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Replacing rubber plantations by rain forest in Southwest China—who would gain and how much?

Michael Ahlheim · Tobias Börger · Oliver Frör

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Abstract The cultivation of rubber trees in Xishuangbanna Prefecture in China's Yunnan Province has triggered an unprecedented economic development but it is also associated with severe environmental problems. Rubber plantations are encroaching the indigenous rain forests at a large scale and a high speed in Xishuangbanna. Many rare plant and animal species are endangered by this development, the natural water management is disturbed, and even the microclimate in this region has changed over the past years. The present study aims at an assessment of the environmental benefits accruing from a reforestation project partly reversing the deforestation that has taken place over the past years. To this end, a Contingent Valuation survey has been conducted in Xishuangbanna to elicit local residents' willingness to pay for this reforestation program that converts existing rubber plantations back into forest. It is shown that local people's awareness of the environmental problems caused by increasing rubber plantation is quite high and that in spite of the economic advantages of rubber plantation there is a positive willingness among the local population to contribute financially to a reduction of existing rubber plantations for the sake of a partial restoration of the local rain forest. These results could be used for the practical implementation of a Payments for Eco-System Services system for reforestation in Xishuangbanna.

Keywords Contingent valuation · Rubber plantation · Reforestation · Environmental valuation · Ecosystem services · Southwest China

M. Ahlheim
Institute of Economics (520 F), University of Hohenheim,
70593 Stuttgart, Germany
e-mail: ahlheim@uni-hohenheim.de

T. Börger (✉)
Plymouth Marine Laboratory, Prospect Place,
The Hoe, Plymouth PL1 3DH, UK
e-mail: tobo@pml.ac.uk

O. Frör
Environmental Economics, Institute of Environmental Sciences, University of Koblenz-Landau,
76829 Landau, Germany
e-mail: froer@uni-landau.de

Introduction

Deforestation as a result of a rising demand for agricultural land is an often reported environmental problem. In the case of tropical Southwest China, one of the main drivers of this development is the cultivation of rubber trees (*Hevea brasiliensis*). In recent decades, this development has also reached the tropical areas of the People's Republic of China (PRC), namely the island of Hainan and the southern part of Yunnan Province. Xishuangbanna Prefecture, which is located at the southernmost rim of Yunnan Province, has witnessed a rapid expansion of rubber monoculture at the expense of both formerly undisturbed tropical rain forest and traditional systems of shifting cultivation (Xu et al. 2014b). While before the reform of the Chinese agricultural sector in the 1980s rubber cultivation was strictly limited to socialist state farms, today also smallholder

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farmers plant rubber trees on their allocated plots. This development together with rising prices for natural rubber has led to unprecedented economic growth in that formerly rather backward region.

At the same time and as a consequence of the special climatic conditions in the area as a transition zone between the tropics and subtropics, Xishuangbanna abounds in plant and animal species and has long been recognized as a biodiversity hotspot (Myres et al. 2000). While it only accounts for 0.2 % of the land area of the PRC (Fig. 1), the region is home to 16 % of China's higher plant species, 21.7 % of mammal species, and 36.2 % of bird species (Li et al. 2007). The major part of the area is covered by different subtypes of tropical forest which is the main ecological characteristic of that region. This flora and fauna make Xishuangbanna an ecologically unique region in China.

New rubber plantations established in the last two decades are located almost exclusively on former forest plots on sloping hillsides, since the valley bottoms are used for the cultivation of paddy rice and other crops. Consequently, it is the tropical forest that has suffered most from the recent expansion of the rubber sector. Therefore, this region exemplifies the typical trade-off between economic development on the one hand and environmental conservation on the other.

