

Economy and Environment Program
for Southeast Asia
Tanglin PO Box 101
Singapore 912404
Phone: (65) 6831-6854
Fax: (65) 6235-1849
E-mail: eeepsea@idrc.org.sg
Web site: www.eepsea.org

RESEARCH REPORT

No. 2004-RR3

Distribution of Benefits and Costs among Stakeholders of a Protected Area: An Empirical Study from China

Yazhen Gong
Center for Chinese Agricultural Policy, c/o
Department of Forest Resources
Management, Faculty of Forestry, 2425 main
mall, University of British Columbia,
Vancouver, V6T 1Z4, Canada.
(gongyazhen@yahoo.com
yzgong@interchange.ubc.ca)

This report provides information on the impact of a new conservation regime in the Fanjingshan National Reserve (FNNR) in Guizhou Province, China. It calculates the economic and social effects that this regime will have on the livelihoods of people living inside the reserve. It shows that, if local people are not compensated for lost incomes, the new plans will increase conflict between locals and the reserve management.

To find a way to pay compensation, the study investigated whether people living in the province around the reserve would be willing to pay for conservation in the FNNR through an eco-tax. These people benefit from conservation in the reserve, but at present pay nothing towards it. The report finds that they would be willing to pay and that the amount that could be collected would more than cover of compensating those affected inside the protected area.

Published by the Economy and Environment Program for Southeast Asia (EEPSEA)
Tanglin PO Box 101, Singapore 912404 (www.eepsea.org)
tel: +65-6235-1344, fax: +65-6235-1849, email: eepsea@idrc.org.sg

EEPSEA Research Reports are the outputs of research projects supported by the Economy and Environment Program for Southeast Asia. All have been peer reviewed and edited. In some cases, longer versions may be obtained from the author(s). The key findings of most *EEPSEA Research Reports* are condensed into *EEPSEA Policy Briefs*, available upon request. The Economy and Environment Program for Southeast Asia also publishes *EEPSEA Special Papers*, commissioned works with an emphasis on research methodology.

National Library of Canada cataloguing in publication

Gong, Yazhen

Distribution of benefits and costs among stakeholders of a protected
area : an empirical study from China

(Research report, ISSN 1608-5434 ; 2004-RR3)
Co-published by the International Development Research Centre.
Includes bibliographical references.
ISBN 1-55250-121-3

1. Nature conservation – Economic aspects – China – Fanjingshan
Ziran Baohuqu.
 2. Environmental protection – Economic aspects – China – Fanjingshan
Ziran Baohuqu.
 3. Fanjingshan Ziran Baohuqu (China) – Environmental aspects.
 4. Land use – China – Fanjingshan Ziran Baohuqu.
- I. Economy and Environment Program for Southeast Asia.
II. International Development Research Centre (Canada)
III. Series: Research report (Economy and Environment Program for
Southeast Asia) ; 2004-RR3.

QH77.C6G66 2004 333.95'16'095134 C2004-980218-6

The views expressed in this publication are those of the author(s) and do not necessarily represent those of the Economy and Environment Program for Southeast Asia or its sponsors. Unless otherwise stated, copyright for material in this report is held by the author(s). Mention of a proprietary name does not constitute endorsement of the product and is given only for information. This publication may be consulted online at www.eepsea.org.

**DISTRIBUTION OF BENEFITS AND COSTS AMONG
STAKEHOLDERS OF A PROTECTED AREA: AN
EMPIRICAL STUDY FROM CHINA**

Yazhen Gong

March, 2004

Comments should be sent to: Yazhen Gong, Department of Forest Resource Management, Faculty of Forestry, 2424 Main Mall, University of British Columbia, Vancouver, V6T 1Z4, Canada.

Email: gongyazhen@yahoo.com or yzgong@interchange.ubc.ca

EEPSEA was established in May 1993 to support research and training in environmental and resource economics. Its objective is to enhance local capacity to undertake the economic analysis of environmental problems and policies. It uses a networking approach, involving courses, meetings, technical support, access to literature and opportunities for comparative research. Member countries are Thailand, Malaysia, Indonesia, the Philippines, Vietnam, Cambodia, Lao PDR, China, Papua New Guinea and Sri Lanka.

EEPSEA is supported by the International Development Research Centre (IDRC); the Swedish International Development Cooperation Agency (Sida) and the Canadian International Development Agency (CIDA).

EEPSEA publications are also available online at <http://www.eepsea.org>

ACKNOWLEDGEMENT

I sincerely present my gratitude and respect to the following institutions and persons:

Environment and Economy Program for Southeast Asia (EEPSEA): for providing me general granting to accomplish this research, which is part of my master's thesis.

Center for Chinese Agricultural Policies (CCAP), Forestry Department of Guizhou Province, Fanjingshan National Nature Reserve (FNNR) and Longli State-owned Forest Farm in Guizhou: for giving me great support in field survey and logistics.

Dr. Jack Ruitenbeek, Dr. Dale Whittington and Dr. Vic Adamowicz: for their invaluable comments and instructions on the whole research. Without their great help, I would not have learned so much.

Dr. Herminia Francisco, Deputy Director of EEPSEA: for her encouragement, enlightening help and comments over my research experience.

Dr. David Glover, Director of EEPSEA: for his kindness, support and patience towards me.

Dr. Jikun Huang, director of CCAP and Dr. Jintao Xu, deputy director of CCAP: for their great support, instructions and comments.

Mr. Zhang Jinlin, Mr. Liu Lang, Mr. Yuan Jinhong and their colleagues from the Forestry Department of Guizhou Province: for their great support.

Mr. Yang Yeqin, Director of FNNR Management Bureau, and his colleagues: for their great support for me while conducting my field survey.

Dr. Margaret Calderon and Dr. Mafa Chipeta: for their help and instructions.

Mr. Wei Jiegen, Mr. Bai Junfei, Miss Liu Haomiao, Miss Wang Xuanwen, Mr. Yuan Liang, Mr. Wu Binjian and Mr. Wang Yang: for their hardwork, great assistance and conscientiousness.

Mr. Xu Zhigang and Mr. Fan Cunhui: for their great help, patience and comments regarding my data analysis.

Mrs. Catherine Ndiaye, Program Assistant of EEPSEA, and Ms. Lin Yuxian, Administrative Secretary of CCAP: for their help with many logistical matters.

TABLE OF CONTENT

EXECUTIVE SUMMARY	6
1. INTRODUCTION	1
1.1. General Background	8
1.2. Research Objectives	9
1.3. Scopes and Limitation of the Research	10
2. DESCRIPTION OF FNNR	10
3. REVIEW OF RELATED LITERATURES	8
4. METHODOLOGY	9
4.1. Conceptual Framework	9
4.2. Data Resources and the Field Survey	10
4.2.1. Data Sources	10
4.2.2. Field Survey	10
4.3. Data Analysis	14
4.3.1. Estimation of benefit foregone by local people in FNNR	14
4.3.2. Estimation of off-site residents' WTP	15
5. EMPIRICAL FINDINGS	17
5.1. Empirical Findings of Opportunity Cost Study	17
5.1.1. Socioeconomic Profile of Respondents	17
5.1.2. Opportunity Cost Born by the Local People in FNNR	26
5.2. Empirical Findings of CVM Study	28
5.2.1. Brief Information of Guizhou Province and Longli County	28
5.2.2. Respondents' Personal and Their Household Profile	29
5.2.3. Respondents' Vote for the Taxation Scheme	34
5.2.4. Multivariate Regression Analysis	36
6. CONCLUSIONS	42
6.1. Conclusions for Opportunity Cost Study	42
6.2. Conclusions for CVM Study	43
6.3. General Conclusions	44
7. POLICY RECOMMENDATIONS AND IMPLICATIONS	44
7.1. Recommendations on Management Schemes	44
7.2. Policy Recommendations	45
7.3. Policy Implications:	46
REFERENCES	47
APPENDIX I	50
APPENDIX II	52
APPENDIX III	53

LIST OF FIGURES

1. Location of FNNR in Guizhou province in China	6
2. Households in Critical Core Group	28

LIST OF TABLES

1. Distribution of Sample Unit Across Three Strata	11
2. Basic Parameters in Quantifying Timber Used for Charcoal Production	14
3. Characteristics of Surveyed Population, FNNR, Guizhou, China, 2001	18
4. Characteristics of Respondents' Households	19
5. Household Activities and Associated Incomes of Households in Each Group in the Year 2000, FNNR, China	21
6. Forestry Activities And Household Incomes in Each Group in 2000, FNNR	23
7. Household Firewood Collection in Year 2000	24
8. Proportions of Households Engaged In Illegal Activities	25
9. Average Quantity of Forest Products Required for Reduction	26
10. Opportunity Cost Born by Local People in FNNR (2001-2005)	27
11. Results of Sensitivity Analysis	28
12. Respondents' Socioeconomic Characteristics in CVM Study	30
13. Respondents' Household Profile of CVM Study	31
14. Respondents' Perceptions on Socioeconomic Issues And Environmental And Resource Conservation	32
15. Mean WTP and Percentage of Respondents Having Different Perceptions	33
16. Percentage of Respondents Who Are Willing to Pay or Not Willing to Pay	35
17. Respondents' Reasons for Vote "No" for The Taxation Scheme	36
18. Respondents' Reasons for WTP for Biodiversity Conservation in FNNR	37
19. Definition of Variables Used in Hurdle Model	38
20. Estimation Results of Hurdle Model for Rural and Urban Respondents	39
21. Marginal Effect of Dependent Variables on Respondents' Willingness to Support And Their WTP for Biodiversity Conservation in FNNR	40
22. Respondents' Expected Values and Mean WTP	43

LIST OF APPENDIX

I. Financial Analysis of Reduced Forest Products in Critical Core Area Group	52
II. Financial Analysis of Reduced Forest Products in Other Core Area Group	53
III. Financial Analysis of Reduced Forest Products in Critical Core Area Group	54

DISTRIBUTION OF BENEFITS AND COSTS AMONG STAKEHOLDERS OF A PROTECTED AREA: AN EMPIRICAL STUDY FROM CHINA

Gong Yazhen ¹

EXECUTIVE SUMMARY

Given the increasing importance of nature conservation in China, the government is committed to improving biodiversity conservation efforts. This goal is being met mainly through the creation, management and policing of 1,276 protected areas. In many of these sites local people's access is restricted. This is often done with little attention to the welfare of the local communities, whose access to natural resources is often greatly reduced.

In contrast to the government's legal justification for this restriction, local communities in protected areas believe that they should be compensated because they have traditional "territorial rights" or have been assigned with land tenure by the government. It is therefore not surprising that various conflicts exist in most of China's protected areas. If the current issues cannot be addressed properly, these conflicts will eventually become an obstacle to sustainable conservation in the country.

This empirical study was conducted to answer the following questions: (1) Are local communities greatly affected by conservation undertaken in protected areas? (2) If the local communities are to be compensated for any loss in livelihood they experience due to this conservation work, what is the minimum amount of the payment that should be given? (3) Are communities that do not live in protected areas willing to pay for biodiversity conservation in them? If yes, is their willingness to pay greater than the economic loss of the affected local communities?

To get the evidence needed, the survey looks at the impact of a new conservation policy in Fanjingshan National Nature Reserve (FNNR), an area of important biodiversity that experiences many of the problems faced by other protected areas.

¹ The researcher is from Center for Chinese Agricultural Policy, Chinese Academy of Sciences. She appreciates the support from EEPSEA, particularly Dr. David Glover and Dr. Herminia Francisco, for this research. The appreciation is also presented to Dr. Jack Ruitenbeek, Dr. Dale Whittington and Dr. Vic Adamowicz for their valuable comments and advice

The survey finds that under the new conservation program, the total net benefit that the local people in FNNR will have to forego is estimated to be CNY 270,000 (US\$ 326,374). This will significantly undermine their quality of life. The survey also finds that households in Longli County (which surrounds FNNR), who do not live in FNNR, are willing to pay for biodiversity conservation in the protected area. The total WTP of Longli's residents for biodiversity conservation in the reserve is estimated to be CNY 2.6 million.

The survey concludes that the Chinese government should pay close attention to the impact new conservation programs have on local people. It also recommends that proper compensation must be given to local communities if new conservation programs are to be implemented in protected areas such as FNNR. It finally recommends that the government explore appropriate mechanisms (such as eco-compensation schemes) to redistribute the costs and benefits of conservation work across the different stakeholder groups who will be affected by it.

1. INTRODUCTION

1.1. General Background

By the end of 2000 there were 1,276 protected nature conservation areas in China. Although great efforts are made to patrol and police these areas, habitat loss and degradation within them are significant problems. This destruction is caused by human impacts such as poaching, illegal logging, mineral extraction, over-grazing and fire (FAO, 2000). It is thought that the communities who live in protected areas are responsible for many of these problems.

As in many other countries, when the central or provincial government establishes a protected area for conservation purposes, it simply restricts local people's access. This is normally done with little attention to the welfare of the local communities, whose access to natural resources is often greatly reduced. Many of these local communities think that they either have traditional "territorial rights", or have been assigned with land tenure by the government, over parts of "their" protected area. However, they receive little or no compensation and become increasingly impoverished and marginalized. Consequently, they are reluctant to give up their traditional patterns of resource use (Dixon and Sherman, 1990) and continue to use protected areas to gather natural resources – to the detriment of successful conservation.

This is in stark contrast to the benefits that people who do not live in protected areas receive from biodiversity conservation; benefits for which they often make no payment. Compounding this "free-rider" problem is the fact that the "offsite" communities involved have little motivation nor awareness of their responsibility to the cause of nature conservation precisely because they pay nothing towards it.

