key process of the bidding trial

Process		Methodologies
1	Expressions of Interest	Sichuan Department of Forestry together with county forest bureaus and village committees publicised the bidding trial project through a variety of media and invited farmers to register expressions of interest
2	Training	Sichuan Department of Forestry and county forest bureaus organised training sessions for local technical staff who then helped farmers to prepare the bids
3	Site Survey	Sichuan Department of Forestry and county forest bureaus organised biophysical survey of lands included in the Expression of Interests Letter, including detailed information of soil type, land type, thickness of soil, slope gradient, distance to water, etc.
4	Development of Afforestation and Management Plans	Sichuan Department of Forestry and county forest bureaus drafted afforestation and management plan based on the results of the site survey
5	Preparation of bidding documents	Peking University, with further inputs from the ANU, VDSE and FEDRC prepared the whole set of bidding documents including contract to be signed between government and successful bidders
6	Submission of Bids	Sichuan Department of Forestry and county forest bureaus, with the help of village committees organised the village committee meeting during which the bidding sessions were convened and bids collected
7	Building biophysical models	Sichuan Academy of Forestry conducted site survey and established biophysical models to predict environmental changes at household level
8	Valuation of the environmental benefits	FEDRC and ANU conducted choice modelling survey and estimated environmental values of the bids
9	Bid assessment	ANU, FEDRC and PKU assessed the bids based on their benefit cost ratios and ranked the bids
10	Letter of Acceptance	Based on the ranking, Sichuan Department of Forestry and county forest bureaus selected successful bids and sent letter

		of acceptance
11	Signing of Contracts, Monitoring and Fund Allocation	County forest bureaus signed contracts with successful bidders, organised the monitoring of compliance and allocated afforestation funds

The bidding trial was conducted in July of 2009 in Wenshan and Shunhe villages of Hongya County, and in Dishui and Zhongba villages of Pengzhou County. The geographical location, biophysical conditions and socio-economic characteristics of these counties and villages were described in one of the research reports (Xu et al 2011). Under the ACIAR Land Use Change (LUC) bidding scheme, farm households were invited to submit proposals to carry out afforestation and management activities during 2009-2012 on three types of lands which they contracted from the village collectives: barren lands, degraded cultivated lands and logging sites. The overall plan for afforestation and management activities was developed by local technical staff taking into consideration the government environmental objectives as well as society's environmental preferences which were obtained through the choice modelling exercise. Within the framework of this overall plan, farm households were able to propose specific afforestation and management activities that suit them best.

Information sessions and the bidding trial were conducted through the villagers' meetings in the four case study villages. Details of the bidding trial, including pricing and enrolment rules, were provided to participants during the information sessions. Table 5.3 shows the bidding characteristics. To ensure the simplicity of participation, a first-price sealed bid, with reserve price being set, was trailed in the case study counties. The bidding was single round rather than multiple rounds. This auction design is similar to that of the Bush Tender trial conducted in Australia. The bidding documents, which contained 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 need further information on the technicalities of afforestation and management or on bid formulation. The bidding trial showed that farmers had minimal request for assistance from technical staff and research team members, as they were relatively familiar with the type of activities that suited them best and with cost estimation of such activities. In each of the villages, the bidding lasted for half a day to one whole day. In one of the villages in Pengzhou, bidding farm households submitted the bids immediately after the villagers' meeting. In other villages, farmers put in the bids the next day.

Table 5.3 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

5.3 Biophysical modelling

The potential environmental impacts of the Sichuan Ecological Restoration Program (SERP) were predicted to extend to the coastal area in the East. For instance, planting trees in Sichuan Province will reduce sediment discharge into the Yangtze River and improve the water quality downstream to Shanghai. Therefore the environmental improvements arising from the ecological restoration program will benefit people both on-site and off-site.

Key attributes of the environmental improvements generated by SERP were identified by scientists at Sichuan Academy of Forestry as well as through two rounds of focus groups conducted by the research team in Chengdu and Shanghai in March and July 2009 respectively. These environmental attributes are water quality improvements, air purification and biodiversity conservation. Specific variables to measure these attributes were selected by scientists at Sichuan Academy of Forestry and were used as dependent variables in the biophysical modelling exercise (see Table 5.4 below)¹.

Table 5.4 Dependent variables used in the biophysical models

Environmental attributes	Dependent variables
Water quality	Reduction in soil erosion
Air purification	Sequestration of SO ₂ , Oxalyl, noxious gases and dust
Biodiversity conservation	Shannon-Wiener index ²

The prediction of the environmental outcome attribute levels resulting from land use changes undertaken at the single farm level involves numerous conceptual complexities and heavy data requirements. The practicalities of application in the context of LUC in Sichuan required the development of a simplified modelling process. This involves the use of research results linking land use changes to environmental outcomes at a regional (Sichuan Basin) level and adjusting those results to reflect differential conditions applying at the individual farm level. Essentially, regional average changes in the environmental outcome attributes per unit of land area involved in a change of management are used as reference points. These averages are then adjusted to reflect farm level divergences from the average. This adjustment process requires the identification of farm level characteristics that would cause divergence and the quantification of that divergence. The following equation sets out this process:

$$F_n^i = R_n \times D_n^i$$

Where F_n^i is the per mu farm level impact of LUC on attribute n , for farm i ,

R_n is the per mu impact of LUC on attribute n at the regional level, and

D_n^i is the divergence factor between farm level impact and regional level impact for farm i .

¹ The environmental attributes were also used in the choice modelling valuation exercise. In this way, the biophysical models are linked to the stage of bid evaluation.

² It is a quantitative indicator to measure the richness of species in the ecosystem and the evenness of the distribution of species (Wang et al 2008).

In turn the divergence factor (D_n^i) for each of the n attributes is a ratio of an index of farm performance in achieving improvements in attribute (I_n^i) and the average index of all farms' performances ($\overline{I_n^i}$):

$$D_n^i = \frac{I_n^i}{\overline{I_n^i}}$$

The index I_n^i is, in turn, a function of j farm-level parameters, X_j^i :

$$I_n^i = f(X_j^i)$$

The operation of the divergence factor requires the assumption that the mean index for each attribute n of the LUC bid proposals submitted corresponds to the regional average performance level. The divergence factor then positions each bid proposal relative to the regional performance, R_n .

Farm level parameters used in the functions to derive the performance indices and hence divergence factors are associated with site condition and the nominated LUC (see Table 5.5 below). The selection of parameters to be included in the divergence factor models and the development of these models are based on site visits by scientists to lands that were nominated for LUC by participating farmers. These parameters can be classified into categories to differentiate the magnitude of contribution of each category to the environmental attribute change. It should be noted that different parameters are chosen for the different environmental attributes, n , taking into consideration their contributions and biophysical links to each specific environmental attribute.

Table 5.5 Parameters in the divergence factor models

	Parameters (X_j^i)	Categories
Site conditions	a. Land type before ecological restoration	Barren land, cultivated land, logging sites
	b. Slope gradient (°)	N.A.
	c. Thickness of soil (cm)	N.A.
	d. Position on the slope	Upper, middle, lower
Proposed LUC	a. Tree species	Conifers, broadleaf
	b. Planting density	High, medium, low
	c. Maintenance measure (times of maintenance in the first three years after tree planting)	N.A.