The outside view on China suggests that nowadays the whole country is obsessed by consumption and economic growth while environmental issues are being more or less neglected. In the present paper, we scrutinize this general prejudice in the light of an empirical study conducted in Xishuangbanna. Using the Contingent Valuation Method (CVM), we wanted to learn about the general attitude of local people towards the trade-off between economic wealth as generated by rubber plantation and environmental enhancement of their home region through reforestation. With this study, we also wanted to contribute to a comprehensive assessment of the overall social benefits accruing from a more sustainable rubber plantation practice in Xishuangbanna.

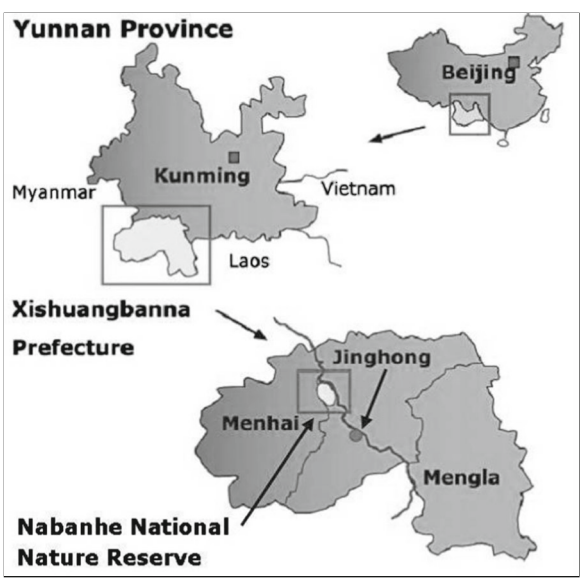

Fig. 1 Map of Xishuangbanna Prefecture and its location in China (LILAC 2006)

In a CVM survey based on more than 2,500 face-to-face interviews, we first asked people living in the city of Jinghong in Xishuangbanna questions regarding their awareness of the environmental deterioration coming along with the encroachment of rubber plantations in the natural forest. Then we suggested a kind of reverse conversion program in the sense that existing rubber plantations would be converted into forest, which we called the "Return-Rubber-Into-Forest" Program (RRFP). After that, we asked respondents whether they would be willing to contribute personally to the realization of this program and, if yes, how much money they would be willing to contribute. Additionally, we asked questions regarding the socioeconomic information of the households interviewed and their attitudes towards different aspects of life like environmental protection in general, government responsibility, their personal life satisfaction, etc. We found that even in the economic center of Xishuangbanna, many people are worried about the crowding-out of rain forest by rubber plantations in their region and that they would be willing to contribute to a reversal of this development.

As already mentioned, the permanent residents of Jinghong are not the only stakeholders in the conflict about economic development versus environmental protection in this area. Other stakeholder groups are the many tourists visiting Xishuangbanna every year, and also people living in other parts of China, who do not come to Xishuangbanna as tourists, might be interested in the preservation of the unique nature there. These stakeholder groups will be surveyed in a follow-up to this study in order to assess the total social benefits accruing from a reforestation program in Xishuangbanna. Taking the results of these different studies together will enable us to get an idea of the overall social benefits that would accrue from a reforestation project in Xishuangbanna. Comparing these

benefits to the social costs of such a project would allow to decide if a reforestation program like the RRFP is recommendable from a social (and political) point of view. The social costs can be roughly subdivided into pure implementation costs and the forgone profits of the owners of those rubber plantations which would have to be converted into forest. While the implementation costs depend on market prices like wages, machine hour rates, material costs, etc., things are more complicated with the assessment of the forgone profits of the rubber farmers. Nevertheless, this value has been assessed by Yi et al. (2014), so that our studies on the social benefits accruing from reforestation in Xishuangbanna could be combined very nicely with these results to consider the question if reforestation in this region would be advantageous from a cost-benefit analysis (CBA) point of view. Further, the results presented in this paper could be used together with the results of the follow-up studies mentioned above and the results of Yi et al. (2014) for a practical implementation of a Payments for Ecosystem Services (PES) system for reforestation in Xishuangbanna.