This research was conducted to illustrate how the inequitable distribution of the benefit and costs caused by conservation work in protected areas could be a critical constraint to the sustainable conservation of natural resources. Specifically, the research tried to answer the following questions: (1) Are local communities greatly affected by conservation undertaken in protected areas? (2) If the local communities are to be compensated, what is the minimum payment they should be given? (3) Are "off-site" communities in China willing to pay for biodiversity conservation in protected areas? If yes, is their WTP greater than the economic loss of the local communities in protected areas?

Fanjingshan National Nature Reserve (FNNR) was selected as a study area since it experiences many of the problems faced by other protected areas in China and, in

particular, is representative of the problems posed by local communities who continue to use protected forest resources to maintain their livelihoods. FNNR also exhibits outstanding biodiversity. In particular it is home to the Guizhou Snub-nosed Monkey (*Rhinopithecus brelichi*) that is an endemic species to China and has been listed as “endangered” in IUCN Red Book since 1994. If the pressures imposed by FNNR’s local communities cannot be alleviated, some species, including the Guizhou Snub-nosed Monkey, may become extinct in very near future. Losing this animal would be a major blow to diversity within the order of Primates (CBSG, 1999).

In order to protect the Guizhou snub-nosed monkey (along with other species in the reserve), FNNR decided to implement a new conservation program designed to run from 2001 to 2010. Two major measures have been taken to protect the monkey: One is to protect the animal’s current habitat by implementing more restrictions on how local households can use the forest. By this means, it is hoped that the monkeys’ population size can be maintained at the current level (about 800). *Ex situ* conservation measures have also been taken: It is planned that by 2010 the captive population of the monkey will rise from 11 to 51. These will be eventually relocated in suitable habitats outside FNNR. In this way it is hoped that the wild population of this species will grow and that the risk of it becoming extinct will be reduced.

1. 2. Research Objectives

The overall objective of this research is to estimate the impact that biodiversity conservation in Fangjingshan National Nature Reserve (FNNR) has on local and off-site provincial communities.

The Specific Research Objectives:

To calculate the net income foregone (ie. the opportunity cost) by local communities in FNNR due to the implementation of the reserve’s new conservation program. The estimated value can be used by the management bureau of the Reserve to calculate the minimum amount of compensation that should be made to the local communities.

To estimate the WTP of off-site communities in the province for biodiversity conservation under the FNNR’s new conservation program.

To explore any factors that significantly affect off-site communities’ WTP for biodiversity conservation in FNNR.

To draw lessons from this research to provide some generalized policy input for decision-making on biodiversity conservation in China.

1.3. Scope and Limitation of the Research

The research is not a valuation study on the total economic values of biodiversity conservation in FNNR. Rather, it focuses on the marginal change in the benefits of the reserve's on-site local and off-site provincial communities due the implementation of a new conservation program.

The estimate of the net income foregone (opportunity cost) by local communities was based on the direct use value of forest resources, including consumptive and productive use values, reaped by the local people in the year 2000. It was assumed that any other economic values that the local people got from the reserve – including indirect use values and non-use values (such as amenity and the ecological functions provided by the forests in the Reserve) – will be constant under the new conservation program.

The survey of provincial communities' WTP for biodiversity conservation was only conducted in Longli County in Guizhou province, which stands in the middle position in the province in terms of population size, GDP per capita and ratio of rural population to urban population.

2. DESCRIPTION OF FANJINGSHAN NATIONAL NATURE RESERVE

Fanjingshan National Nature Reserve (FNNR) is a national nature reserve that is under category 1a of the IUCN management system of protected areas (CSIS 2000). FNNR is situated in the northeastern part of Guizhou Province in Southwest China (Figure 1) and is approximately 530 km away from Guiyang, the capital city of the province. It is located from 108°45'55" to 108°48'30" longitude and between 27°49'50" and 28°1'30" latitude and covers a total geographic area of 41,900 ha.

FNNR contains outstanding biodiversity and relatively undisturbed primary forest compared with any other areas on the same latitude in the world. For this reason FNNR is considered an important “Green Gene Bank” in China. FNNR has 44 forest types and, in particular, 13 communities of Chinese dovetrees (*Davidia involucrate*). The Chinese dovetree communities cover a total area of 80 ha. and this makes FNNR the most focused distribution area for this species in the country (Zhou et al., 1990).

About 1,200 animal species and 1,800 plant species, including 20 endemic plant species such as *Abies fanjingshanensis* (Fanjingshan fir), have been identified in FNNR. The reserve is particularly important because it is the only remaining habitat for the endangered Guizhou Snub-nosed Monkey. It is estimated that the total population of this animal is between 750 and 800 and that the total distribution range of their habitat in FNNR is only 275 km². Scientists from IUCN have predicted that this isolated species has a 25% chance of becoming extinct within next 100 years if the current pressures they are facing cannot be alleviated (CBSG of IUCN, 2000). However, it has also been stated that the wild population of Guizhou Snub-nosed Monkey could maintain itself well into the future if the degradation of its habitat and hunting are controlled through intensive conservation management (Bleisch, 1993).

The biodiversity in FNNR, including the Guizhou Snub-nosed Monkey, faces various threats from the economic activities of local people. Currently, 118 households live in the reserve’s core area and 3,152 households live in the reserve’s buffer zone. These local communities have depended heavily on the biodiversity in the reserve for their livelihood. Firewood harvested from the reserve is the main fuel used for cooking and local people have felled Asian oaks and beeches to make charcoal for home consumption and for sale. These two tree species are used by the Guizhou Snub-nosed Monkeys for food and shelter.

FNNR is located on the boundary by Jiangkou, Songtao and Yinjiang counties. In Songtao and Yinjiang, more than half of population belongs to two ethnic minorities, namely the Miao and Tujia. People from Miao ethnic group have traditionally collected herbs for medicinal use in the reserve, while people from Tujia ethnic group traditionally used wood from the reserve to construct houses. Local people also used to set snares inside the reserve to poach wildlife. These snares inevitably killed the monkeys and other key protected species in the Reserve.

The management bureau of FNNR has realized that the conservation of biodiversity in the Reserve must be improved. To do this they have implemented a new conservation program that will significantly restrict local people’s economic activities in the Reserve. This program has legal backing and will be enforced through policing, patrolling and punishment.

However, the local communities believe that they should have the right to use the forest, some of which has been distributed to them under the “household responsibility system” that is part of China’s national land use policies. They complain that they have had to shoulder a considerable financial burden for conservation in FNNR. They point to the fact that neither the government nor the management bureau of the Reserve has provided them with any compensation for the economic loss they have experienced because of the reduction in the harvest of natural resources they can collect. In addition, they state that they have few alternative ways of making a living other than using the forest in the Reserve. Therefore, they say they have no choices but to continue using the protected forest for their livelihood. Given these disagreements over issues such as land tenure and the legitimacy of the use rights of the local communities, it is not surprising that conflicts have escalated between the management bureau and the local communities. Such conflicts have become an obstacle to sustainable conservation in FNNR.

3. REVIEW OF RELATED LITERATURES

In the framework of cost-benefit analysis, opportunity cost measures the value of whatever society must give up to implement the policy (Boardman et al., 1996). The opportunity costs of a protected area are the benefits that society or individuals lose when an area is protected (Dixon and Sherman, 1990). In many developing countries, opportunity costs result from the need to restrict the use of a protected area by nearby residents. In such a case the residents have to give up the outputs that they have been accustomed to receiving, which may be significant to their livelihood. Dixon and Sherman (1990) see the need to either provide compensation for local residents if they have to give up products from a protected area or develop alternative income sources to replace them. Without this compensation, local communities may be very reluctant to give up their traditional use patterns. It is also essential to estimate the proper value of compensation when a government believes that compensation measures might be advisable (Ferraro and Kramer, 1997). However, so far only a few detailed empirical studies have been done to quantifying the impacts of establishing protected areas on local communities in developing countries (Dixon and Sherman, 1990).

Various experts have recommended some possible valuation techniques to estimate the impact of protected areas on local communities. The loss in the production of timber and other outputs could give an estimate of opportunity costs when a place is designated as, for example, a wildlife sanctuary with restrictions imposed on its economic use (Mathur, 1978). An estimate of the economic impact of conservation programs in protected areas on local people could be based on their WTP to prevent the protected area being created, or on their willingness to allow the existence of the protected area (Ferraro and Kramer, 1997). Shyamsundar and Kramer (1997) applied cash flow analysis and risk analysis to estimate the costs borne by local people due to the establishment of a protected area in eastern Madagascar. The study made use of primary data, obtained by CVM through a series of open-ended unstructured interviews, and secondary data. The

study revealed some of the motives behind local resistance towards conservation efforts (Phillips, 1998).

It has been mentioned that assessments of losses as perceived by the residents may be seriously understated if WTP measures are used. This means that compensation payments based on such measures might not fully offset the loss of well-being experienced by local communities in protected areas (Ferraro and Kramer, 1997). The technique of estimating opportunity costs of local people in protected areas by using CVM is therefore still under debate.

4. METHODOLOGY

4.1. Conceptual Framework

According to the Kaldor-Hicks criterion in welfare economics, a policy should only be adopted if those who gain from it can fully compensate those who will lose out and still be better off themselves. This criterion highlights one important policy making consideration: that as long as the policy generates positive net benefits, it is at least possible to compensate losers so that the policy can lead to a Pareto improvement (Perkins, 1994; Boardman et al. 1996). A Pareto improvement is achieved if a reallocation of resources makes at least one person better off and no one worse-off.

In the context of environmental and natural resources protection, disagreements commonly occur between those parties concerned with development and those concerned with conservation. However, these disagreements could be reconciled if those groups that directly bear the costs of any conservation programs can be compensated by appropriate policies or incentive mechanisms. It is thought that the nonuse value that biodiversity conservation provides off-site communities can be passed to the local population through such economic incentives and financing mechanisms. So far, little information has been produced about the opportunity costs that local people must bear for biodiversity conservation and the WTP of off-site communities for that biodiversity conservation work.

This research tried to estimate the opportunity costs born by local communities for biodiversity conservation undertaken in FNNR. It also tried to estimate the WTP of off-site communities for this work. The calculation of local people's opportunity costs was based on the quantification and monetization of the economic contribution made by forest products to the livelihoods of local people in the year 2000. The off-site communities' WTP for biodiversity conservation in FNNR was calculated by means of CVM.

4.2. Data Sources and the Field Survey

4.2.1. Data Sources

Both primary and secondary data were used to achieve the study's objectives. Primary data for the estimation of opportunity cost was gathered using questionnaire surveys from 59 "natural villages" (sub-units of administrative villages). 238 respondents were interviewed between December 2000 and March 2001 (see Appendix I). The primary data for the estimation of WTP was collected from Longli County. 244 respondents in 25 villages in rural areas and 247 respondents in urban areas were interviewed using questionnaires.

4.2.2. Field Survey

1. Sampling Strategy for Opportunity Cost Study

The stratified random sampling method was used to choose respondents in the data collection exercise for the estimation of the local people's opportunity cost. The sampling frame consisted of 3,150 households living within or on the boundary of FNNR. These households were stratified into three groups. This sorting was based on the proximity of the households to the critical habitat of the Guizhou snub-nosed monkey and the restrictions imposed on their activities by the reserve under the new conservation program. The three strata are as follows:

Critical core area group This consists of 11 households living in the most critical habitat of the Guizhou snub-nosed monkeys. Their activities are believed to have the most significant impact on the animals since they live in the monkey's mating and breeding area. By the end of 2005 these households will not be allowed to make any economic use of the forest in the reserve (including the collection of firewood). It is proposed that they should be relocated.

Other core area group This consists of 107 households who are living in other parts of the core area of the reserve. By 2005 they will only be allowed to collect half of the current quantity of firewood they harvest. Timber cutting for marketing will not be allowed and timber cutting for house construction will have to be approved and inspected by the Management Bureau of FNNR. Charcoal products that are made with kilns will be restricted. Charcoal products that are in open pits for commercial purposes will be prohibited. Animal poaching will be forbidden. Digging of stumps for commercial purposes will also be terminated.

Buffer zone group This consists of 3,032 households living in the experimental area (including those living on the boundary). They will not be allowed to cut timber and poach animals. Charcoal products made with kilns for commercial purposes will be forbidden while the charcoal products made in open pits for commercial purposes will be reduced to half of the current level. Charcoal products made with kilns for home consumption will not be allowed either. It is proposed that the harvesting of firewood, estimated to be 30,000 m³ (or about 40,000 tons), should be reduced in the next five years.

The sample size for interviewing was determined by applying the following formula. The allocation of the total sample across the three groups is shown in Table 1.

$$n = \frac{N}{1 + Ne^2}$$

where: n = sample size

N = the total population (sample frame)

e = desired margin of error (5% in this research)

Table 1. Distribution of Sample Units Across Three Strata

Category	# of households	# of respondents	% of total respondents	% of total households
Critical core area group	11	9	4	82
Other core area group	107	57	24	53
Buffer zone group	3,032	172	72	6
Total	3,150	238	100	.

2. Sampling Strategy for Contingent Valuation Survey

Purposive sampling was used to choose the sites for the CVM questionnaire survey. Using government statistics and the *Statistics Yearbook* (2001) of Guizhou Province, Longli county was selected based on its GDP per capita, population size and its ratio of rural population to urban population. Five rural townships were randomly selected and all five urban districts were chosen. In each township, five villages were randomly selected. In these villages the residents were first categorized into three groups by household income and then ten respondents were chosen from each group. In each district in the urban area, 50 respondents were randomly chosen from the ID registration books kept by the district management offices. At the end of the survey, 500 questionnaires were obtained, 491 of which were considered as valid for data analysis.