The divergence factor models are established to estimate the impact of farm level parameters on each of the environmental attributes. In particular, the contribution of each parameter to the overall impact on environmental attributes is modelled via the creation of a performance index I_n^i . A coefficient (β_j) is estimated for each parameter X_j^i to show its relative contribution to the environmental impact. The mathematical model of the environmental impact can thus be expressed with the following formula:

$$I_n^i = \sum \beta_j X_j^i$$

where I_n^i denotes the impact of farm level parameters on the n th environmental attribute, $n = 1, 2, 3$ for farm i ,

X_j^i is a vector of j farm level parameters for farm i , and

β_j is the coefficient of the j th parameter.

The parameters (X_j^i) can be measured at the farm level using either qualitative or quantitative scales. When X_j^i is qualitative (e.g. type of lands), the parameter takes the value of the categories of this specific farm level parameter (e.g. barren land, cultivated land or logging sites). The categories that contribute the most to the environmental attribute are given a value closer to 1.0³. When X_j^i is quantitative (e.g. slope gradient or thickness of soil), the parameter takes the value that reflects its relative contribution to the overall impact on I_n^i , the farm performance index⁴. The values assigned to the parameter coefficient, β_j , are determined by the relative contribution to the overall impact on the index, I_n . The development of the values of the parameters and their coefficients were based on the biophysical relationship between the parameter and the environmental attribute which is established using observed ecological data. Where ecological data and scientific information are not available, these values and coefficient were developed based on expert experiences and judgment. In the linear functional form of the index function, the sum of the coefficients, β_j , across all j parameters is equal to one.

5.4 Economic modelling: choice modelling (CM) survey

The information on the potential environmental benefits of land use change is a key component of the bidding document. It is used by the Government to estimate the potential environmental benefits arising from the proposed land improvement activities and hence to evaluate the bids. The choice modelling (CM) approach was used in this research to estimate people's willingness to pay for environmental benefits arising from proposed land use change activities under the SERP in Sichuan Province. CM is a "stated preference" technique in which respondents in a survey are asked to make choices between resource management alternatives. Each alternative is described in terms of its impacts on the environmental attributes of interests and a monetary payment. The choices made by respondents provide information on the extent they are willing to trade-off the environmental attributes against a monetary cost to themselves. CM surveys were conducted in cities identified as experiencing benefits from land use change activities in the upper reaches of the Yangtze River.

The development of the survey questionnaire involved two rounds of focus groups. The questionnaire was preliminarily developed using the results from the first round of focus groups held in Shanghai and Chengdu in March 2009. Through four focus group discussions, attributes that frame the change to be valued were initially defined from the demand-side perspective. The supply-side perspective was also taken into consideration as attributes were selected on the basis of what policy-makers, scientists and researchers perceived to be important as factors that can be modified by policy (Blamey et al. 1997). In addition, risk and uncertainty of outcomes were explicitly incorporated into the CM design. Two survey instruments were designed and respondents randomly received one of the two instruments. In one treatment, respondents were asked to state their preferences for certain outcomes. In the other treatment, uncertainty about the outcomes was incorporated into the choice sets. The uncertainty attribute in the questionnaire was defined as the chance of the described improvement occurring.








³ For example, as the "logging sites" contribute the most to soil erosion reduction, followed by "barren land" and "degraded cultivated land", the parameter values given to these categories are 1.0, 0.4 and 0.3 respectively.

⁴ For example, if the "thickness of soil" is 60cm, the converted value of this parameter is $60/100 = 0.6$ to show its relative contribution to soil erosion reduction. As thicker soil contributes more to soil erosion reduction, a 90cm-thickness of soil takes the value of 0.9 in the biophysical model.

The ranges over which the levels of these attributes vary were specified based on scientific research conducted in the area and projections made by experts from China National Environmental Monitoring Centre and Sichuan Academy of Forestry. The range of the attributes is between the projected level in the ‘without ecological restoration’ scenario and the best level that could be achieved under the three-year ecological restoration program in Sichuan. Scientific uncertainty associated with such projections as well as the effectiveness of the implementation of the ecological restoration program were captured by changes in the uncertainty attribute’s level.

Four more focus groups were held in July 2009 in Shanghai and Chengdu to confirm the earlier identified attributes and to refine the draft questionnaire. The clarity and presentation of information in the questionnaire, cognitive burden and confusion as well as perceived bias of information were also tested in these focus groups. A web-based survey was conducted in August 2009 in Shanghai and Chengdu. To meet the requirement of statistical testing for the choice models, a target of 1000 households was set to be interviewed in Shanghai and Chengdu for the four-attribute survey questionnaire (without the uncertainty attribute), with 500 households in each sub-sample. An additional 500 households were interviewed for the five-attribute survey questionnaire (with the uncertainty attribute), with 250 households in each of Shanghai and Chengdu. Altogether 1500 questionnaires were collected.

Figure 5.3 Example of a choice set from the Ecological Restoration Program questionnaire

Management Option	Water Quality	Air Quality	Biodiversity	Uncertainty	Cost	Your choice
						
Combination of measures in vegetation recovery	Sediment discharge into the Yangtze River (tons)	Number of days with good to excellent air quality	Number of plant species on waste lands	Chance of improvement occurring	How much you pay each year (3 years)	Select one option only
Conditions in 20 years						
<i>Option A- No new actions</i>	100 million	250 days	200	Not applicable	¥0	<input type="checkbox"/>
<i>Option B</i>	97 million	290 days	600	50%	¥500	<input type="checkbox"/>
<i>Option C</i>	98 million	275 days	500	90%	¥300	<input type="checkbox"/>

The implicit price for each environmental attribute available was thus derived through the CM work. Together with the biophysical modelling results, the environmental benefits arising from the land use change activities proposed in each bid were calculated.

5.5 Bid evaluation of allocation of government funds

Bid evaluation under the LUC scheme was carried out through an analysis of the net-benefit arising from alternative farmer bids. The net benefit of each bid was derived using bid price information and the potential environmental benefits that the nominated

conservation activities in the bid will generate. Bids with negative net benefits were excluded. The bids were then ranked on the basis of the benefit cost ratio of each bid, with the highest benefit cost ratio providers of environmental goods and services being identified and selected into the conservation contracts until government funding is exhausted. In three of the case study villages except Dishui Village of Pengzhou County, all submitted bids were successful bids as the total bid price in each of these villages was within the government budget limit. In other words, the proposed afforestation area was less than those that could be financed by government funds. An official notification letter was sent by local governments to successful bidders which also specified 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 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 their lands.

Contracts were signed between the county forest bureaus and successful farm households in October 2009. Based on the contract, government payments will 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 can start planting in the autumn season. During the course of the project, the compliance of the contract is monitored by local forest bureaus and the task is facilitated by the Sichuan Forestry Department.