While these considerations refer to the efficiency aspects of the results of our study, the data collected here are also meaningful from an equity or social justice point of view. They allow us to determine the main socioeconomic and attitudinal characteristics of those households who would benefit most (or least) from a practical implementation of the RRFP. That means that our study addresses the efficiency aspects of such an environmental program as well as its equity aspects.

Potentially supporting the three objectives stated above, this study is the first application of the CVM in this context in China. The study employs a representative in-house survey based on detailed population statistics. Since neither a comprehensive CBA of such land-use changes nor a PES system has been implemented in that region, the results of this study are novel and therefore add to the expanding literature of welfare assessments of land-use change. The paper is structured as follows. Section 2 sketches the development of the rubber industry in Xishuangbanna including an overview of the environmental consequences. In the "Methodology" section, the CVM and its welfare-theoretical background are shortly introduced and then the details of our survey in Xishuangbanna are explained. The "Results and analysis" section presents the results of our study and the "Conclusions" section provides our concluding remarks.

The development and environmental impact of rubber cultivation in Southwest China

The development of the rubber sector in Southwest China

Rubber trees were not introduced in Xishuangbanna until the 1950s. After the PRC had been established in 1949, the first state rubber farms were set up in the mid-1950s and rubber was exclusively cultivated by these socialist production units. Farmers from provinces in central China belonging to the group of Han Chinese, the major ethnic group in the PRC, were relocated to Xishuangbanna to work in the state farms. The local ethnic groups were not recruited for mainly political reasons and left with their existence as subsistence farmers. According to the ideology of the socialist state at the time, the Han were considered the only ethnic group fit for advanced industrial production, whereas the ethnic minorities were regarded as backward and not up to use modern production techniques (Sturgeon and Menzies 2006).

It was not until the early 1980s that this clear divide started to erode. On one hand, the remigration of state farm workers to their home provinces and the resulting labor shortage made state farm managers hire minority workers as substitutes. On the other hand, fundamental reforms in the Chinese agricultural sector changed the institutional setting by allowing smallholder farmers to cultivate rubber trees on their allocated plots. This marked the starting point of a rapid expansion of rubber cultivation outside the state farms which were not allowed to further expand their rubber plantations after 1995 (Sturgeon 2010). This development, which accelerated throughout the 1990s into the new century, occurred in several waves. The driving force of the expansion was the government's policy to make minority smallholder farmers plant rubber trees to meet the rising domestic demand, as well as to raise (mostly indigenous) farmers' incomes (Sturgeon 2010). Since in China rubber plantations officially count as forest, the planting of rubber trees has also been regarded as a countermeasure against deforestation in recent years. Yet, this further development of the rubber industry is the main reason for the tremendous decline in natural forest in the region. Today, the continuous expansion of rubber cultivation is primarily driven by the high domestic demand for natural rubber associated with the rapid development of China's automobile production (Li et al. 2007). Since

the price of natural rubber continues to be very high and since it is possible today to cultivate rubber trees even on steep mountain slopes and at ever higher altitudes, more primary and secondary forest land have been transformed into rubber plantations over the past years. The rapid expansion of rubber plantations in Xishuangbanna is documented in Fig. 2 and Table 1. The right-hand column shows the share of all rubber plantations of the total area of Xishuangbanna Prefecture (1,922,000 ha).

On plots of an altitude of up to 1,000 m, rubber plantations have become by far the dominating form of land use in the region. With around 287,373 ha of plantations, rubber trees today cover about 15 % of the prefecture's surface according to official government figures (Table 1). However, several authors claim that the actual size of plantations is already well beyond 400,000 ha (Qiu 2009; Xu et al. 2014b), which is about 22 % of the region's total area. Basically, two types of plantations can be distinguished. Relatively old plantations managed by the state farms and younger and still expanding plantations run by minority smallholder farmers. The latter have succeeded as entrepreneurs in the rubber business (Sturgeon 2010) and thus refuted the alleged backwardness of the local ethnic groups. According to Sturgeon and Menzies (2006), the old divide which portrayed Han settlers in the state farms as modern and minority smallholder farmers as backward has been reshaped in recent years.