3. Questionnaire Design for Opportunity Cost Study

Quantitative information on the forest products harvested by households was required to determine the amount of foregone benefits that local people experienced due to the new conservation program. In a highly sensitive protected area like FNNR, it was very likely that the survey would generate poor information on “illegal” activities. Therefore, designing a well-structured questionnaire was critical.

A pretest survey was conducted in early March 2001. The initial design of the questionnaire on opportunity cost was based on secondary information. It was noticed that on some sensitive questions, such as animal poaching in the reserve, questioning techniques played a significant role in the success or failure of the survey. In the final version of the questionnaire some adjustments were made in the way questions were asked.

It was also observed during the pretest survey that people tended not to reveal complete information about their household income (especially income from illegal activities such as animal poaching). In comparison, they were quite open to questions relating to household expenditures. Given this situation, a focus group discussion was held to get general information about the activities (especially “sensitive” activities) undertaken by households in various villages in the reserve. This discussion investigated topics such as how the establishment of the reserve has changed resource utilization, what constituted the main sources of livelihood for households in the reserve, respondents’ perceptions of the reserve management and their thoughts on development problems and possible solutions within FNNR. Village members from families with different levels of income made up the focus group. The information obtained from the discussion was used later in the formal survey as a reference point for individual interviews.

The questionnaire used for the formal survey consisted of six parts, which looked at the following areas: (1) respondents’ demographic and socio-economic characteristics and information on their households and villages; (2) household activities, including farming, forest, husbandry, fishery and apiary, and their corresponding incomes; (3) quantities of forest products (timber and NTFPs) harvested both for home consumption and marketing; (4) incomes from the harvest of forest products that were both sold in the market and consumed at home; (5) time spent on collecting home-use forest products or on collecting and selling marketed forest products; and (6) household expenditures.

The final questionnaire included household expenditure so that enumerators could look at two streams of information – on household income and household expenditure – to find out whether there was a big discrepancy between the two. This was used to judge whether respondents gave real information or not. If a big discrepancy was found, the

follow-up questions could then be focused on “illegal” activities such as animal poaching and charcoal production for commercial purposes.

The reference information from focus group discussion and the comparisons between household income and expenditure was vital. It meant that information relating to “illegal” activities such as animal poaching could be verified. However it was noted that such information could only be regarded as a minimum value for income from illegal activities since many respondents did not fully reveal this kind of information.

4. Questionnaire Design for Contingent Valuation Survey

The initial questionnaire for the CVM survey was based on information detailing the new conservation program that has been proposed for FNNR. In March of 2002, a pretest survey was conducted in a rural area in Northern China, far away from FNNR. This found that some respondents could not easily grasp the concept of biodiversity since it was introduced in a very abstract way. During a subsequent focus group discussion, participants were asked to explain biodiversity and biodiversity conservation in their language. Their replies were used to refine the final questionnaire. In early May a second pretest survey was held in both rural and urban areas of Longli County – the target area for the CVM survey. An unexpectedly high ratio of “Yes” answers was obtained from the respondents and it was found that the questionnaire contained too many leading queries. Revisions were therefore made.

In China, eco-compensation is becoming a “hot” issue. The government is moving towards introducing an “eco-value” taxation scheme to channel funding from the public, most of whom currently pay little or nothing for natural resource conservation. It is believed that using tax to pay for projects such as biodiversity conservation programs could be more effective and equitable than the current donation payment mechanism. Therefore, in this research, tax was used as a payment vehicle to gauge the WTP of off-site communities for biodiversity conservation in FNNR. The “bidding game” procedure was used to find out this information. One problem with this approach is starting point bias, to avoid this issue the starting point for tax payment was provided to the respondents with reference to their household assets, however, it should be noted that this does not guarantee that the problem would be avoided.

The final version of the questionnaire used in the CVM survey comprised six parts, which investigated the following issues: (1) respondents’ locations and some of their basic background; (2) respondents’ perceptions on some socio-economic and environmental issues; (3) respondents’ perceptions and awareness regarding protected areas and biodiversity conservation; (4) respondents’ perceptions of conservation and taxation programs and WTP questions; (5) respondents’ personal information and information on their families; (6) enumerators’ valuation on the quality of the survey.

4.3. Data Analysis

4.3.1. Estimation of the Benefits Foregone by Local People in FNNR

The estimation of the benefits foregone by local people involved three steps: (1) quantification of timber and non-timber forest products harvested; (2) calculation of the net present value (NPV) of benefits foregone by the local people in FNNR under the new conservation program; and (3) sensitivity analysis.

1. Quantification of Timber Products and Non-timber Forest Harvested by Local People

Market prices were used to calculate the benefits and costs of marketed forest products. The direct substitute approach, using surrogate prices, was used for those forestry products that had no market prices or are not exchanged in local markets. These products were: the air-dried firewood used by households in the reserve for cooking and space heating, and the green wood they used for charcoal production. Coal is the closest substitute for wood as a fuel in the study area so it was used as the ‘substitute good’ in these calculations. Conversion factors were used to accurately compare coal and firewood and coal and firewood for charcoal production (Table 2 gives details of the values used).

Table 2: Basic Parameters in Quantifying Timber Used for Charcoal Production

Means for making charcoal	Wood moisture	Wood density	LHV of wood used	Conversion factors
	(Dry basis)	(tons/m ³)	GJ/ton	(m ³ /tons)
With kilns	30%	0.725	8	6
Without kilns	30%	0.725	8	10

Source: FAO, 1997, 2000

2. Calculation of NPV of Benefits Foregone by Local People

The net present value (NPV) of the benefits of products was calculated by applying the following formula:

$$NPV = \sum_{j=1}^n \frac{B_{ij} - C_{ij}}{(1+r)^j} = \sum_{j=1}^n \frac{P_{ij}Q_{ij} - C_{ij}}{(1+r)^j}$$

where: B_i = Benefits of forest product i in period j

C_i = Cost involved with product i in period j

P_i = price of product i ;

Q_i = quantity of product i ;

C_i = costs involved with product i

r = Discount rate

$n = 5$ in this study

The monetary values of the benefits and costs assigned to the forest products affected by the new conservation program were based on the relevant values of products that were harvested for commercial purposes and home consumption in the year 2000.

3. Sensitivity Analysis

Sensitivity analysis was used to take into account potential changes in financial loan rates and also to allow for some uncertainties relating to assumptions used in the financial analysis.

In financial analysis, it was assumed that 100% of the firewood collected by the households in the buffer zone was from the reserve, however, according to reserve managers questioned during the field survey, about 30% of firewood collected by these households was from areas outside the reserve. Sensitivity analysis was used to see what effect this finding would have on forest income.

The discount rate of 3% is the interest rate that has been applied to credit loans for poverty alleviation in China in recent years. Sensitivity analysis was used to see what effect fluctuations in this rate would have on household revenues from the forest sector.

4.3.2. Estimation of Off-Site Residents' WTP

In the CVM study, respondents were told that a new conservation program would be implemented in FNNR in order to prevent the endangered Guizhou snub-nosed monkey from becoming extinct. This means in theory that a possible increase will be made in Q (biodiversity conservation quality) from Q^0 to $Q^1 > Q^0$. The respondents were also told that the new conservation program would incur an annual conservation cost of RMB 6 million. Half of this would be funded by the government budget, while the other half would be channeled from other sources, including a new temporary eco-value-added tax scheme in Guizhou Province.

The respondents were then asked whether they would like to support such a taxation scheme. It was assumed that a respondent would only answer “Yes” if they thought that they would still, on balance, feel better off. If the answer was “Yes”, the respondents were asked what tax they would be willing to pay (denoted as WTP) on an annual basis from 2003 to 2010 (the time during which the new conservation program would be implemented).

Hanenann and Kanninen (1996) considers that a respondent has an indirect utility function $V(P, Q, Y, S, \varepsilon)$, in which P, M, Q, S, ε denote the price of market good, the quality of the environment good, income, his/her socio-economic characteristics and unobserved components, respectively. This means that, assuming a respondent receives an improvement in his/her utility under the new conservation program, the amount of his/her maximum WTP (denoted as C) for the conservation measures should satisfy the following formula:

$$V(P, Q^1, Y-C, S, \varepsilon) \geq V(P, Q^0, Y, S, \varepsilon)$$

The data obtained by the CVM questionnaire about the respondents' WTP was left-censored at the value of zero. Analysis using the Tobit model was therefore initially tried – this model implies that the variables affecting whether or not to pay or how much to pay are the same. However, during the analysis, it was noticed that the variables affecting whether or not to pay might be different from the variables affecting how much to pay, therefore, the “double hurdle model” was adopted. This idea originated from Crag (1971), who proposed a generalized approach that considers the difference of parameters or variables that affect the decision about whether or not and how much to acquire. The model was specified as follows:

$$Y_i^* = X_i' \beta + \varepsilon_i \quad \text{decision function of how much to pay}$$

$$H_i^* = Z_i' \alpha + v_i \quad \text{decision function of whether or not to pay} (I_i=1 \text{ if } H_i^* > 0, \text{ otherwise } I_i=0)$$

$$Y_i = Y_i^* \quad \text{if } X_i' \beta + \varepsilon_i > 0 \text{ and } I_i=1$$

$$Y_i = 0 \quad \text{otherwise}$$

where:

Y_i^* : the latent variable representing how much the respondents are willing to pay.

H_i^* : the latent variable describing whether the respondents are willing or not willing to pay. If $H_i^* > 0$, then the respondents are willing to pay; otherwise, not willing to pay.

Y_i :the observed WTP of respondents. If the respondents are willing to pay, then Y_i is WTP; otherwise Y_i is zero.

Z_i :independent variables of participation equation

X_i :variables of WTP equation

ε_i and v_i are the normal dependent error terms of the respective equations, whose

correlation coefficient is defined as rho.

The two equations were estimated by means of LME. When the error terms are dependent or correlated, the LM function is specified as follows (Yen and Jones, 2001):

$$L(\alpha, \beta, \sigma^2, \rho) = \prod_{i=1}^N \left[1 - \Phi(z_i' \alpha, x_i' \beta / \sigma, \rho) \right]^{1-I_i} \prod_{i=1}^N \left[\Phi\left(\frac{z_i' \alpha + \rho(y_i - x_i' \beta) / \sigma}{\sqrt{1 - \rho^2}}\right) \frac{1}{\sigma} \phi\left(\frac{y_i - x_i' \beta}{\sigma}\right) \right]^{I_i}$$

When the error terms are independent or uncorrelated, the LM function is reduced to the function as follows:

$$L(\alpha, \beta, \sigma^2) = \prod_{i=1}^N \left[1 - \Phi(z_i' \alpha) \Phi(x_i' \beta / \sigma) \right]^{1-I_i} \prod_{i=1}^N \left[\Phi(z_i' \alpha) \frac{1}{\sigma} \phi\left(\frac{y_i - x_i' \beta}{\sigma}\right) \right]^{I_i}$$

5. EMPIRICAL FINDINGS

5.1. Empirical Findings of the Opportunity Cost Study

5.1.1. Socioeconomic Profile of Respondents

1. Personal Profiles of the Respondents

The respondents' socio-economic characteristics are presented in Table 3. About 65% of respondents from the three groups were males. This is because most of the interviews were conducted in the evening when the male family heads were at home. They, in general, participated more actively in interviews than the women.

The average age of all respondents surveyed was 41.82 years. The oldest respondent interviewed was 76 years old and the youngest was 19 years old. A little more than one third of the respondents from each group were between 21 and 35 years of age.

There was only one respondent whose age was below 20 years. According to the respondents most young people (around 20 years old), who had finished nine years (or less) of education, were working in other provinces to earn cash for their families or to support themselves.

Only a very small proportion of the respondents were employed or self-employed. Most relied on farming and forestry activities for their livelihoods.

All respondents from the critical core area group belonged to ethnic minorities (one belonged to the Tujia Sand; eight belonged to the Miao). In the other core area group, 58% and 28% of the respondents belonged to the Tujia and the Miao, respectively. In the buffer zone group, half of the respondents belonged to the Miao ethnic group while 18.60% of the respondents belonged to the Tujia ethnic group.

About 60% of the respondents had obtained primary education. Very few respondents had been to high school.

Table 3: Characteristics of the Surveyed Population, FNNR, Guizhou, China, 2001

Variables	Critical core area group		Other core area group		Buffer zone group		Overall	
	Number	%	Number	%	Number	%	Number	%
Gender								
Male	6	67	37	65	114	66	157	66
Female	3	33	31	35	58	34	81	34
Ethnic groups								
Tujia	1	11	16	28	86	50	103	43
Miao	8	89	33	58	32	19	73	31
Han	0	0	8	1	51	29	59	25
Others	0	0	0	0	3	2	3	1
Job								
Farmer	7	78	53	93	155	90	215	90
Others	2	22	4	7	17	10	23	10
Civil status								
Single	1	11	11	20	12	7	24	10
Married	8	89	43	75	154	90	205	86
Widow	0	0	2	3	5	2	7	3
Divorced	0	0	1	2	1	1	2	1
Age								
20 & below	0	0	0	0	1	1	1	1
21-35	3	33	21	37	60	35	84	36

36-49	2	22	18	32	62	36	82	34
50 & above	4	45	18	31	49	29	71	30
Education								
0 years	1	11	7	12	25	15	33	13
< 17 years	6	67	35	61	102	59	143	60
6-17 years	2	22	14	25	42	24	58	25
10-12 years	0	0	1	2	3	2	4	2

2. Household Characteristics of Respondents

The household characteristics considered included household size, the number of rooms in each house, the year the houses were constructed, the areas of rice paddy and crop land, the sufficiency of cultivated crops for food, total household incomes and expenditures in the year 2000, plans to move to other places, and willingness to be moved. Table 4 is a summary of some of this information.