5.6 Evaluation of the efficiency and feasibility of the bidding scheme

One criterion used to assess the efficiency of the bidding scheme is whether it achieved cost savings as compared to the command and control fixed-price scheme. A number of factors need to be taken into consideration. First, even though the government holds site specific information on the environmental impacts of land improvements under the CCFGP, the transformation function that maps the land improvement actions (inputs) into outcomes may not be known with certainty. Hence, a comparison of the bidding scheme and the fixed-price scheme was based on the land improvement plans (or performance where feasible) instead of potential environmental outcome in the two scenarios. 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 CCFGP or NFPP funding system. Second, transaction costs associated with on-site research, bidding administration, compliance monitoring were included in the policy evaluation.

The incentives structure for land improvement providers was examined and analysed. A post-bidding survey was conducted to find out the key factors that affect farmers' decisions in participating in the bidding trial. A total number of 194 households from both participants and non-participants of the bidding scheme were surveyed. The key factors that may influence farmers' choices include farmers' socio-economic conditions, their experiences with previous CCFGP or NFPP programs, their perceptions of the bidding scheme such as distrust and uncertainty about the scheme, and environmental attitudes of farmers. Issues of interest also include whether collusion presents any problems in the Chinese context, the influence of information dissemination on farmers' choices of participation, and the role of technical assistance from county forest bureaus. Whether farmers will be able to develop their own bid is 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 pricing opportunity cost confusing.

Based on these analyses, the feasibility of introducing the bidding scheme for land improvements activities in rural China were explored in this report.

6 Achievements against activities and outputs/milestones

Objective 1: To evaluate the feasibility of using the bidding schedule to allocate government ecological funds in China.

no.	Activity	outputs/ milestones	completion date	Comments
1.1	Expression of interests by local farmers	<ul style="list-style-type: none"> ➤ Set up organising committee ➤ Publicise bidding trial ➤ Express interests 	February 2009 April 2009 April 2009	The organising committee was facilitated by Sichuan Department of Forestry and comprised representatives from local forest bureaus and village heads. Information dissemination was carried out through a variety of media.
1.2	Site survey to develop afforestation and management plan	<ul style="list-style-type: none"> ➤ Develop the list of activities under the bidding trial 	May 2009	Based on land areas to be nominated under the registration of interests, local technical staff visited these sites and proposed a list of afforestation and management activities to be included in the bidding trial.
1.3	Development of the bidding documents	<ul style="list-style-type: none"> ➤ Develop the template for the afforestation and management plan, letter of notification, contract to be signed between successful bidders and local governments ➤ Research report on the trial of the bidding scheme published 	July 2009 July 2009	The whole set of bidding documents were prepared by Peking University and the ANU, with technical inputs from Sichuan Department of Forestry, VDSE and FEDRC.
1.4	Bid submission	<ul style="list-style-type: none"> ➤ Organise village meetings/ bidding sessions ➤ Farmers submit bids ➤ Research report on the organisation and implementation of the bidding trial published 	July 2009 July 2009 December 2010	The bidding trial was conducted in Shunhe and Wenshan villages in Hongya County, and Zhongba and Dishui villages in Pengzhou County. Bids were collected by the local forest bureaus and data entry was organised. These bids were later analysed and ranked by research team members, with the assistance of local staff.
1.5	Biophysical modelling	<ul style="list-style-type: none"> ➤ Establish biophysical models to predict environmental changes at farm household level ➤ Research report on bio-physical modelling published 	September 2009 October 2010	Soil erosion reduction model, air purification model and biodiversity model were established by scientists at Sichuan Academy of Forestry. These models were developed to predict environmental changes arising from nominated activities under each bid.

1.6	Choice modelling survey and data analysis	<ul style="list-style-type: none"> ➤ Environmental attributes identified through focus groups ➤ Draft questionnaire refined ➤ CM survey conducted ➤ Implicit prices of environmental attributes calculated ➤ WTP derived ➤ Research report published 	<p>March 2009</p> <p>July 2009</p> <p>August 2009</p> <p>October 2009</p> <p>January 2010</p>	<p>This part of the research work and the design of the survey questionnaire were carried out during March to July 2009. The CM survey was conducted in Shanghai and Chengdu in August 2009. Data analysis was completed in October 2009.</p>
1.7	Bid evaluation	<ul style="list-style-type: none"> ➤ Estimate potential environmental benefits of the bids ➤ Rank bids ➤ Select successful bids 	October 2009	<p>The environmental benefit for each bid was calculated using both the biophysical modelling and choice modelling results. The environmental benefit was then compared to the cost, i.e. the bid price. The bids were ranked based on their benefit cost ratios, with successful bids being selected until the government funds were exhausted.</p>
1.8	Notification of successful bidders and signing contracts	<ul style="list-style-type: none"> ➤ Send Letter of acceptance to successful bidders ➤ Sign Contracts between successful bidders and local governments 	October 2009	<p>This work was organised and facilitated by Sichuan Department of Forestry, with the help of county forest bureaus and village councils. The contracts were signed for a duration of 3 years from 2009-2012, with specific rights and responsibilities of farmers and local forest bureaus detailed in the contracts.</p>
1.9	Fund allocation and afforestation	<ul style="list-style-type: none"> ➤ Allocate funds to successful bidders ➤ Launch afforestation and management activities 	November 2009	<p>Immediately after funds were allocated, farmers launched afforestation and management activities. Autumn planting normally starts in October/ November in Sichuan Province. Payments were set to be made in several instalments, with the second and third instalments paid upon successful completion of the tasks outlined in the bidding documents.</p>
1.10	Monitoring of compliance	<ul style="list-style-type: none"> ➤ Monitor the afforestation and management activities ➤ Allocate the rest of the government payments 	November 2009 - now, ongoing	<p>The monitoring of compliance was carried out by local forest bureaus, with the assistance of local technical staff. As the contract duration is for three years till 2012, the monitoring work is on-going even that this research project officially finished in November 2010.</p>

1.11	Post-bidding survey	<ul style="list-style-type: none"> ➤ Both participants and non-participants of the bidding trial were surveyed in two of the case study villages. 	June 2010	This was a supplemental element of the research project and was not in the original project design. After the bidding trial stage was finished, the research team found it was crucial to follow up with the process to find out if there are problems associated with bidding trial design, how farmers perceive the bidding process, and how afforestation and management activities were carried out in the field.
1.11	Policy analysis to evaluate the efficiency and effectiveness of the bidding scheme and to explore the feasibility of putting in place the bidding scheme	<ul style="list-style-type: none"> ➤ A comparison of the outcome (in this case land improvement performance) in the command and control and bidding scenarios. ➤ Research Report published ➤ Policy guideline for the bidding scheme prepared. 	February 2011 February 2011	The second year of this research project (i.e. year 2010) involved on-site tracking and monitoring as well as a post-bidding survey to enable a comprehensive policy analysis of the bidding trial. The policy analysis was carried out after the post-bidding survey was completed in the second half of 2010. FEDRC, with the technical inputs from the ANU, will draft the policy brief/ guidelines for the implementation of the bidding scheme in China.