Economic benefits versus environmental degradation

The enormous profitability of planting rubber trees is obviously the main driver of the fast expansion of rubber plantations. Stone (2009) reports that average incomes of an exemplary township in the prefecture have increased 10-fold between 1988 and 2003. While there are surely also other economic factors causing this high-speed development, rubber cultivation is certainly an important contributor. According to Qiu (2009), the per-hectare yield of rubber today is about 15,000 RMB annually, while farmers can get a mere 2,000–3,000 RMB per hectare from cultivating rice or tea. Xishuangbanna is a very important rubber production base delivering 35 % of the total natural rubber output of the PRC (Lu and Lin 2010). It is therefore not surprising to see that rubber production makes up about 30 % of the total GDP of the prefecture (Hu et al. 2008). With such a big influence of this sector, it is obvious that income increases of rubber farmers trickle down to other sectors and thus enhance the economic performance of the whole region. Alongside with tourism, the rubber industry has been the major driver of the positive development of the local economy since the mid-1980s.

Despite the undeniable economic benefits for the rubber farmers and the whole region, this trend entails many negative ecological and environmental consequences. Above all, the replacement of natural forests and traditional shifting agricultural land by both large-scale and small-scale rubber plantations leads to a huge loss of biodiversity (Ziegler et al. 2009). Between 1976 and 2003, forest cover in the prefecture shrank at an average annual rate of about 14,000 ha per year, which reduced the total forest area to 50 % and the share of primary forest even to 3.6 % of the total area (Li et al. 2007). Another source reports a forest cover of only 42.9 % in 2008 (Jiang et al. 2011). However, while the

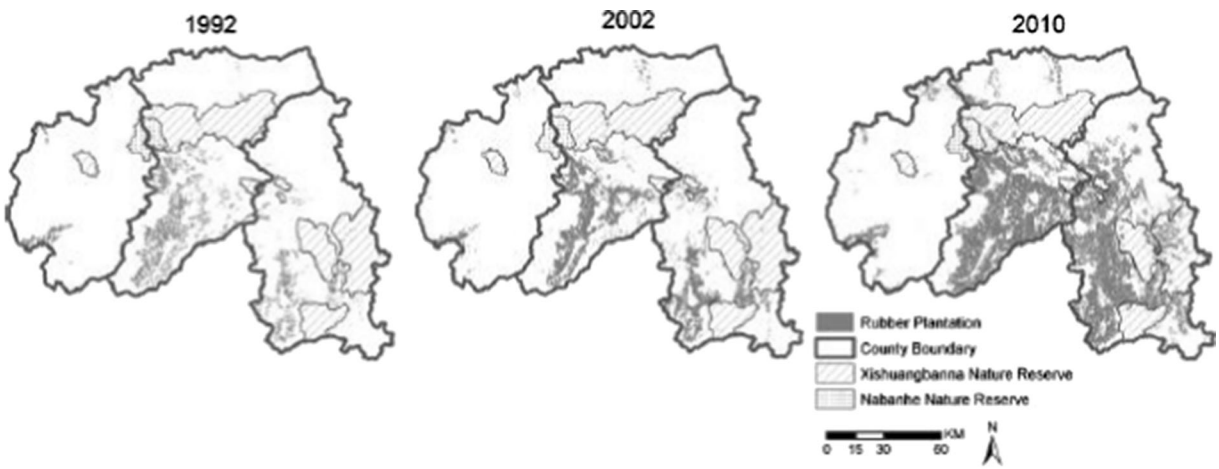

Fig. 2 Expansion of rubber plantations in Xishuangbanna 1992 to 2010 (Source: Xu et al. 2014b, p. 751)