The mean household sizes were five, four and five persons in the critical core area group, the other core area group and the buffer zone group, respectively. According to Family Planning Policy in China, families in rural area are allowed to have a maximum of two children. One reason for the discrepancy between policy and practice in two of the groups could be the fact that many respondents in these groups were from this Songtao county. This county is an autonomous county of the Tujia and the Miao ethnic minorities and the implementation of the Family Planning Policy in this area is therefore relatively weak. Households in the other core area group were from Jiangkou county, where the implementation of the Policy is stronger.

Table 4: Characteristics of Respondents' Households

Variables	Critical core area group		Other core area group		Buffer zone group		Overall	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Household size(Persons)	5	2	4	2	5	6	5	2
Area Ricepaddy(Mus)	2	1	5	5	2	7	3	2
Area cropland (Mus)	4	3	2	2	2	6	2	1
Cash income (CNY)	3615	1089	3632	2030	3173	1955	3190	7111
Expenditure (CNY)	3691	2385	3463	2427	3413	2520	3416	7886
No of rooms in the house	2	1	3	3	3	5	3	2

Over half of the respondents in the critical core area group (56%) and almost half of respondents in the other core area group (49%) answered “no” when they were asked whether the crops they cultivated in the year 2000 were sufficient to supply food for their families. A big portion of respondents in the buffer zone group (about 73%) answered “no” to the same question. Overall, the crops produced by 67% of the respondents' households in the year 2000 were not sufficient to supply their food requirements.

Therefore, these households had to spend a certain amount of money to buy supplementary food from the market.

In the year 2000, the average cash incomes were about CNY 3,615, CNY 3,632 and CNY 3,173, respectively, for households in the critical core area group, the other core area group and the buffer zone group respectively. Their average expenditures were about CNY 3,691, CNY 3,463 and CNY 3,413, respectively. The figures for the households' cash income may be an under-estimate since the respondents did not completely reveal their real incomes, however this information still gives a good indication that the local people in FNNR did not have much cash left over to save.

When asked whether they had plans to move to other places in the next five years, almost all respondents answered "No". Only one respondent from the other core area group answered "Yes" to this question. This is in contrast to the belief of the management staff of the protected area (and others) that the best way to solve the ongoing conflict between conservation and community development is to relocate people from the area's core zone.

When asked whether they were willing to move out of the reserve if the government would give funding for resettlement, 67% of the respondents from the critical core area group answered "No", as did 61% of the respondents from the other core area group.

The main reasons why some respondents were not willing to be moved were: (1) they felt that the quality of the water and air they used was much better than that outside of the reserve and they valued the health benefits this provided; (2) they did not know what livelihoods would be available outside the reserve; (3) they were uncertain that they would be provided with rice paddies or crop lands so that they could grow food; (4) they were accustomed to living in their current homes, which had been theirs since birth, and they simply do not want to live in other places.

The main reasons given by those willing to move were: (1) living conditions would be much more convenient outside the reserve, because currently there are no roads and electricity in villages inside the protected area; (2) their children would get a better education outside the reserve. Currently there are no schools in their villages and children have to walk at least 6 km to go to school every day; (3) there would be more employment opportunities outside the reserve; (4) life would be harder in their villages in the future since the management bureau of the reserve had already begun to implement stricter conservation measures and no alternative means of making a living has been offered to them yet.

The above findings show that resettlement is not a simple economic problem but is also affected by complicated social, cultural and physiological factors. In light of this, the government should pay close attention to these other social factors if the resettlement measure is adopted.

3. Characteristics of the Villages Surveyed

The survey showed that there were no primary schools in the villages in the core area groups and that there were only primary schools in the buffer zone area. On average, children in the villages of the critical core area, the other core area and the buffer zone area had to walk a distance of 7 km, 6 km and 2 km (one way), respectively, to go to primary school. The average distances between the villages in the critical core area group and their nearest market was about 24 km. The distance between villages in the other two groups and their nearest market was 15 km. Given such long distances and the poor roads, people in most villages in the reserve kept their purchasing activities to a minimum. They therefore depended heavily on the natural resources in the reserve for their everyday needs.

4. Incomes Earned by Local People in 2000

Although this study focused on the foregone benefits experienced by local people from the forestry sector, information on incomes from other activities, such as crop cultivation, husbandry, fishery and apiary, and labor services, is important if a whole picture of household income is to be gained. The survey results show that in 2000 an average household earned a total income of CNY 12,232. 74% of this was the estimated monetary value of products consumed at home, the rest was cash income. Table 5 summarizes incomes gained by households in the three groups in FNNR.

Table 5: Household Activities and Associated Incomes of Households in Each Group in the Year 2000, FNNR, China

Activities	Home Consumption						Cash Income						Total Household Income			
	Critical core area		Other core area		Buffer zone		Critical core area		Other core area		Buffer zone		Critical core area		Other core area	
	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%
Crop Cultivation	1,782	20	2,238	23	1,614	18	0	0	14	1	17	1	1,782	14	2,253	
Forestry	6,327	72	6,723	69	6,594	74	1,724	48	1,905	52	1,419	45	8,050	65	8,283	
Husbandry	693	8	764	8	718	8	324	9	508	13	297	10	1,018	8	1,273	
Fishery & apiary	0	0.0	1	0	1	0	0	0	10	1	2	0	0	0	11	
Labor Service	0	0.0	0	0	0	0	911	25	514	14	893	28	911	7	514	
SAL&SUB&INT	0	0.0	0	0	0	0	444	12	94	2	103	3	444	4	94	
Other Activities	0	0.0	0	0	0	0	211	6	586	16	443	13	211	2	586	
Total	8,802 ^a	100.0	9,726 ^a	100	8,921 ^a	100	3,615 ^a	100	3,632 ^a	100	3,173 ^a	100	12,417 ^a	100.0	13,013 ^a	10

Remarks:

(1) The same letters in rows show that the mean values are not significantly different at 5% significance level among three groups.

(2) Percent (%) means the percentage of income of each activity relative to the total from all activities in each column.

(3) Total household income is the summation of estimated monetary value of home-consumed products and cash income from marketing or other sources in year 2000.

(4) SAL&SUB&INT: incomes from salary, subsidy and interest in the year 2000.

The above table shows that on average, forestry income accounted for about 65% of the total household income for households in all three groups. This indicates that, at least in the year 2000, forestry activities in FNNR played the most significant role in local people's livelihoods, followed by crop cultivation. In terms of the average cash income and average income of home-consumed products, the highest contributions were also from the forestry sector for households in all three groups. For average cash income alone, cash income from the forestry sector contributed about 50% of the total household cash incomes in all three groups. The second highest contribution to the average total household cash income came from labor services outside of the province.

Table 6 is a summary of the forestry income earned by households in the three different groups in FNNR. In 2000, households in all three different groups earned almost the same amount of average forestry income (about CNY 8,050). This finding indicated that the households in the three groups might undertake similar forestry activities and that the scale of their harvests might be similar. Statistical analysis also showed that there was no significant difference in the average forestry cash incomes between households in the critical core area group and those in the buffer zone group. However there were significant differences in the average forestry cash incomes among households in the critical core area group and the other core area group, and households in the other core area group and the buffer zone group. This may be due to the reason that the households in the critical core area group and the buffer zone group generated forestry incomes mainly from bamboo (about 40%) and charcoal production (about 40%) while households in the other core area group earned their forestry cash income from bamboo (31%), animal poaching (27%) and also from charcoal production (14%).

6. Bamboo Production and Firewood Collection in FNNR in 2000

(1) Bamboo Production

Bamboo and bamboo products were important cash sources in a range of villages in the FNNR in the year 2000. On average, the local people in the reserve gained about CNY 494 of cash income from the economic use of bamboo. The cash income from these activities accounted for about 35% of the households' total forestry cash incomes (see Table 6). Statistical analysis shows that households in the critical core area group had the highest average cash income (about CNY 692.22) from these activities, followed by households in the buffer zone group (about CNY 514). Households in the other core area group earned the lowest average cash income from bamboo production (about CNY 479). Compared with other forest cash incomes, the average cash income from the economic use of bamboo made the highest contribution to the average forestry cash income of households in the critical core area (40% of critical core group and 31% of other core area group). For households in the buffer zone group, cash income from bamboo accounted for the second highest proportion (about 36%) of the household total

forestry income. For households in this group, the most important source of forestry cash income was charcoal production.

Table 6: Forestry Activities and Household Incomes in Each Group in the Year 2000, FNNR, China.

Activities	Home Consumption						Cash Income						Total Household Income					
	Critical core area		Other core area		Buffer zone		Critical core area		Other core area		Buffer zone		Critical core area		Other core area		Buffer zone	
	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%
Charcoal production	1,094 ^a	17	1,054 ^{ab}	16	1,314 ^{ac*}	20	677 ^a	39	229 ^b	15	535 ^{ac}	38	1,771 ^{ab}	22	1,283 ^a	15	1,837 ^{bc}	23
Without kilns	593 ^a	10	936 ^a	14	1,140 ^a	17	35 ^a	2	0 ^a	0	75 ^c	5	628	8	936	11	1,214	15
With kilns	500 ^a	8	117 ^{bc}	2	174 ^c	3	642 ^a	37	229 ^{b*}	15	460 ^{c*}	32	1,143	14	347	4	634	8
Log	0	0	0	0	0	0	11 ^{a*}	1	273 ^{b*}	18	133 ^{ac}	9	11 ^a	1	273 ^b	3	133 ^{ac}	2
Firewood	5,233 ^a	83	5,670 ^a	85	5,280 ^a	80	0	0	0	0	0	0	5,233	65	5,670	70	5,280	66
Wood product	0	0	0	0	0	0	0 ^a	0	0 ^a	0	46 ^b	3	0 ^a	0	0 ^a	0	46 ^{bc}	1
Bamboo products	0	0	0	0	0	0	692 ^a	40	179 ^b	12	494 ^c	34	692	9	479	6	494	6
Raw bamboo	0	0	0	0	0	0	0 ^a	0	300 ^b	19	20 ^{ac}	1	0 ^a	0	68 ^b	1	20	1
Herbs & wild vegetable	0	0	0	0	0	0	309 ^a	18	57 ^{ab*}	4	137 ^{ac*}	10	309	4	57	1	137	2
Animal poaching	0	0	0	0	0	0	35 ^a	2	422 ^b	27	72 ^{ac}	5	35	0	422	5	72	1
Other forest activities	0	0	0	0	0	0	0 ^a	0	100 ^b	6	2 ^{ac}	0	0	0	100	1	2	0.0
Total	6,327 ^a	100	6,723 ^a	100	6,594 ^a	100	1,724 ^{a*}	100	1,559 ^{ab}	100	1,419 ^{c*}	100	8,050 ^a	100	8,078 ^a	100	8,032 ^a	100

Remarks:

- (1) The same letters in rows in each part of the incomes show that the mean values are not significantly different at 5% significant level among the three groups.
- (2)* Significantly different at 10% significant level.
- (3) Percent (%) means the percentage of income of each activity among that from all activities in each column.
- (4) Total household income is the summation of estimated monetary value of forest products and cash income from selling forest products in the market.

(3) Firewood Collection

Table 7 provides a summary of information on firewood collection in the year 2000. Firewood has become increasingly scarce in forests adjacent to the reserve following the implementation of restriction measures within its borders. Before the establishment of the reserve, local people were free to collect firewood both from the collective-owned forest and from the state-owned forests. After the reserve was established, they were only allowed to collect firewood in the collective-owned forests. These were distributed to them as “responsibility hills”. In recent years, local people have had to walk further to reach “responsibility forests” that have not had their stocks of firewood depleted. In 2000, households in the other core area group had to spend about 72 working days to collect firewood for cooking purposes while those in the buffer zone group spent about 135 working days.

Table 7: Household Firewood Collection in the Year 2000

Firewood	Critical core area	Other core area	Buffer zone
Annual consumption (tons)	17 ^a	18 ^a	17 ^a
Standard deviation of annual consumption	7	6	54
Average collection time (working days)	97 ^a	72 ^b	135 ^c
Standard deviation of collection time	40	42	54
Mean monetary value (CNY)	5,233 ^a	5,670 ^a	5,280 ^a
Standard deviation of the mean value	2,180	1,750	1,647
Forest products consumed in the home as a share of household's total income (%)	83	84	80
Firewood as a share of household's total income from forest exploitation (%)	65	68	66

Remark:

The same letters in the row means no significant difference of monetary value of firewood for an average household across three groups in FNNR.

7. Intensity of Illegal or Semi-illegal Activities Undertaken by Households

Charcoal production (both in kilns and in open pits), the harvesting of logs and wood products, and the poaching of animals were considered as illegal or semi-illegal forestry activities by the reserve. Nonetheless, the local people in the reserve were commonly engaged in these activities to generate cash, despite the risk of being penalized. Table 8 summarizes the information on the proportion of households engaged in these illegal activities.