Objective 2: To enhance cooperation between resource management agencies and research bodies in China.

no.	activity	outputs/ milestones	completion date	Comments
2.1	Site survey conducted jointly by local governments and scientists	<ul style="list-style-type: none"> ➤ Collect data on soil conditions, land type, thickness of soil, slope gradients etc. based on lands initially nominated by interested farmers. ➤ Analyse the information collected and propose possible afforestation and management activities. 	May 2009	Cooperation and information sharing were key to this activity. Through this activity, coordination among biophysical scientists and officials from local forest bureaus, land administration and water resource authorities was strengthened.
2.2	Consultations held during the development of Afforestation and Management Plan and the Contract	<ul style="list-style-type: none"> ➤ Cooperation among resource management agencies and research bodies has been enhanced. 	July 2009	Various stakeholders were involved in the process, including local forest bureaus, village heads, Sichuan Department of Forestry, FEDRC, ANU, PKU and VDSE.
2.3	Develop household-level biophysical models	<ul style="list-style-type: none"> ➤ Cooperation among the local forest bureaus and Sichuan Academy of Forestry has been enhanced. 	September 2009	Several visits were arranged for scientists at the Sichuan Academy of Forestry to refine and improve the biophysical models. The work was jointly done with local forest bureaus and village heads.

2.4	Predict environmental changes at farm household level	<ul style="list-style-type: none"> ➤ Use of biophysical models to predict environmental changes for each farm land being nominated. 	October 2009	Environmental changes at farm household level were calculated by technical staff at county forest bureaus, with the help of scientists at Sichuan Academy of Forestry.
2.5	Policy analysis	<ul style="list-style-type: none"> ➤ Research report published ➤ Research reported at AARES 	February 2011 February 2011	Policy analysis involved close cooperation between FEDRC, Sichuan Department of Forestry and PKU, as well as ANU and VDSE. Details of the organisation and implementation of the bidding trial were presented at AARES in February 2011 by research team members at PKU and FEDRC.
2.6	Project meetings	<ul style="list-style-type: none"> ➤ Regular project meetings to discuss and summarise project findings and guide the bidding trial ➤ Final project symposium 	December 2008 June 2009 April 2010 March 2011	These meetings were attended by representatives from resource management agencies at various levels, including Sichuan Department of Forestry and local forest bureaus as well as from research institutions such as Sichuan Academy of Forestry and PKU.

Objective 3: To promote community participation in natural resource management.

no.	activity	outputs/ milestones	completion date	Comments
3.1	Landholders from the project area registered an expression of interest in village meetings.	<ul style="list-style-type: none"> ➤ Community participation was promoted. 	April 2009	These village meetings provided farmers with an avenue to express their interests and concerns in natural resource management.
3.2	Farmers proposed their preferred afforestation and management activities	<ul style="list-style-type: none"> ➤ Proposed afforestation and management activities outlined in the bidding documents. 	July 2009	Based on the proposed list of afforestation and management activities, farmers can decide on their preferred activities. More decision making power was given to local farmers in natural resource management.
3.3	Post-bidding survey	<ul style="list-style-type: none"> ➤ Farmers' perceptions of the bidding trial were obtained through the survey. 	June 2010	Both participating and non-participating farmers of the bidding trial were consulted about the design and implementation of the bidding trial. This gave farmers an opportunity to voice their opinions, and farmers' suggestions will be used as inputs in the design and implementation of future bidding schemes.

Objective 4: To continue capacity building in the partner country institutions.

no.	activity	outputs/ milestones	completion date	Comments
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4.1	Familiarisation of the Bush Tender trial	<ul style="list-style-type: none"> ➤ Better understanding of the Bush Tender trial ➤ Increased technical capacity to conduct the bidding trial 	April 2009	The Chinese research team (from FEDRC, PKU, Sichuan Department of Forestry and county forest bureaus) visited Australia to learn the experiences of the Bush Tender trial in Victoria. Field visits were arranged and discussions carried out with regards to the design and implementation of the bidding trial in China.
4.2	Training sessions provided to local technical staff	<ul style="list-style-type: none"> ➤ Increased capacity of county officials and technicians 	May 2009	The managers for the implementation of the bidding trial provided training to technical staff who then helped landholders to prepare the afforestation and management plan. The aim of training is to help technical staff comprehend the tender process and site-specific ecological restoration techniques.
4.3	CM training conducted at ANU	<ul style="list-style-type: none"> ➤ CM data analysis and report drafting 	October 2009	Two researchers from FEDRC visited ANU during September - October 2009 and participated in environmental economics courses and seminars. Guidance in CM data analysis and the use of Nlogit software was provided to the Chinese team members.
4.4	AARES 2011	<ul style="list-style-type: none"> ➤ Presentations on research findings. 	February 2011	Chinese research team members from PKU, FEDRC and Sichuan Forestry Department attended the AARES and presented the paper on the bidding trial.
4.5	The involvement of the China Environmental Economics Program	<ul style="list-style-type: none"> ➤ Research experience and technical capacity in auction design theories and practice. 	Throughout the project implementation during 2008-2011	Peking University hosted the China Environmental Economics Program. Two researchers from the Program participated in this bidding trial project. This research project helped to increase the research capacity of the China Environmental Economics Program in the use of this specific market-based instrument in ecological restoration in China.
4.6	Regular project meetings	<ul style="list-style-type: none"> ➤ Guidance was provided to the Chinese team members and local people in the field 	Throughout the project implementation during 2008-2011	This resulted in increased technical and policy analysis capacity of partner country institutions in applying MBIs to natural resource management.

7 Key results and discussion

7.1 Results

The table below (Table 7.1) 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 mu⁵. 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).

Table 7.1 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

⁵ One Mu equals 0.067 hectares.

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 7.2), 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 7.2 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

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.

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 7.3 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 7.3 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 7.1 to 7.4 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 7.1 Budget allocation based on BC ratio (Wenshan)

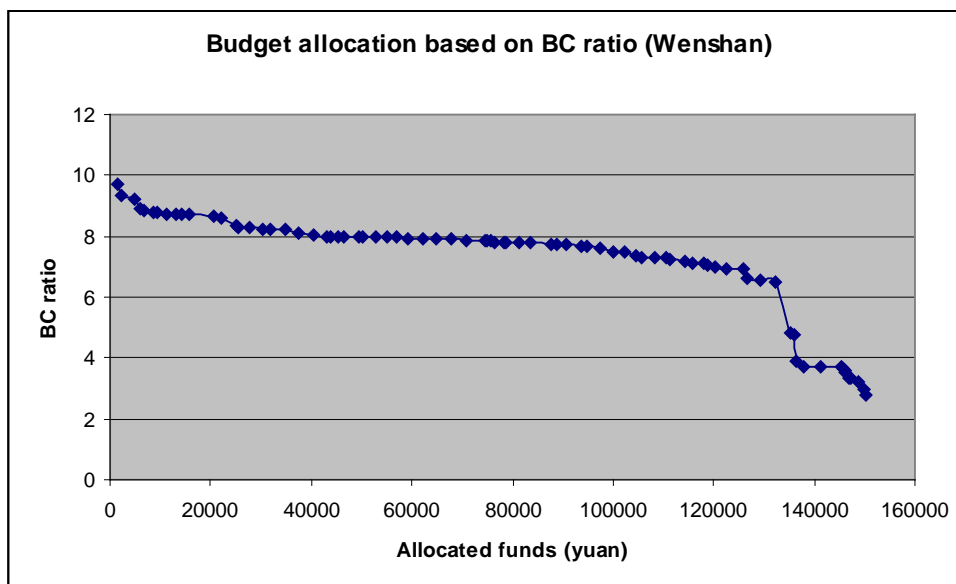


Figure 7.2 Budget allocation based on BC ratio (Shunhe)