Table 1 Total area of rubber plantations in Xishuangbanna 1965 to 2011

	Rubber plantations	
	Hectare	Share of total area
1965	8,474	0.44 %
1970	19,491	1.01 %
1975	21,235	1.10 %
1980	35,191	1.83 %
1985	61,561	3.20 %
1990	89,864	4.68 %
1995	97,033	5.05 %
1999	143,180	7.45 %
2004	173,100	9.01 %
2009	254,613	13.25 %
2010	271,307	14.12 %
2011	287,373	14.95 %

Source: 1965–1995, Fu et al. (2004); 1999–2011, Xishuangbanna Bureau of Statistics

loss of natural forest is the most obvious consequence of rubber cultivation, its ecological implications are much harder to assess. Li et al. (2006) criticize that still too few studies exist which investigate the effects of this rapid loss of forest cover on species composition and biodiversity.

Moreover, the existence of monocultures threatens the hydrological system of the area. This includes the problem of increased precipitation run-off, which reduces rainwater infiltration into the soil in the plantations. Rubber plantations have been found to lead to three times higher surface water run-off compared to rain forest. Moreover, rubber trees have been found to work as "water pumps" compared to rain forest vegetation (Tan et al. 2011), since they consume more water than the natural vegetation. This is due to the fact that the trees have to compensate for the tapped latex and the lack of the cooling effect of rain forest vegetation resulting in more evapotranspiration in the monocultures. This development has led to an increasing number of desiccated streams (Ziegler et al. 2009). The increased stress on the hydrological system further results in drier microclimate, which becomes apparent in less pronounced fog in winter (Qiu 2009) and overall fewer foggy days (Li et al. 2007). Finally, rubber monocultures require the use of large quantities of pesticides and chemical fertilizers which endangers water quality in local rivers and streams (Ziegler et al. 2009). Water quality is also threatened by increased sediment loads in surface waters as a result of more soil erosion on the sloped land converted into rubber plantations. Mann (2010) reports a study by the Xishuangbanna Tropical Botanical Garden which finds soil erosion in rubber plantations to be increased by a factor of 45 compared to rain forest which also increases the risk of landslides (Ziegler et al. 2009). Overall, it appears that the economic benefits of rubber cultivation, which are obvious in the region, are bought at an ever increasing ecological and environmental price. One of the few case studies to evaluate the overall decline in ecosystem services resulting from large-scale rubber cultivation finds that except for raw material production all other types of ecosystem services such as nutrient cycling, climate regulation, and the provision of habitat decrease when rain forest is converted into rubber monocultures (Hu et al. 2008).

The anthropocentric perspective of this study

From these considerations, it follows that rubber cultivation in Xishuangbanna constitutes "a classic standoff between economics and ecology" (Mann 2010, p. 565). Not surprisingly, this development has attracted the interest of natural and agricultural scientists (e.g., Li et al. 2007; Hu et al. 2008; Xu et al. 2014b; Yi et al. 2014). Yet, while these studies focus on the natural science perspective of the land-use changes and their environmental consequences, there is still no welfare economic assessment of these developments. Yi et al. (2014) present a quantification of productivity of rubber plantations and compare these with biodiversity indicators on a spatial scale. These authors want to give advice on where reforestation efforts would lead to most efficient biodiversity protection at lowest economic costs in terms of forgone rubber production. Another study by Xu et al. (2014b) discusses environmental and social costs of increased rubber cultivation. While it presents a categorization of indicators of environmental and social changes resulting from the development of the rubber industry, it cannot provide a quantification of these costs. To the best of our knowledge, there exists no information on the environmental costs of rubber cultivation in terms of welfare losses suffered by the affected population (Sturgeon and Menzies 2006). The present study tries to fill this gap from both a qualitative and a quantitative perspective. On the