Table 8: Proportions of Households Engaged in Illegal Activities

	% of household in critical core area group	% of households in other core area group	% of households in buffer zone group
Not engaged in any illegal activities	11	8	33
Engaged in one kind of illegal activity	33	26	40
Engaged in two kinds of illegal activity	56	33	20
Engaged in three kinds of illegal activity	NA	33	6
Total	100	100	100

In the critical core area group, making charcoal with kilns for commercial purposes was the most common activity undertaken, while no households cut timber to make wooden products for marketing. Only one household in the critical core area group was not engaged in any commercial exploitation of the forest. This was explained by the fact that all the members of that household were working as laborers outside the province. This indicates that if the households in this group had other income sources, they might depend much less on the protected resources. Animal poaching did not appear to be a problem in villages in this group. According to the respondents, the Guizhou Snub-nosed Monkeys sometimes passed by the respondents' cropland or rice paddys, especially when the monkeys were short of food. The local people were aware that they should not set traps or other devices that might hurt these animals. This awareness was largely due to the vigorous education activities carried out by reserve staff.

Households in the critical core area group were more intensively engaged in "illegal" activities than households in the other two groups. This was thought to be due to the following reasons: first, as discussed earlier, in comparison to the other two groups, this group of households could not earn as much from bamboo production since less bamboo grew in the dense forest around them; second, patrols and other restriction measures taken by the reserve were less intense in this group's area; and third, compared with households living in the buffer zone, this group of households had less opportunities to earn cash from non-forest activities.

During the survey, the respondents in the critical core area group said that they would be impoverished if the new conservation program was implemented and stricter restrictions placed on their use of forest resources, especially those deemed "illegal". They said that the reserve management bureau should help them to find alternative means of making a living if more restrictions were imposed on them in the future. If this did not happen, they said they would not stop using forest resources in the reserve even if this meant being punished.

Table 8 shows that the households in the buffer zone group were the least intensively engaged in “illegal” activities in the forest of the reserve. This was mainly because they had a more diversified range of income sources from places outside the reserve.

5.1.2. Opportunity Cost Born by the Local People in FNNR

Table 9 provides a summary of the average reductions in forest product harvests which the different household groups are required to make during the implementation of the new conservation program.

Table 9: Average Reduction Required in Quantity of Forest Products Harvested

Products	Year 2001			Year 2002			Year 2003, 2004			Year 2005		
	Critical Core area	Other core area	Buffer zone	Critical core area	Other core area	Buffer zone	Critical core area	Other core area	Buffer zone	Critical core area	Other core area	Buffer zone
WCPW/oKHU (m ³)	NA	NA	NA	NA	NA	NA	NA	NA	NA	10	NA	NA
WCPW/Okmkt (m ³)	NA	.	NA	NA	.	NA	NA	.	NA	NA	.	NA
WCPW/KHU (m ³)	5	1	2	1	NA	NA	NA	NA	NA	NA	NA	NA
WCPW/KMKT (m ³)	5	2	4	1	NA	1	NA	NA	NA	NA	NA	NA
Firewood (m ³)	NA	3	2	NA	3	2	NA	3	2	23	3	2
Marketed timber (m ³)	1	NA	NA	1	NA	NA	1	NA	NA	1	NA	NA
Sub total (m³)	11	6	8	3	3	3	1	3	2	34	3	2
Bamboo & Bamboo Product (pieces)	NA	NA	NA	NA	NA	NA	NA	NA	NA	72	NA	NA

Remark:

- (1) Cells with "." denotes that households did not harvest the products in the year 2000.
- (2)WCPW/oKHU: wood used for making charcoal without kilns for home use.
- (3)WCPW/oKMKT: wood used for marking charcoal without kilns for marketing purposes.
- (4)WCPW/KHU: wood used for marking charcoal with kilns for home consumption.
- (5)WCPW/KMKT: wood used for marking charcoal with kilns for marketing purposes.

Table 10 presents the amount of benefit foregone by households in the three groups under the new conservation program (for detailed results of financial analysis, see the appendix). Although the absolute value of the opportunity cost born by the local people is not big compared to household income in developed countries, in regions such as FNNR it represents a significant proportion of total household income. Therefore, the opportunity cost born by households for the new conservation program will have a great impact on households' welfare.

Table 10: Opportunity Cost Borne by Local People in FNNR (2001-2005)

	Critical core area group	Other core area group	Buffer zone group
Average NPVs of households' opportunity cost	CNY 2,577 (US\$ 311)	CNY 1,826 (US\$ 220)	CNY 810 (US\$ 98)
NPVs of opportunity cost of all households	CNY 2,8347 (US\$ 3419)	CNY 19,5382 (US\$ 23,568)	CNY 247,212 (US\$ 28,205)
Average annulaized NPVs of households' opportunity cost	CNY 612 (US\$ 74)	CNY 434 (US\$ 52)	CNY 192 (US\$23)
Average household total income compounded to 2001	CNY 8,533 (US\$ 1,033)	CNY 8,562 (US\$ 1,037)	CNY 8,514 (US\$ 1,030)
Proportion of opportunity cost to total household income (%)	7.58%	5.42%	2.26%

The results show that, on average, households in the critical core area group (*Figure 2*) will bear the highest opportunity cost. This is because this group will have the tightest restrictions imposed on them because they live closest to the critical habitat of the Guizhou Snub-nosed Monkey. The reserve management has decided to relocate this group of people to places outside the reserve in 2005. The total relocation cost is estimated to be CNY 300,000. As discussed earlier, some households in this group said that they did not want to be relocated, therefore, the government must take this fact into account when making its plans.

The sensitivity analysis showed that when the proportion of firewood collected from inside FNNR by households in the buffer zone area was reckoned at 70%, it accounted for approximately 66% of the total forest income of these households. According to the results presented in Table 11, a change of 30% in the quantity of firewood collected, changed the opportunity cost born by households by about 57%. This indicates that for this group of households, the proportion of firewood collected from inside the reserve is an important factor in the opportunity cost born by these households. This also implies that the establishment of firewood forest outside the reserve or on its boundary will have a much less significant impact on households' welfare. This is important since there might be some "leakage" outside the reserve if the collection of firewood in the reserve is simply restricted and no alternatives to firewood (such as alternative fuels) are provided.

Figure 2: Households in the Critical Core Group

Table 11: Results of Sensitivity Analysis

	Critical core area group		Other core area group		Buffer zone group	
	Mean	Total	Mean	Total	Mean	Total
	CNY	CNY	CNY	CNY	CNY	CNY
Interest rate						
6.03%	2,577	28,345	1,826	195,368	810	2,455,576
3%	3,028	33,304	2,018	215,921	902	2,735,868
Firewood collection						
100% collection	.	.	.	.	810	2,455,576
70% collection	.	.	.	.	461	1,398,475

Table 11 is the summary of the results of the sensitivity analysis. It shows that the lower discount rate (the government poverty alleviation loan rate) results in households losing a higher amount of net forest income, given the same amount of reduction of resource utilization. It can be inferred that the lower discount rate could help encourage the local people to reduce the rate at which they utilize the current forest resources. This is where government financial policies could help resource conservation in the protected areas.

5.2. Empirical Findings of Contingent Valuation Study

5.2.1. Brief Information of Guizhou Province and Longli County

Guizhou Province, located in Southwest China, has a total geographic area of 176,100 km² and a total population of 3,798,5100. Among all 33 mainland provinces (cities and regions), Guizhou's population size was ranked as 17th. The annual net income per capita of rural residents and the annual disposable income per capita of urban residents in Guizhou Province ranked 30th and 24th, respectively in mainland China.

Longli's total population in 2000 was about 199,700, 91% of which was rural population. However, the urbanization level of Longli is relatively higher than many other counties in the province. In 2000 the net income per capita of rural people in Longli was CNY 1,375, which is almost the same as the provincial average level (CNY 1,374.16). For the urban population in the county, the average net income per capita was also close to the average level of the whole province.

5.2.2. Respondents' Personal and Household Profile

The total sample size of interviewees in Longli County was 244 and 247 in rural and urban areas, respectively. Table 12 summarizes the socioeconomic characteristics of the respondents and their average amount of WTP. Male respondents accounted for 56% and 85% of the total respondents surveyed in urban and rural areas respectively. Men recorded higher levels of WTP compared with women.

The average age of urban and rural respondents was 46 years and 43 years, respectively. More than half of the respondents in both urban and rural areas were middle-aged. In urban areas, the older respondents had a higher WTP than the younger ones. In rural areas, although the older respondents' mean WTP was lower than that of younger people, the difference between them was not big. About 90% of respondents were married. In urban areas the mean WTP of married respondents was lower than that of unmarried or divorced respondents. The same was true in rural areas, although the difference was not as big.

On average more than half of the urban respondents had finished their secondary school education (nine years) and about 60% of the rural respondents had finished their primary school education (six years). From 244 rural respondents, only three had completed college education. Only 9% of rural respondents were employed (including the self-employed) or had some skills. Most of them (91%) gained their household income from agricultural production. In urban areas about 54% of the respondents were employed or had some skills.

Table 12: Respondents' Socioeconomic Characteristics in CVM Study

Variables	Urban Respondents			Rural Respondents		
	Number	%	Mean WTP	Number	%	Mean WTP
Gender						
Male	138	56	35 (44)	208	85	12 (15)
Femal	109	44	30 (64)	36	15	7 (11)
Ethnic Group						
Han	206	83	34 (57)	143	59	10 (14)
Ethnic minorities	41	17	30 (35)	101	41	12 (16)
Civil Status						
Married	224	91	31 (39)	218	89	11 (15)
Other	23	9	54 (125)	26	11	9 (9)
Job						
Farm job	133	54	34 (44)	22	9	12 (13)

Non-farm job	114	46	31 (64)	222	91	11 (15)
Age						
18-34	57	23	27 (32)	87	36	13 (16)
35-59	144	58	32(62)	127	52	10 (14)
60&above	46	19	44(48)	30	12	10 (14)
Mean Age	46 (14)			43 (13)		
Education						
0 years	11	4	20 (34)	20	8	8 (11)
1-6 years	60	24	30 (79)	147	60	11 (15)
7-12 years	134	54	25 (32)	74	30	12 (15)
>12 years	42	17	65(59)	3	1	13 (15)
Mean Education	9 (4)			5 (3)		

In Longli County, most people from ethnic minorities live in rural areas. Some minority people have their own nature conservation customs. For example, in Jiabai Village in Wanzhai Township, the Buyi ethnic minority has established its own norms and regulations on the harvest of trees for home use. Village members are also obliged to conserve their forest under the norms of their own group. In Jiabai, the mean WTP of the respondents was CNY 18 (other villages had a mean of CNY 11). This highlights the importance of people's awareness of natural resource conservation on their willingness to pay for the conservation. Table 13 is a summary of the respondents' household profile.

Table 13: Respondents' Household Profile of CVM Study

	Urban	Rural
Average household size (persons)	4 (1)	5(2)
Average annual net income per capita (CNY)	3,227 (2,750)	917 (938)
% of households who own houses	72	96
Average housing area per capita (square meters)	26 (21)	28 (22)
Average estimated value of respondents' own houses per capita (CNY)	12,410 (26,432)	2,081 (2,667)
% of households having TVs	98	69
% of households having phones	86	9

Remarks: Standard deviation of mean values in parentheses.

In 2001, the surveyed households in rural areas and urban areas gained an average net income of CNY 917 and CNY 3,227, respectively. Reported incomes were systematically lower than real annual net incomes since almost all households were very reluctant to reveal the real figures. It was observed that in the urban area respondents

only revealed their nominal income rather than their actual monthly salaries. In rural areas the respondents only revealed their incomes from agricultural production. They did not completely include other income such as money sent by family members working in cities.

The average size of rural and urban households was five and four persons respectively. This was almost the average household size (three persons) in urban Guizhou in 2001. About 86% of the urban families had telephone connections, while in rural areas only 9% of households had telephones installed in their houses. In one village surveyed, no households had a telephone. Almost all urban families owned a TV. In rural areas, 74 respondents' families did not have TVs. Almost all of these respondents had not heard of protected areas and conservation. The survey found that 110 out of 244 rural respondents only had the TV as their source of information about protected areas and conservation. In urban areas more than 60% of the respondents had at least two sources to obtain this information. Therefore, it can be inferred that information dissemination about conservation issues is more of a challenge in rural areas than in urban areas.

The survey gauged respondents' views on socioeconomic and environmental conservation issues by asking them to select the most urgent problem from a list of 10 issues that the government should solve within next ten years. These were: work lay-offs, poverty, social order, bribery, degradation of forest and grassland, pollution, drug addiction, lack of opportunities for poor children to go to school, overall economic development of the country and health care. The results of this part of the survey are summarized in Table 14.

Table 14: Respondents' Perceptions on Socioeconomic Issues And Environmental And Resource Conservation

	Urban respondents	Rural respondents
The first problem need be solved by the government within next ten years	Work lay-offs (20% of the respondents)	Poverty
The second problem need be solved by the government within next ten years	Corruption (18% of the respondents)	Children of poor families are unable to go to school
The third problem need to be solved by the government within next ten years	Pollution	Degradation of forest
The most important reason causing environmental degradation	Economic development	Economic development
% of respondents who have heard biodiversity before	28%	17%
% of respondents who have heard of protected areas	94%	70%

before		
% of respondents who have been to a protected area before	45%	14%
% of respondents who have heard of FNNR before	83%	55%
% of respondents who have been to FNNR before	10%	1%
% of respondents who believe that the government can implement the conservation program in FNNR successfully	85%	83%
% of respondents who think using taxation to support conservation is fair	66%	82%

In urban areas, the respondents' first priority was the issue of work lay-offs and their second priority was corruption among government officials. About 40% of the rural respondents considered that the government should first solve the problem of poverty. Their second priority was to create more opportunities for rural children to go to school, which in fact is also closely related to poverty alleviation. This indicates that in Longli County, both urban and rural respondents attached the highest importance to their economic development. This is probably because unemployment and low incomes are major problems for many people in the county.