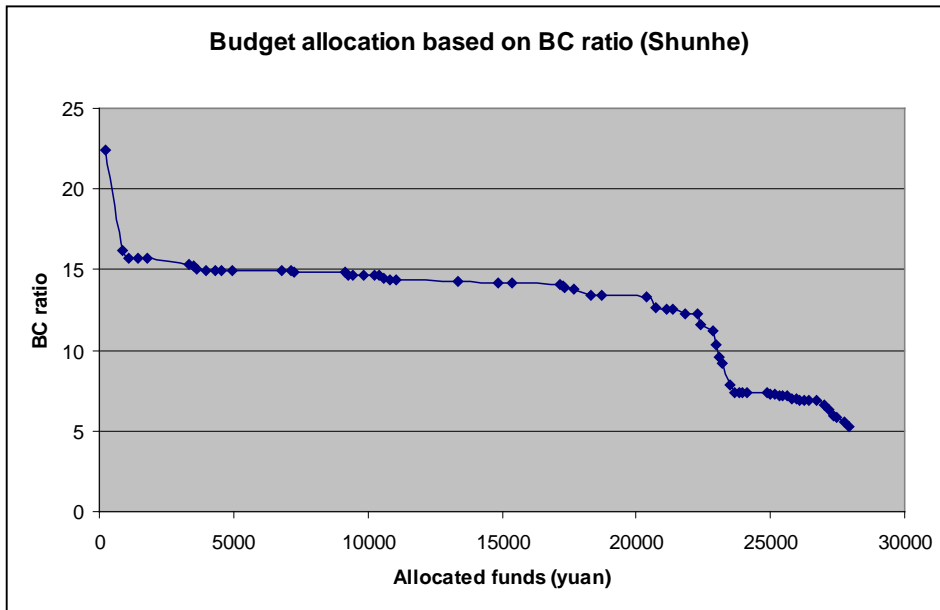


Figure 7.3 Budget allocation based on BC ratio (Dishui)

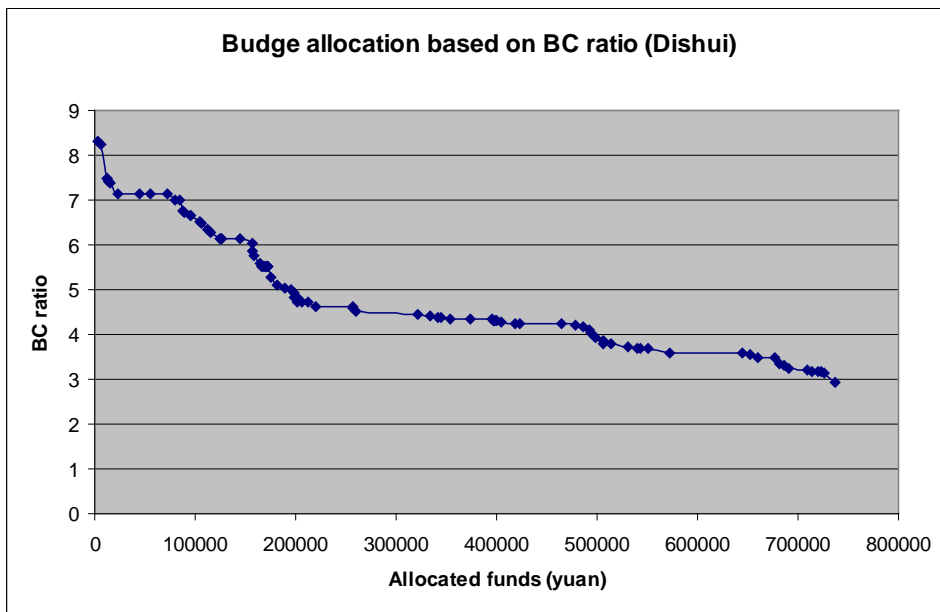
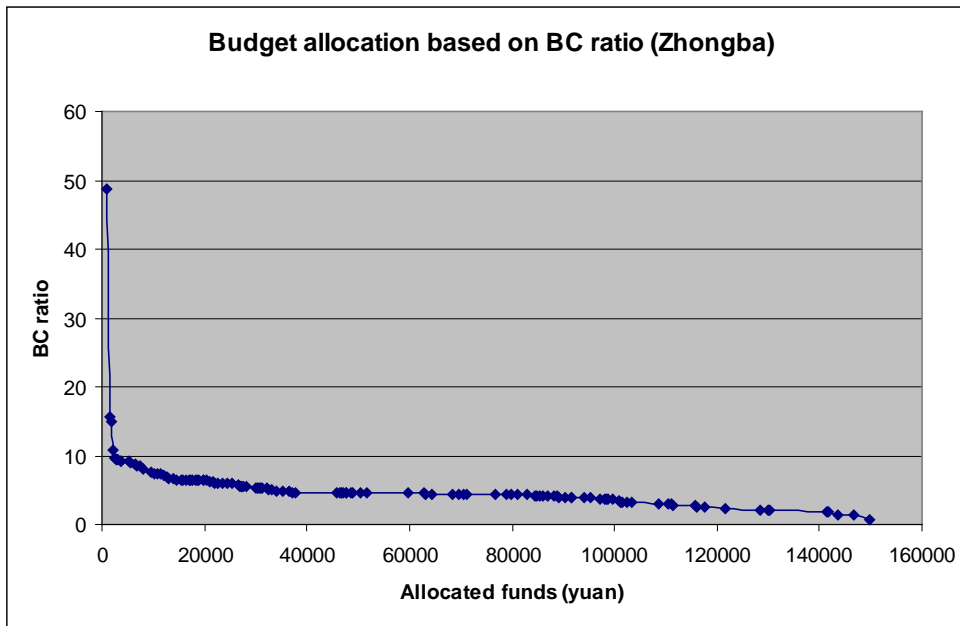


Figure 7.4 Budget allocation based on BC ratio (Zhongba)



The marginal cost (supply) curves for the four pilot villages (see Figures 7.5 to 7.8) 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 7.5 Marginal cost curves for environmental benefits in Wenshan Village

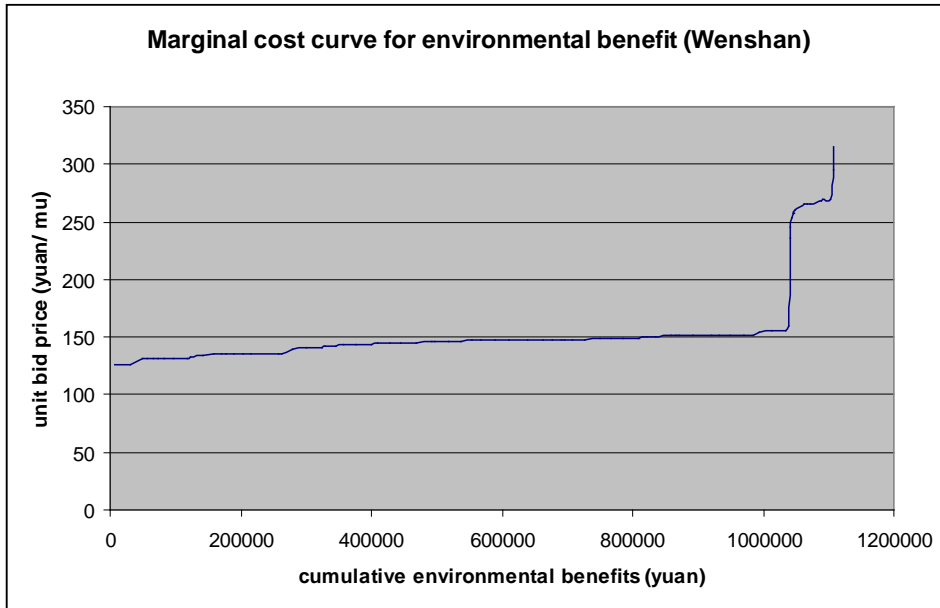


Figure 7.6 Marginal cost curves for environmental benefits in Shunhe Village

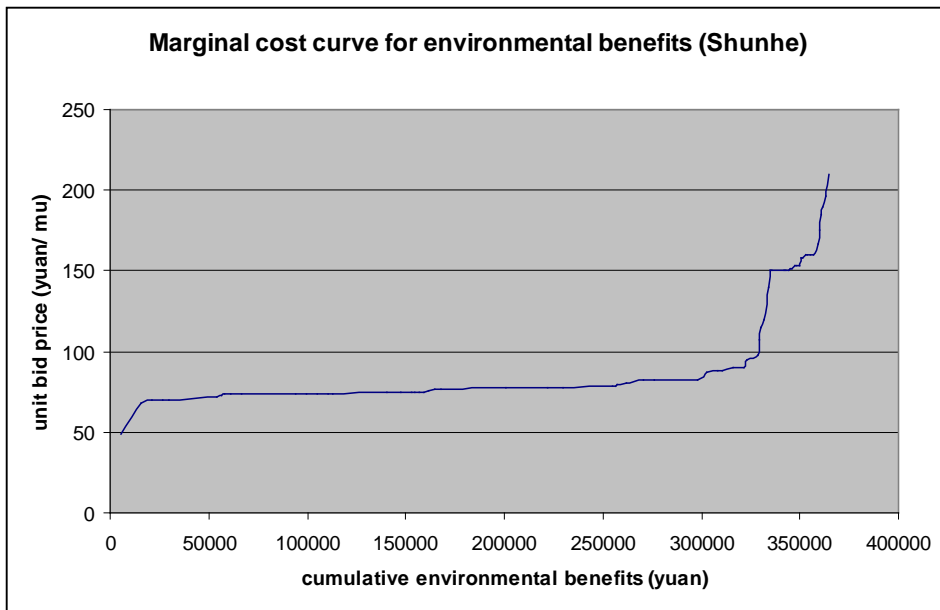


Figure 7.7 Marginal cost curves for environmental benefits in Dishui Village

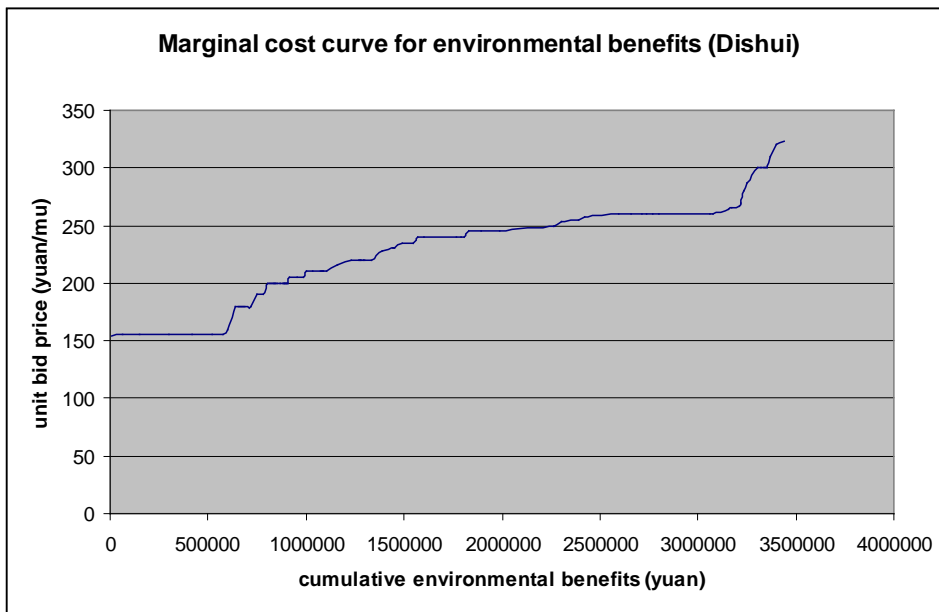
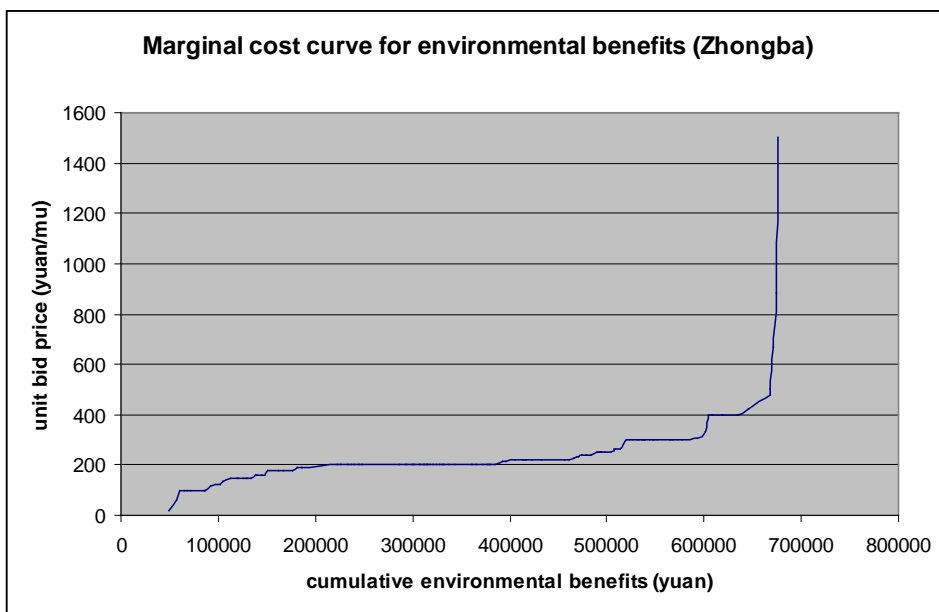


Figure 7.8 Marginal cost curves for environmental benefits in Zhongba Village



7.2 Discussions

Efficiency of the bidding scheme

The efficiency of the LUC bidding scheme is assessed in part 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 7.4 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 7.4 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 7.4 arises because the availability of funds meant that bid proposals with relatively low benefit-cost ratios were selected and allocated contracts⁶. 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.