Despite this the respondents still had an awareness of the importance of environmental protection and natural resource conservation. The survey found that the third most important problems for urban and rural respondents were pollution and the degradation of forest, respectively. This implies that if people get better incomes they would probably attach higher importance to environmental resource conservation and, in turn, would be more willing to make voluntary contributions to conservation. Therefore, for conservation measures to ultimately succeed, it is very important for the government to help people increase their incomes

During the questionnaire survey, the respondents were also asked to express their opinions on the most significant cause to environmental degradation. Both rural and urban respondents highlighted economic development. They added that the local government should make comprehensive environmental planning part of the process of economic development.

When they were asked whether they had some idea of what biodiversity was, 28% of the urban respondents and 17% of the rural respondents answered "Yes". About 94% of urban and 70% of rural respondents said that they had heard of protected areas. About 45% of the urban respondents and 20% of the rural respondents had been to one. About 83% of the urban respondents and more than 50% of the rural respondents had

heard of the name of FNNR. This high proportion might be due to the fact that FNNR is used as a Logo for the Tongren Prefecture in daily TV weather broadcasts.

Before the respondents were asked to vote for the taxation scheme, they were asked to rank several statements. One stated that the government is capable of implementing the designed conservation program. The other stated that using taxation to fund biodiversity conservation in protected areas is fair. Table 15 summarizes the results of this exercise.

Table 15: Mean WTP and Percentage of Respondents Having Different Perceptions

Statements			1. The government can implement the designed conservation program in FNNR successfully.	2. Using taxation to channel funding for conservation in protected areas is fair.
Urban respondents (n=247)	Agree	Percentage (%)	83	66
		Mean WTP (CNY)	33 (54)	40 (61)
	Disagree	Percentage (%)	17	34
		Mean WTP (CNY)	38 (52)	17 (27)
Rural respondents (n=244)	Agree	Percentage (%)	85	82
		Mean WTP (CNY)	11 (15)	12 (16)
	Disagree	Percentage (%)	15	18
		Mean WTP (CNY)	5 (5)	6 (9)

Remark: The numbers in the brackets are standard deviation of the mean.

The survey results showed that more than 80% of respondents believed that the government could implement the proposed conservation program in FNNR successfully. Respondents who had high confidence in the government's capabilities, had a higher mean WTP than that of those who had less confidence in the government. More than 60% of the urban respondents and over 80% of the rural respondents said that it was fair to use taxation to channel funding for biodiversity conservation in protected areas. Those who were positive about the use of tax to pay for conservation had a higher mean WTP than those who were negative.

The influence of these two factors – people's confidence in the government and their perceptions on the fairness of using taxation to support conservation – on people's willingness to pay for the biodiversity conservation program in FNNR was tested using multiple regression analysis (results below).

5.2.3. Respondents' Vote for the Taxation Scheme

In China, eco-compensation has become an increasingly important issue and the government is therefore initiating an eco-tax program to support conservation. In light of these developments such a tax was proposed as a payment instrument in this survey. To gauge support for such a scheme, respondents were briefed on the need for conservation work in the reserve and on the details of the proposed new FNNR conservation program and how it would be funded. They were then asked to vote on whether they would back the taxation scheme outlined in the following scenario:

Taxation Scenario

Guizhou Provincial Government plans to impose a new local tax, called Eco-value-added Tax, from 2003 to 2010. The tax will be collected on a per capita basis from all households within the province. The only purpose of this temporary taxation scheme is to channel money from the public for the "For Our Green Hope Fund". All tax collected will be transferred to the Fund to implement the new conservation program in FNNR.

Respondents were told that if they voted "Yes", this implicitly meant that they planned to pay some amount of tax within the next eight years. Those who voted "Yes", were asked how much they would be willing to pay *per year* for the new conservation program. They were also asked why they would be willing to pay.

The survey results show that about 82% of the urban respondents (202 of 247 respondents) and about 89% of the rural respondents (217 of 244 respondents) voted "Yes" for the taxation scheme (see Table 16).

Table 16: Percentage of Respondents Who Are Willing to Pay or Not Willing to Pay

	Urban respondents		Rural respondents		Overall	
	Number	%	Number	%	Number	%
Willing to pay	202	82	217	89	419	85
Not willing to pay	45	18	27	11	72	15
Total	247	100	244	100	491	100

Among the 27 rural respondents who voted "No", 25 respondents stated that they could not afford to pay, but would if they could. Other respondents said that biodiversity conservation was none of their families' business since they got no benefit from it. In

urban areas, the picture was more complicated. About 56% of the respondents who voted “No” said that they could not afford to pay given their low family income. More than one-third of the respondents said that they did not believe that the government would use the tax collected for biodiversity conservation in FNNR. Some urban respondents added that biodiversity conservation should be the government’s responsibility and not theirs.

Table 17: Respondents’ Reasons for Voting “No” for the Taxation Scheme

Statement	Urban respondents		Rural respondents	
	Number	%	Number	%
1. Biodiversity conservation in FNNR has none of my family's business	5	11	2	7
2. I don't think biodiversity conservation in FNNR is part of my family's responsibility	7	16	1	4
3. I don't believe that the tax I pay will be really used for biodiversity conservation in FNNR	15	33	2	7
4. My family are unable to pay	25	56	26	96
5. I refuse to answer this question	2	4	0	0
6. Other reasons	11	24	1	4

All of those respondents willing to pay for biodiversity conservation in FNNR had one or two reasons for saying “Yes”. More than 80% said that conserving biodiversity in FNNR was the common responsibility of all Chinese people. About 50% of all respondents said that they wanted to save biodiversity in FNNR for future generations. More than one-third said that they simply felt happy knowing that biodiversity existed in FNNR. Only two respondents cited all six reasons listed in the Table 17. To some extent, the relatively high proportion of respondents who had more than one reason why they were willing to pay for biodiversity might have been caused by the potentially leading questions posed by the survey team.

Table 18: Respondents’ Reasons for WTP for Biodiversity Conservation in FNNR

Reasons	Urban respondents		Rural respondents	
	Number	%	Number	%
1. I can take personal pleasure in knowing or seeing biodiversity	70	35	75	35

In FNNR that will continue to exist in the future.				
2. Biodiversity in FNNR should have its own right to exist whether it is useful or not for human society now and in the future.	40	20	32	15
1. Although I and my family don't use biodiversity in FNNR, I'd like it to be conserved in order to have more options for its potential uses in future	40	20	43	20
4. I want to save biodiversity in FNNR for my future's generations	100	50	111	51
5. It is our common responsibilities to conserve biodiversity in FNNR	172	85	173	80
6. Other reasons	17	8	23	11

Remark:

In the table $x\%$ = the number of respondents giving corresponding reasons/ the total number of the respondents who are willing to pay

5.2.4. Multivariate Regression Analysis

Multivariate regression analysis was conducted to: (1) explore the statistical significance of factors that might affect the respondents' WTP; (2) estimate the expected WTP of different groups; and (3) clarify the marginal change of WTP and the probability to pay with respect to different independent variables.

The Hurdle model was applied in the regression analysis (Table 20 lists the definition of variables used in the Hurdle model). Results of an LR test of the participation equation and the WTP equation show that the null-hypothesis that these two equations are independent is rejected at the 1% significant level (see Table 19), therefore, the following LM function was used in the regression analysis:

$$L(\alpha, \beta, \sigma^2, \rho) = \prod_{i=1}^N \left[1 - \Phi(z_i' \alpha, x_i' \beta / \sigma, \rho) \right]^{1-I_i} \prod_{i=1}^N \left[\Phi\left(\frac{z_i' \alpha + \rho(y_i - x_i' \beta) / \sigma}{\sqrt{1 - \rho^2}}\right) \frac{1}{\sigma} \phi\left(\frac{y_i - x_i' \beta}{\sigma}\right) \right]^{I_i}$$

Table 20: Definition of Variables Used in Hurdle Model

Variables	Definitions and Units	Urban respondents (n=247)		Rural respondents (n=244)	
		Mean	S.D.	Mean	S.D.
gender*	male=1, female=0	0.56	0.50	0.85	0.36
ethcata*	ethnic group that the respondent belong to 1=Han ethnic group 0= Ethnic minorities	0.83	0.37	0.41	0.49
donabf*	whether have donation experience before have=1, do not have=0	0.52	0.50	0.38	0.49
famnrcns*	familiar with conservation familiar=1 unfamiliar=0	0.73	0.44	0.58	0.49
hhsz	household size (persons)	3.50	1.29	4.60	1.76
age	respondent's age (years)	46.34	13.53	43.09	12.78
respoedu	respondent's education(years)	8.98	4.09	5.48	3.24
spousedu	respondent's spouse's education (years)	7.41	4.59	3.11	3.32
rejobca*	respondent's job types 1=non-farm job 0= farm job	0.56	0.50	0.14	0.36
incapita	annual net income per capita (CNY)	3227.48	2750.00	917.78	937.64
surank*	rank whether the government can implement conservation program in FNNR successfully successfully=1 unsuccessfully=0	0.85	0.36	0.83	0.38

Remark: Variables with mark of * are discrete variables.

In a linear regression model, the coefficients of corresponding independent variables are exactly the marginal effects of the independent variables on dependent variable. However, in such a non-linear regression model as double hurdle model, the fitted value of the dependent variable is a nonlinear function of the coefficients, therefore, the coefficients cannot be interpreted as the marginal effects. In order to evaluate the real effects of marginal change of the independent variables on WTP and probability to participate, the marginal effects of every independent variable at the respective sample mean were calculated from the derivative of

$$E(y_i) = \int_0^{\infty} \Phi\left(\frac{z_i'\alpha + \rho(y_i - x_i'\beta)/\sigma}{\sqrt{1-\rho^2}}\right) \frac{y_i}{\sigma} \phi\left(\frac{y_i - x_i'\beta}{\sigma}\right) dy_i \quad \text{and} \quad P(y_i > 0) = \Phi(z_i'\alpha, x_i'\beta/\sigma, \rho)$$

with respect to the independent variables and evaluated at the means of independent variables. Table 20 and Table 21 present the results of regression analysis and the marginal effect of dependent variables on WTP.

As shown in Table 20 that Wald statistics with 11 degrees of freedom is 58.40 and 59.54, respectively, for rural and urban respondents, at the 1% significant level. This indicates the null hypothesis that the non-intercept coefficients are jointly zero, therefore, the independent variables included in the double hurdle model that was applied in the analysis, are highly significant in explaining the respondents' WTP for biodiversity conservation program in FNNR.

Table 21: Estimation Results of Hurdle Model for Rural and Urban Respondents

Variables	Rural respondents (n=244)			Urban respondents (n=247)		
	Coefficient	t-value	p-value	Coefficient	t-value	p-value
WTP equation						
gender	6.61 ^{**}	2.37	0.02	3.52	0.44	0.66
ethcata	-0.21	-0.11	0.92	-6.49	-0.66	0.51
age	-0.14 [*]	-1.68	0.09	0.48	1.57	0.12
hhsz	-0.45	-0.77	0.44	-6.74 ^{**}	-2.13	0.03
surank	3.52	0.61	0.54	30.47 ^{**}	2	0.05
famnrcons	5.76 ^{***}	2.77	0.01	16.68 [*]	1.89	0.06
donabf	0.94	0.43	0.66	8.18	1.03	0.3
respoedu	-0.001	0	1	1.26	1.16	0.25
spousedu	0.66 ^{**}	1.99	0.05	0.48	0.54	0.59
rejobca	-3.03	-1.1	0.27	-17.06 ^{**}	-2.03	0.04
incapita	0.006 ^{***}	4.93	0	0.006 ^{***}	3.75	0
_cons	-1.61	-0.21	0.83	-40.62	-1.53	0.13
participation equation						
gender	0.44 ^{**}	2.23	0.03	0.06	0.39	0.7
ethcata	-0.008	-0.06	0.95	-0.09	-0.5	0.61
age	-0.009 [*]	-1.63	0.1	0.01 [*]	1.77	0.08
hhsz	-0.03	-0.86	0.39	-0.13 ^{**}	-2.2	0.03
surank	0.27	0.67	0.51	0.59 ^{**}	2.1	0.04
famnrcons	0.41 ^{***}	2.81	0.01	0.35 ^{**}	2.15	0.03
donabf	0.04	0.28	0.78	0.2	1.34	0.18
respoedu	0	-0.05	0.96	0.02	1.24	0.22
spousedu	0.04 [*]	1.91	0.06	0.01	0.57	0.57
rejobca	-0.24	-1.25	0.21	-0.33 ^{**}	-2.11	0.04
incapita	0.0003 ^{***}	3.92	0	0.0001 ^{***}	3.31	0
_cons	-0.12	-0.23	0.82	-0.91 [*]	-1.85	0.06
/lnsigma	2.66 ^{***}	55.9	0	4.00 ^{***}	73.79	0
LR test of indep. eqns. (rho = 0): chi2(1) = 89.87 Prob>chi2=0.00				LR test of indep. eqns. (rho = 0): chi2(1) = 114.67 Prob>chi2= 0.00		

Log likelihood = -907.1098	Log likelihood = -1128.519
Wald chi2(11)=58.40	Wald chi2(11)=59.54
Prob > chi2 =0.00	Prob > chi2=0.00