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

⁶ 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.

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.

8 Impacts

8.1 Scientific impacts – now and in 5 years

In China the allocation of government ecological funds has normally been carried out through an administrative approach, such as the case with the CCFGP and NFPP. Specifically, a "broad brush" approach was adopted with which funds were allocated with the same payment level across various land slots. This has led to inefficient use of government funds. In contrast, the bidding trial that was piloted in this project was aimed at farmers revealing individually their true opportunity costs of land improvement activities. The results of this project show that the bidding scheme has great cost saving potentials compared to the traditional command and control approach. Local officials from the Sichuan Department of Forestry and county forest bureaus found that the bidding scheme approach is more scientifically based and systematic. There is an indication that the bidding scheme will be further trialled in some other villages or townships in Sichuan and at various levels (i.e. through farmers' associations) in the future. This will help local forest officials in finding the most efficient way to allocate government ecological funds.

Findings from this research project have already been used as a good example in seminars and workshops to showcase how market-based instruments can be used to improve the efficiency and effectiveness of natural resource management in China. It is anticipated that MBIs such as the bidding scheme can be more widely used in natural resource management in China in the coming years.

In addition, impacts include that findings from this project (i.e. using the bidding scheme for conservation) are novel in terms of testing the applicability of the mechanism in the developing country context as well as contributing to the international literature in this field. Research findings can be used by other social scientists to further develop the auction design theory especially in the field of land improvements and nature conservation.

8.2 Capacity impacts – now and in 5 years

Capacity building has been achieved through various project activities that have taken place during the past three years. The research capacity of the Chinese partners has been greatly enhanced through this project. In particular, the research capacity of the Chinese counterparts has been improved through the preparation for the bidding trial, short courses on auction design and choice modelling, on-site supervision by Australian project members of critical phases of the research, and the attendance at the AARES conference.

The FEDRC is affiliated to the State Forestry Administration, the executing agency for the implementation of CCFGP and a number of other land use change programs such as the Three North Shelterbelt Program and Sand Control Program. FEDRC is the main policy research institute that provides the Government with policy recommendations. This research project has further enhanced capacity building within FEDRC, and hence contributes to more comprehensive decision-making in the implementation of land use change programs in China. As a continuation of the initial project (ADP/2002/021), the research capacity of FEDRC has been further enhanced through the design of the bidding scheme, non-market valuation exercise, and policy analysis on the feasibility of the bidding scheme. Training on the CM theory and data analysis were provided to researchers from the FEDRC. Through such training, researchers from FEDRC enhanced their capacity in conducting CM studies independently. In the long run, FEDRC will promote the use of CM in other forestry and environmental policy studies in China.

The research capacity of Sichuan Forestry Department has been enhanced through the implementation of the trials in the two counties of the Province. Local technical staff gained a better understanding of the bidding scheme through training sessions provided to them by the managers of the implementation of the bidding trial. In particular, the managers of the bidding trial from Sichuan Department of Forestry, with the help of the research team members, provided training to local technical staff who then helped landholders to prepare the afforestation and management plans. The aim of the training was to help local technical staff to comprehend the tender process and the site-specific ecological restoration techniques. Through such training, the use of market-based instruments in general and how some of these market approaches can be adapted and used in the Chinese context has also been better understood at the local level. Local capacity has also been enhanced through the development of the biophysical models at the farm household level. Both local officials (including forest bureau staff and village heads) and farmers were better informed of how to relate afforestation and management activities to potential environmental improvements. This helps to increase local capacities in developing land improvement plans in the future.

With a strong research focus on the theory and application of the auction and bidding design, the research experience and capacity of the China Environmental Economics Program at PKU has been extended to one of the most innovative MBIs. The research project has also improved the capacity for interdisciplinary research among the Chinese and Australian researchers through closer cooperation between the biophysical scientists and economists at various stages of the project implementation. ANU has benefited from a deeper understanding of resource management issues and the application of market-based instruments in the developing country context. VDSE has extensive practical experience in designing and operating auction systems, being at the forefront of Australian application. VDSE has gained experience from applying MBIs to a developing country context plus interaction with ANU.

8.3 Community impacts – now and in 5 years

8.3.1 Economic impacts

Some immediate economic impacts have already been identified with funds having been allocated to those successful bidders. First, farmers have received subsidies for their proposed land improvement activities. Second, farmers have had more choices over the use of their lands and hence higher income from other on-farm activities embodied in their land improvement plans.

Research findings will contribute to the establishment of the ecological compensation mechanism in China. The establishment of the ecological compensation mechanism has been on the policy agenda of the Chinese Government for almost a decade. However, due to the complexity of defining beneficiaries and quantifying environmental benefits, policies studies in this area are largely under-developed in China. The bidding scheme trialled in this research project is one way forward. It will have significant economic impacts on Chinese farmers who were previously under-compensated for their land improvement activities. With the applicability of research findings extending to the other parts of China including the North West region, the expected economic impact on rural community will be far-reaching. It is anticipated that the magnitude of cost savings to the government spending on ecological programs will be around one fifth of the total government spending on rural environmental programmes. Currently the Chinese Government has a budget of around CNY 700 billion to finance the key land use change programs across China. The expected economic benefits of this project will come from policy changes that are brought about by the project's research findings. If the bidding scheme can be promoted and adopted in the key land use change programs in China, then the cost savings would be a public benefit attributable to the this project.

With incentives for land use change built into the bidding scheme, better targeting of sites for land improvement activities has been achieved. This will lead to an increase in land productivity and better yield and quality of trees/ grass. The increase in land productivity and potentially more land area to be included into these land use change programs with the same amount of funding will improve the livelihood and well-being of the poor, normally resided in the ecologically fragile and remote area in China. In addition, efficiency gains will be achieved through an improvement in the cost-effectiveness of the government land use change programs. Better targeting of program sites will also lead to improved environmental benefits arising from these land use change activities. The ultimate goal of the land use change programs in environmental improvements and sustainable natural resource management will be met in the long run.

Given that the research project is well placed to have its recommendations accepted in the policy process, the probability of the project benefits being achieved is high. The market-oriented bidding scheme trialled in this project will have important implications for the future design of the key land use change programs in China, and the adoption of policy advice is expected to be achieved within 5-10 years given it is a phased process.

Australian benefits from the project involves insights into the development of MBIs for environmental benefits through application in an alternative/ contrasting context. This will strengthen the Australian technical capacity in the development of auction theory and auction design. The integration of choice modelling results into the auction design process trialled in this project proves that this is a more systematic and scientific way for bid valuation. Even though this approach has not been attempted in Australia, it could be applied in the future. Additionally, the improved environmental protection will afford benefits to those Australians who value the survival of species currently threatened by land uses in China.

8.3.2 Social impacts

The social impact has been brought about mainly through community participation during information sessions of the bidding trial, the development of afforestation and management plans, and the development of biophysical models at farm household level, and the preparation of bid submissions. More decision-making power has been given to local communities in their land use decisions and consultations were held between local governments and farm households in the two case study counties. This will bring further changes to the policy-making process for the implementation of the land use change programs in China. With the development of micro-level biophysical models, the social awareness of the importance of environmental improvements has also been raised among local communities. This is a key component to ensure the successful implementation of land use change programs at the grass-roots level.

8.3.3 Environmental impacts

Through the development of biophysical models at the farm household level that relate afforestation and management activities to environmental improvements, farmers and local officials were better informed of the environmental impacts of their land use practices. Local awareness of environmental protection was raised through this practice. In the long run, a more efficient way (through the bidding scheme) will be used by the Chinese Government to stimulate the provision of environmental goods and services. With the trial and assessment of the proposed bidding scheme in assigning land use change activities, this project will potentially contribute to better environmental performance within the government budget constraints.

8.4 Communication and dissemination activities

The project team is well placed to have the research outputs recognised by the key policy makers through the role played by the China National FEDRC. The FEDRC is affiliated to the State Forestry Administration, and is responsible for the development of policy recommendations relating to natural resource management where forestry activities are involved. The Centre also has close associations with the various Provincial Forest Bureaus and policy-making bodies such as the State Council Economics Development and Research Centre, Ministry of Finance, and other related ministries. The FEDRC therefore plays a pivotal role in policy development and adoption by bringing together information from various sources to advise both the Central Government and Provincial Governments on natural resource management. This research project has become part of that process.

The goal of the project was to develop policy measures (in this case the introduction of a bidding scheme) that will improve the cost-effectiveness of government finance for key land use change programs in China. To achieve the project goals will require those who make the policies that affect natural resource management to be exposed to the outputs of the project and be convinced of their merits.

To ensure that the research outputs gained a high profile within the FEDRC and hence in the policy adoption process of the Central and Provincial Governments, a number of communication activities have been undertaken as integral components of the project:

- A sequence of Research Reports have been published in both English and Mandarin;
- A web-site has been set up in which the Research Reports are available for downloading in both English and Mandarin;
- A sequence of seminars and workshops on the conduct and results of the research has been organised. These have been delivered to various stakeholders both at the central and provincial levels.

Communication and dissemination activities have been conducted during project initiation workshop, on-site project meetings organised by the local Organising Committee, site visits to the case study counties by local officials and scientists, regular project meetings and telephone conferences to coordinate overall project implementation, focus group meetings organised for the choice modelling survey, and final project symposium which was attended by key policy makers in natural resource management, agricultural policies as well as finance in China. Through these activities, all related stakeholder groups were informed of the bidding trial, the specific tasks that are required for project implementation, and the series of policy approaches taken by the Chinese government in improving the environment.

In addition, there have been communication and dissemination activities not directly related to the project. A workshop was organised for researchers from the Ministry of Agriculture in China whereby the ANU research team introduced the use of MBIs in natural resource management in the Chinese context, in particular the use of CM in estimation of environmental benefits. The aim of this workshop was to help the Chinese Government to design its grassland payment for environmental services scheme.

In April 2010, Professor Jeff Bennett gave a public lecture at Ren Min University in China on Land Tenure, Land Degradation and Property Rights Protection in China. In March 2011, Professor Jeff Bennett gave a public lecture at Peking University on water resources management and two lectures at Chinese University of Science and Technology on the main findings of the LUC project and environmental valuation. Key findings from the bidding trial were used as an example to elaborate on the thematic topic. The implications of the bidding trial for land tenure and property rights protection in China were discussed and brought to the attention of the larger audience among both the policy and academic circles in China.

Each of the communication activities were focused on convincing policy makers of the merits of the research process, its findings and the recommendations arising. It is expected that the bidding scheme will be trialled in other parts of China after this project is finished, so that its application can be extended and finally incorporated into the land use change programs in China.

9 Conclusions and recommendations

9.1 Conclusions

In conclusion, the LUC bidding trial results shows that a bidding scheme can be both practically feasible and more efficient than previously used schemes 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.

9.2 Recommendations

Based on the findings of the bidding trial, there are four main recommendations for the introduction and implementation of the bidding mechanism for ecological restoration in China.

The first recommendation relates to the scale at which future bidding schemes can be conducted. As the potential social dispute arising from different levels of payments under the bidding schemes has been proven unlikely through this project, it is possible to scale up the bidding trial to expand it to a wider area in Sichuan Province. Future bidding schemes could be conducted so that budget allocation occurs at the township or county level. On one hand this may reduce the transaction costs in the implementation process and further improve the use efficiency of financial funds. Research results suggest that finding effective methods to reduce transaction costs is key to successful implementation of ecological afforestation bidding schemes in the future. On the other hand, conducting bidding schemes at township or county level would also ensure 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. Greater level of heterogeneity leads to more efficiency gains from the bidding schemes.

Second, long-term incentive structures needs to be built into the bidding schemes to ensure the sustainability of the provision of environmental goods and services. The term of the conservation contracts under the LUC bidding scheme in Sichuan Province is only three years. Hence the bids put forward by participating farmers reflected the costs that would incur during the first three years following plantation. While continuous efforts and inputs will be required to maintain the forests established under the scheme, only a few farmers were informed of avenues for accessing additional financial support from other sources following the expiration of the three-year contract. 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.

Thirdly, institutional barriers especially at the local level need to be tackled in order for the bidding scheme to be implemented successfully. A lot of work in the implementation of the bidding scheme is done by relying on local government; however, delivery of financial resources cannot bring direct benefits for them. Therefore, in the implementation process, the local government often resists it and thinks that the great workload does not receive appropriate compensation. It will be a serious problem to reasonably allocate the financial capital and improve the gains among the different levels of government. Behavioural change at the local government level is necessary before such projects can be truly successful.

Lastly, more in-depth research components relating to auction design and contract design need to be incorporated into future bidding schemes. These include the choice between different payment formats (discriminatory format or uniform pricing), the reserve price strategy, whether the auction should be conducted with a fixed budget or with a fixed output target, dealing with bidder learning in repeated auctions, capturing conservation synergies through joint bidding, the choice of bid evaluation systems, and information hidden versus information revealed to bidders (Latacz-Lohmann and Schilizzi 2005). Different auction designs have different impacts on bidding behaviour and auction outcomes. Similarly, the stipulation in the management contracts the rights and conditions necessary to implement land improvements, conditions of payment and compliance, and penalty for non-compliance needs to be better crafted for future bidding schemes in China.

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10.2 List of publications produced by project

A number of publications have been published over the past year. These include:

- Wang, X., Bennett J., Dai, G. And Xie, C., 2009. *The Use of Bidding Scheme to Improve the Efficiency of Government Ecological Funds (in Chinese)*, Forest Economics 2009 (12).
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