Table 22: Marginal Effect of Dependent Variables on Respondents' Willingness to Support and their WTP for Biodiversity Conservation in FNNR

Variables	Rural respondents (n=244)			Urban respondents (n=247)		
	dy/dx	T-value	Mean of x	dy/dx	T-value	Mean of x
Marginal change of WTP						
gender*	4.64***	2.46	0.85	2.38	0.44	0.56
ethcata*	-0.16	-0.1	0.41	-4.48	-0.64	0.83
age	-0.10*	-1.65	43.09	0.33	1.58	46.34
hhsz	-0.34	-0.78	4.57	-4.59**	-2.12	3.5
suraca*	2.55	0.65	0.97	18.01**	2.37	0.93
famnr~s*	4.31***	2.72	0.58	10.94**	1.98	0.73
donabf*	0.71	0.42	0.38	5.59	1.04	0.52
respoedu	-0.002	-0.01	5.48	0.85	1.16	8.98
spousedu	0.50*	1.9	3.11	0.33	0.54	7.41
rejobca*	-2.24	-1.16	0.14	-11.70**	-2.02	0.55
incapita	0.004***	4.53	898.61	0.004***	3.74	3227.48
Marginal change of probability for Willingness to Support						
gender*	0.16**	2.11	0.85	0.02	0.39	0.56
ethcata*	-0.003	-0.06	0.41	-0.03	-0.51	0.83
age	-0.003*	-1.63	43.09	0.004*	1.77	46.34
hhsz	-0.01	-0.86	4.57	-0.05**	-2.2	3.5
suraca*	0.1	0.63	0.97	0.23**	2.07	0.93
famnr~s*	0.14***	2.78	0.58	0.13**	2.11	0.73
donabf*	0.014	0.28	0.38	0.07	1.34	0.52
respoedu	-0.0004	-0.05	5.48	0.01	1.24	8.98
spousedu	0.015*	1.9	3.11	0.0034	0.57	7.41
rejobca*	-0.08	-1.2	0.14	-0.12**	-2.13	0.55
incapita	0.0001***	3.91	898.61	0.00004***	3.3	3227.48

The regression analysis shows that the knowledge respondents have about resource conservation and environmental protection is statistically significant in terms of their willingness to pay and the amount that they are prepared to contribute. It indicates

that the more knowledge a respondent has, the more support and money they will give for biodiversity conservation.

The regression analysis results also show that net income per capita is statistically significant in terms of respondents' willingness to pay for conservation and the amount that they are prepared to contribute. This indicates that the respondents' household net per capita income significantly determines their willingness to support biodiversity conservation in FNNR.

The analysis found that in urban Longli, respondents' confidence in the government's capability to implement the conservation strategy is linked to their willingness to pay for biodiversity conservation in FNNR. It also found that in rural Longli, there is no such correlation. This is probably because urban citizens in China have more political freedom than their rural counterparts. They are therefore able to be more selective in how they support government schemes.

From Table 20 it can be seen that if an urban respondent trusts in the government's capabilities their support for the conservation program is 23% higher than those who do not share their confidence. The WTP of those who trust the government on this issue is also shown to be CNY 18 yuan higher than that of the doubters. This implies that it is vital for the government to establish the trust of urban citizens if they are to maximize public support for biodiversity conservation.

It is also interesting to note that the survey shows that in rural Longli, the education level of respondents' spouses affects their willingness to support biodiversity conservation. It indicates that the higher the education level of a female family head, the more financial support that family will be willing to give biodiversity conservation in FNNR. It also shows that better female education in rural areas will greatly boost support for biodiversity conservation.

In rural Longli, gender is shown to be an important factor in determining the support respondents will give to conservation. Table 20 shows that male respondents' WTP is higher than female respondents'. The likelihood of men supporting biodiversity conservation in FNNR is 44% higher than that of women. This might be because in rural areas women are more focused on issues such as the family financial budget, while the men focus more on issues such as politics and conservation. On the other hand, in urban areas, the difference between men and women was not so marked.

Household size was shown to affect urban respondents' willingness to support and pay for biodiversity conservation in FNNR. This was not the case for rural respondents. This might be due to the fact that in urban areas few taxes are collected on a

per capita basis, while in rural areas, the opposite is true. Rural respondents are therefore used to this type of tax and do not give special considerations to household size, while in urban areas this type of tax is new and respondents are therefore highly sensitive to the impact their household size will have on the amount of money they will have to pay.

In urban Longli, the respondents' job type was found to be important in determining their willingness to support and pay for conservation in FNNR. This was not the case in rural Longli. This could be due to the fact that in the analysis, job type was divided into two categories, farm work and non-farm work. In rural Longli, people's job type is highly homogenous under these categories. However, urban respondents who have farm jobs, commonly live in the suburbs of the city and therefore witness at first hand the degradation of their surrounding environment. They also realize the importance of natural resource conservation to agricultural production. This means that they have a different perspective on these issues to city dwellers whose work is not farm-related.

Only in rural Longli, was the respondents' age shown to affect rural respondents' willingness to support and pay for biodiversity conservation in FNNR. It seems that the older a rural respondent was, the less support they would provide. This might be explained by the fact that during the survey, older rural respondents said they did not have any plan to visit FNNR in the future. This was not the case for older urban respondents. These comments also show that some respondents attach more importance to the use value of the protected areas than to its non-use values (such as bequest values).

An analysis was carried out on the marginal effect of each variable on respondents' support and WTP for biodiversity conservation. It gave the following information: (1) When the annual net income per capita is increased by CNY 100, respondents' mean WTP increased by about CNY 0.4. (2) If a respondent has some knowledge of or is familiar with conservation, then the possibility of them be willing to pay for biodiversity conservation in FNNR increased by 14% and their WTP is CNY 4 yuan higher than a respondent who does not have this knowledge; (3) One year's extra education increased the probability that a rural respondent's spouse would support conservation by 1.5%. It also increased their WTP by CNY 0.5 yuan.

In the analysis, the mean WTP, which is the simple average of the observed WTP, was computed (see Table 22). With an infinite sample that presents a normal distribution, the mean WTP of the randomly selected respondents can be good enough to present the average WTP of the total population of the surveyed area. However, in empirical studies such as this research, it is impossible to get an infinite sample that presents an asymptotic distribution. Therefore, the expected value of WTP was also computed based on the means of independent variables which represent the overall socioeconomic and related aspects of the population in the surveyed area. The following equation was used to compute the expected value of WTP:

$$E(y_i) = \int_0^{\infty} \Phi\left(\frac{z_i'\alpha + \rho(y_i - x_i'\beta)/\sigma}{\sqrt{1-\rho^2}}\right) \frac{y_i}{\sigma} \phi\left(\frac{y_i - x_i'\beta}{\sigma}\right) dy_i$$

$$P(y_i > 0) = \Phi(z_i'\alpha, x_i'\beta/\sigma, \rho)$$

Table 22: Respondents' Expected Values and Mean WTP

WTP	Rural respondents (n=244)	Urban respondents (n=247)
Mean WTP (CNY)	11 (15)	33 (54)
Expected Values of WTP (CNY)	12	37

Remarks: The numbers in brackets are standard errors of the mean.

The expected values of WTP is about 9% and 12% higher than the mean WTP in rural and urban Longli respectively. The differences approach to zero asymptotically when the sample size becomes larger and larger. Even based on the mean WTP of both rural and urban respondents, the total WTP of residents of Longli is estimated to be CNY 2.6 million.

6. CONCLUSIONS

6.1. Conclusions from the Opportunity Cost Study

It was discovered that local people in FNNR were heavily dependent on the forest in the reserve for their livelihood. In the reserve, firewood and charcoal are the only two forms of energy used by households for cooking and heating. The firewood is therefore highly significant for the local people's livelihood.

It was found that, on average, forestry income, including the estimated monetary value of forest products for home consumption and cash income from forest products, accounted for about 65% of total household income in year 2000. The cash income from forestry products accounted for 45% (or even higher) of the cash income structure for all households living in FNNR.

According to various conservation laws and regulations in China, in protected areas charcoal production for commercial purposes and animal poaching are stipulated as "illegal" activities. Unfortunately, given limited cash income sources, all households in FNNR were engaged in such "illegal" activities. For households living in the core area, charcoal production with kilns or animal poaching made the second greatest contribution to their forestry cash income. For households living in the buffer zone group, charcoal production made the greatest contribution to their household forest cash income.

If they are not provided with any alternatives, it is believed that these households will have to continue to use forest resources in the reserve and that the Guizhou Snub-nosed money will continue to be under pressure from humans. Moreover, without local support for the conservation, it will be hard for the government and the management bureau of the reserve to successfully implement conservation programs in the FNNR in the long run.

Under the new conservation program, the total net benefit that the local people in FNNR will have to forego is estimated to be CNY 270,000 (US\$ 326,374). Since forestry income accounts for more than 65% of the total income for households in all three groups in year 2000, the reduction caused by the new conservation program will significantly undermine the local people's quality of life. If the local people are not compensated, they will, in all likelihood, feel resentful about the conservation work in the reserve. Conflict between them and the reserve management bureau is therefore likely.

It was found that more than 60% of households in the core area are not willing to be resettled to other places even if they are given support by the government. The respondents revealed that they felt more comfortable living in the reserve, enjoyed its fresh and clean air and had a feeling of security that they could at least support their families by using adjacent forest resources. They feared that if they were resettled, they would not get the farmland they needed to grow food nor the employment they would need to earn money. However, those respondents who expressed a willingness to be resettled said they were attracted by the availability of more jobs and better educational opportunities in places outside the reserve.

6.2. Conclusions from the Contingent Valuation Study

Households in Longli County, who do not live in FNNR, are willing to pay for biodiversity conservation in FNNR mainly because they feel a common responsibility for the work and hope that future generations will benefit from it. The total WTP of Longli's residents for biodiversity conservation in the reserve is estimated to be CNY 2.6 million.

Although some people preferred to contribute to biodiversity conservation by donation rather than by tax payment, most respondents would like to make their contributions through tax payment.

Although the residents in Longli give priority to their livelihoods because of their low household incomes, they still have a high awareness of environmental protection and natural resource conservation issues. This knowledge has a significant influence on their willingness to support and pay for biodiversity conservation in FNNR.

Both in rural and urban Longli, respondents' household per capita income influences their willingness to support and pay for biodiversity conservation in FNNR. The higher a respondent's net income, the higher the probability that they will support biodiversity conservation and the greater the amount of money they will be inclined to contribute.

In rural areas, the level of the female family heads' education and the respondents' gender and age all affect their willingness to support and pay for biodiversity conservation in FNNR.

In urban areas, the respondents' confidence in the government's capability, the respondents' job types and their households' size all affect their willingness to support and pay for biodiversity conservation in FNNR.

6.3. General Conclusions

In Longli County both urban and rural respondents are willing to pay for a biodiversity conservation program implemented in FNNR. Their WTP almost covers the total opportunity cost born by local communities for the new conservation program. Guizhou Province has a total rural population of 29 million and an urban population of 9 million. The total WTP of provincial residents is therefore estimated to be much greater than all the cost that will occur in the implementation of the new conservation program in FNNR. These include local people's opportunity costs and project's implementation costs (CNY 60 million). Therefore, if the local people's losses can be compensated, the implementation of the new conservation program will improve the welfare of the whole society.

7. POLICY RECOMMENDATIONS AND IMPLICATIONS

7.1. Recommendations for Management Schemes

The following is an attempt to provide some recommendations on the possible management schemes that can be adopted by FNNR. These recommendations are based on the observations of this study and on successful experiences in other countries. These include the integrated conservation program implemented in the Makiling Mountain Protected Areas in the Philippines.

In short, it is recommended that the Chinese government and the management bureau of FNNR implement a community-based conservation program that integrates the development of local people's livelihoods in the following possible ways:

To hire and train local people as forest guards so that the forest resources are protected and “illegal” activities more effectively stopped.

To establish new schools in some villages in the reserve since in most villages surveyed there are no schools. With more schools established nearby, new generations can get a better education and so become less dependent on the forest in FNNR for their livelihoods in the future.

To encourage and organize local people to generate cash income from non-timber forest products (NTFPs), such as bamboo, herbs and wild vegetables.

To encourage local people in FNNR to progressively adopt new and more sustainable energy sources for cooking and heating in order to replace the firewood they currently harvest from the reserve.

7.2. Policy Recommendations

The Chinese government should pay close attention to the impact that new conservation programs have on local people. It is recommended that proper compensation be given to local communities if new conservation programs are to be implemented in protected areas such as FNNR.

Households living in the core of protected areas, such as those in the critical core area group in FNNR, have few alternative means of making a living other than using forest resources. Without the support and participation of such local people, it is difficult to implement conservation programs since they live in dense forest, where the detection of illegal activities is often difficult. Therefore new conservation programs will have the greatest negative impacts on the livelihoods of such groups of people. Therefore, it is suggested that close attentions should be paid to the structure of their current income sources when compensation or alternative livelihood means are considered.

It is common for local communities who are currently living in protected areas (such as 11 households in the critical core area group in FNNR), to be land-based and forest-dependent. Therefore, if their relocation is considered necessary, it is important to provide them with a land-based resettlement strategy that takes their livelihood needs into account.

It is recommended that the government disseminate information and provide educational programs to increase all citizens' awareness and knowledge of resource conservation and environmental protection. This should be done in a number of ways to ensure that it is effective and wide-reaching.

It is recommended that the government make great efforts to build up people's confidence in the government's nature conservation abilities. This is especially important in urban areas because it has a significant effect on the support city dwellers give to biodiversity conservation in protected areas.

It is recommended that the government provide better education to women in rural areas since this will boost support for conservation.

It is recommended that the government explore appropriate mechanisms (such as eco-compensation schemes) to redistribute the costs and benefits of conservation work across the different stakeholder groups who will benefit from it.

7.3. Policy Implications:

This survey has shown that, even in a backward province such as Guizhou Province, people are willing to pay for biodiversity conservation. However it has also shown that as people's income rises so does the amount of money they are willing to contribute to nature conservation. From these findings it can be inferred that, with the continuous increase in the net income per capita of people in China, the potential funding for nature conservancy that can be supplied by the public is expected to increase greatly. The government should therefore introduce some strategies to mobilize this potential funding for conservation in protected areas.

More should also be done to ensure fairer distribution of the costs and benefits of conservation programs between on-site and off-site households by schemes such as eco-taxes. If this is done, many conservation programs implemented in protected areas in China could be efficient and desired both from a social, economic and conservation standpoint.

REFERENCES

- Anthony E. Boardman, Greenberg, D.H., Vining, R. and Weimer, D.L.. 1996. Cost-benefit Analysis: Concepts and Practice. Prentice-Hall, Inc. *P.31-33*
- Billy Manoka, 1999. Existence Value: A Reappraisal and Cross-cultural Comparison. Draft Final Report presented at the EEPSEA bi-annual meeting, Singapore, 1999.
- Camille Bann, 1997. An Economic Analysis of Tropical Forest Land Use Options, Ratanakiri Province, Cambodia. EEPSEA Research Report Series, Singapore.
- Camille Bann, 1998. The Economic Valuation of Tropical Forest Land Use Options: A Manual for Researchers. *EEPSEA Research Report Series*, Singapore. *p.106*
- CBSG of IUCN, 1999. Guizhou Snub-nosed Monkey—Conservation and PHVA Workshop Draft Report. Conservation Breeding Specialist Group, USA.
- Cyril Bogahawatte, 1999. Forestry Policy, Non-timber Forest Products and the Rural Economy in the Wet Zone Forests in Sri Lanka. *EEPSEA Research Report Series*, Singapore. *p.37, p.47*
- David Pearce and Moran, D., 1994. The Economic Value of Biodiversity. In Association with the Biodiversity Program of IUCN—The World Conservation Union. Earthscan Publication, Ltd. London *p.1-129*
- David Pearce, 1992. The Economic Valuation and the Natural World. Background paper for World Bank Report 1992. The World Bank. *p.3-8*
- Dixon, J.A. and Sherman, P.B., 1990. Economics of Protected Areas: A New Look at Benefits and Cost. London: Earthscan Publication Ltd.
- Edward B. Barbier, 1987. The Concept of Sustainable Economic Development. *Environmental Conservation:14 (2): 101-110, 1987.*
- Freeman III, A.M, 1993. The Measurement of Environmental and Resource Values. Resource for the Future (RRF), Washington D.C.
- Geir B. Asheim, 1994. Sustainability: Ethical Foundations and Economic Properties—Policy Research Working Paper. World Bank

Heidi J. Albers and Grinspoon, E., 1997. A comparison of the enforcement of access restrictions between Xishuangbanna Nature Reserve (China) and Khao Yai National Park (Thailand). *Environmental Conservation* 24(4): 351-362, 1997.

Igor Vojnovic, 1995. Intergenerational and Intragenerational Equity Requirements for Sustainability. *Environmental Conservation*: 22(3): 223-228, 1995.

IUCN/UNEP/WWF, 1991. Caring or the Earth: a strategy for sustainable living, Gland, Switherland.

Jeffrey A. McNeely, Miller, K.R., Reid, W.V., Mittermeier, R.A., and Werner, T.B.,1990. Conserving The World's Biological Diversity. IUCN, WRI, CI, WWF-US, the World Bank. Gland, Switherland and Washington.

Jeffery A. McNeely, 1992. The Biodiversity Crisis: Challenges for Research and Management in Conservation of Biodiversity for Sustainable Development, O.T. Sandlund, K. Hindar and A.H.D.Brown (editors), Scandinavian University Press, Sweden.

Jeffrey A. McNeely, 1999. Mobilizing Broader Support for Asia's Biodiversity: How Civil Society Can Contribute to Protected Area Management. IUCN, Gland, Switzerland.

John G. Crag, 1971. Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods. *Econometrica*: 39 (5), 1971

John G. Robinson, 1992. The Limits to Caring: Sustainable Living and the Loss of Biodiversity. *Conservation Biology*: 7(1): 20-29, 1993.

Kerry Smith, 1993. Nonmarket Valuation of Environmental Resources: An Interpretive Appraisal. *Land Economics*:69 (1): 1-26, 1993.

Ma. Slome B. Bulayog, 1998. Economic Implications of Biodiverstiy Preservation in Mounta Pangsupan, Philippines. An Unpublished PH.D Dissertation, University of the Philippines at Los Banos (UPLB), Laguna, Philippines.

Mohan Munasinghe and McNeely, J.(ed.), 1994. Protected Area Economics And Policy: Linking Conservation and Sustainable Development. IUCN and the World Bank, Washington D.C. p.1-30

Pham Thi Xuan Mai, Hai, T.Q., and Thinh, K.V., Valuation of Non-timber Forest Prouducts in Luong Son District, Hoa Binh Province in *Economy & Environment: Case Studies in Vietnam* by Hermie Francisco and David Glover (edit), 1999. Roma Graphics, Inc., Philippines. p.151

Priya Shyamsundar and Kramer, R., 1997. Biodiversity Conservation—At What Cost? A Study of Households in the Vicinity of Madagascar's Mantadia National Park. *Ambio* 26 (3):180-184, 1997.

Rameshwar S. Mathur, 1978. Methodological Studies for Analysis And Planning of Non-wood Outputs of Forestry. F.A.O. , 1978.

Randall A. Kramer and Mercer, D.E., 1997. Valuing a Global Environmental Good: U.S. Residents' Willingness to Pay to Protect Tropical Rain Forests. *Land Economics*: 73 (2): 196-210, 1997.

Richard B. Norgaard, 1992. Sustainability and the Economics of Assuring Assets for Future Generation. Policy Research Working Papers, The World Bank.

Richard C. Ready, Jean C. Buzby, and Dayuan Hu, 1996. Difference between Continuous and Discrete Contingent Value Estimates. *Land Economics*: 72 (3): 397-411, 1996.

Richard T. Carson, Wilks, L. and Imber, D., 1994. Valuing The Preservation of Australia's Kakadu Conservation Zone. *Oxford Economic Papers* 46(1994):727-749.

R.K. Maikhuri, Nautiyal, S., Rao, K.S., Chandrasekhar, K., Gavali, R., and Saxena, K.G., 2000. Analysis and resolution of protected area-people conflicts in Nanda Devi Biosphere Reserve, India. *Environmental Conservation* 27(1): 43-53, 2000

Robert Cameron Mitchell and Carson, R.T., 1989, 1990. Using Surveys to Value Public Goods: The Contingent Valuation Method. Resource for the Future, Washington D.C.

Shashi Kant, 1997. Integration of Biodiversity Conservation in Tropical Forest and Economic Development of Local Communities. *Journal of Sustainable Forestry*, Vol.4 (1/2), 1997

Suthawan Sathirathai, 1998. Economic Valuation of Mangroves and the Roles of Local Communities in the Conservation of Natural Resources: Case Study of Surat Thani, South of Thailand. *EEPSEA Research Report Series*, Singapore.

Theodore Panayotou and Glover, D., 1994. Economic and Financial Incentives for Biodiversity Conservation and Development in *Biodiversity Conservation in the Asia and Pacific Region*, ADB&IUCN, 1995.

United Nations, 1993. The Convention on Biological Diversity.

Zhou Zhenxian and Yang, Y.Q., (edit), 1990. Studies on Fanjingshan Mountain. People's Publication House of Guizhou Province. Guiyang, Guizhou, China

APPENDIX I

Financial Analysis of Reduced Forest Products in Critical Core Area Group

Unit: CNY

YEAR	2001 I= 6.03%	2002 I= 6.03%	2003 I= 6.03%	2004 I= 6.03%	2005 I= 6.03%
BENEFITS					
1. CHARCOAL					
(1)CPBW/OKHU	0	0	0	0	2897
(2)CPBW/OKMKT	9	9	9	9	9
(3)CPBW/KHU	2752	306	0	0	0
(4)CPBW/KMKT	3496	388	0	0	0
2. FIREWOOD	0	0	0	0	57562
3.TIMBER MARKETING	4	4	4	4	4
4. ANIMAL POACHING	77	77	77	77	77
5.BAMBOO	0	0	0	0	6015
6.FERNS&HERBS&WV	0	0	0	0	1504
TOTAL BENEFIT	6337	784	89	89	68068
COSTS					
1. CHARCOAL					
(1)CPBW/OKHU	0	0	0	0	307
(2)CPBW/OKMKT	8	8	8	8	8
(3)CPBW/KHU					
LABOR COST	941	105	0	0	0
EQUIPMENT	1100	1100	0	0	0
(4)CPBW/KMKT					
LABOR COST	2339	260	0	0	0
EQUIPMENT	1100	1100	0	0	0
TAX	210	210	210	210	210
2. FIREWOOD	0	0	0	0	16147
3.TIMBER MARKETING	4	4	4	4	4
4. ANIMAL POACHING	6	6	6	6	6
5.BAMBOO	0	0	0	0	10052
6.FERNS&HERBS&WV	0	0	0	0	148464
TOTAL COST	5707	2792	228	228	27684
NPV	28345				

LEGEND:

- (1)CPBW/OHU: charcoal products made without kilns (open pits) for home consumption
- (2)CPBW/OKMKT: charcoal products made without kilns (open pits) for commercial purposes
- (3)CPBW/KHU: charcoal products made with kilns for home consumption
- (4)CPBW/KMKT: charcoal products made with kilns for commercial purposes

APPENDIX II

Financial Analysis of Reduced Forestry Products in Other Core Area Group

Unit: CNY

YEAR	2001	2002	2003	2004	2005
	I= 6.03%	I= 6.03%	I= 6.03%	I= 6.03%	I= 6.03%
BENEFITS					
1.CHARCOAL					
(1)CPBW/KHU	2171	241	0	0	0
(2)CPBW/KMKT	3134	348	0	0	0
2.FIREWOOD	60672	60672	60672	60672	60672
3.TIMBER MARKETING	3406	3406	3406	3406	3406
4.ANIMAL POACHING	9017	9017	9017	9017	9017
5.OTHER FOR ACT	2136	2136	2136	2136	2136
TOTAL BENEFIT	80536	75820	75231	75231	75231
COSTS					
1.CHARCOAL					
(1)CPBW/KHU					
LABOR COST	788	98	0	0	0
EQUIPMENT	10700	10700	0	0	0
(2)CPBW/KMKT					
LABOR COST	2990	332	0	0	0
EQUIPMENT	10700	10700	0	0	0
TAX	210	210	210	210	210
2.FIREWOOD	17020	17020	17020	17020	17020
3.TIMBER MARKETING	742	742	742	742	742
4.ANIMAL POACHING	1208	1208	1208	1208	1208
5.OTHER FOR ACT	321	321	321	321	321
TOTAL COST	44679	41321	19501	19501	19501
NPV			195368		

LEGEND:

(1)CPBW/OKMKT: charcoal products made without kilns (open pits) for commercial purposes

(2)CPBW/KHU: charcoal products made with kilns for home consumption

(3)CPBW/KMKT: charcoal products made with kilns for commercial purposes

(4)OTHER FOR ACT: other forestry activities

APPENDIX III

Financial Analysis of Reduced Forestry Products In Buffer Zone Group

Unit: CNY

YEAR	2001	2002	2003	2004	2005
	I= 6.03%	I= 6.03%	I= 6.03%	I= 6.03%	I= 6.03%
BENEFITS					
1. CHARCOAL					
(1)CPBW/OKMKT	5536	5536	5536	5536	5536
(2)CPBW/KHU	96553	10728	0	0	0
(3)CPBWK/Mkt	323018	35891	0	0	0
2. FIREWOOD	1377945	1377945	1377945	1377945	1377945
3.TIMBER MARKETING	22872	22872	22872	22872	22872
4. ANIMAL POACHING	43421	43421	43421	43421	43421
TOTAL BENEFIT	1869345	1496393	1449774	1449774	1449774
COSTS					
1. CHARCOAL					
(1)CPBW/OKMKT					
LABLOR COST	51647	51647	51647	51647	51647
(2)CPBW/KHU					
LABLOR COST	79359	8818	0	0	0.00
EQUIPMENT	303200	303200	0	0	0.00
(3)CPBW/KMkt					
LABLOR COST	200485	22276	0	0	0
EQUIPMENT	303200	303200	0	0	0
TAX	58821	58821	58821	58821	58821
2. FIREWOOD	534600	534600	534600	534600	534600
3.TIMBER MARKETING	17348	17348	17348	17348	17348
4. ANIMAL POACHING	1277	1277	1277	1277	1277
TOTAL COST	1518083	1269332	631839	631839	631837
NPV		2455576			

Legend:

- (1)CPBW/OKMKT: charcoal made without kilns (open pits)for commercial purpose.
- (2)CPBW/KHU:charcoal products made with kilns for home consumption.
- (3)CPBWK/MKT:charcoal products made with kilns for commercial purpose.