qualitative level, it is assessed whether the population in the respective area has an understanding and awareness of the environmental changes taking place. On the quantitative level, the study aims at the assessment of the social value of a land-use change aiming at a partial reforestation of rubber plantations in Xishuangbanna. Unlike the work of Hu et al. (2008) who employ the more natural science-based valuation approach of Costanza et al. (1997), the present study takes a strictly anthropocentric and preference-based perspective on the economic valuation of environmental goods which is characteristic of the CVM. Since the economic benefits resulting from a conversion of forest land into rubber plantations directly affect human well-being in the region, it is necessary to compare these to the benefits of an alternative land-use scenario, namely reforestation in a cost-benefit framework. Since this CBA framework has societal profitability at its core (Hanley and Barbier 2009), all changes are being assessed from the perspective of the society, i.e., of its constituents. This justifies the anthropocentric perspective in the quantification of benefits resulting from reforestation of current rubber plantations.

Methodology

Willingness to pay for improvements in environmental quality—the contingent valuation method

The anthropocentric perspective of economics leads us to a valuation approach where the value of a certain environmental improvement is measured in terms of the change in well-being or utility it causes for the population affected by this improvement. On the level of a single household h, this utility change ΔU_h can be expressed using the indirect utility function $v_h(\cdot)$ as

$$\Delta U_h = U_h^1 - U_h^0 = v_h(p, z^1, I_h) - v_h(p, z^0, I_h) \quad (1)$$

where p is the vector of market prices, I_h is household h's income and z^0 and z^1 are two vectors of environmental parameters describing the state of the environment before and after the environmental improvement, respectively. The utility change ΔU_h described in (1) can be expressed in monetary terms by the maximum amount of money the household would be willing to give up in order to obtain the environmental improvement from z^0 to z^1. This amount equals household h's maximum willingness to pay (WTP_h) for this environmental improvement so that

$$v_h(p, z^1, I_h - \mathrm{WTP}_h) - v_h(p, z^0, I_h) = 0 \quad (2)$$

This kind of monetary valuation of environmental changes is based on the trade-off between market consumption as represented by the household's disposable income on one the hand and environmental quality z on the other. The overall social value of a change of environmental quality from z^0 to z^1 is measured as the sum of the individual WTP_h of all H households affected by this project. This social value can then be compared to the social costs of the project.

In this study, we use the CVM (Carson and Hanemann 2005). The CVM is an interview-based valuation method according to which households from a representative sample are asked their WTP for a certain environment-enhancing project. Practical CVM surveys typically start with a set of questions regarding respondents' knowledge on and awareness of the respective environmental problem. Then a thorough description of the policy scenario to be valued (e.g., reforestation of rubber plantations) is offered. This is followed by the so-called payment scenario, which describes the kind of individual contributions to the financing of the public project. Thereupon, the elicitation question follows where respondents are asked their maximum WTP for the project in question. In this study, we employ the payment card (PC) approach where respondents are asked to select the amount of their household's maximum WTP from a list of different payment intervals. Additionally, CVM questionnaires typically contain extensive sets of attitudinal and sociodemographic questions. These aim at an assessment of the motives and determinants of the individual WTP statements as well as the distributive effects of the project in question. Households stating the highest (lowest) WTP will benefit most (least) from this project. So the sociodemographic characteristics of the interviewed households in combination with their WTP statements give an indication of the distributional effects of the project if it is realized.

Contingent valuation in China

The history of the CVM in the PRC is rather short with most applications reported during the last decade. Topics include environmental goods as different as

reduced air pollution (Hammitt and Zhou 2006; Wang and Mullahy 2006; Wang et al. 2006, 2007; Wang and Zhang 2009), water quality improvements (Day and Mourato 2002; Du 1998; Lin et al. 2011; Wang et al. 2011; Zhang 2011), different kinds of ecosystem services (Tao et al. 2012; Xu et al. 2003, 2006), conservation of urban biodiversity and recreational amenities (Chen and Jim 2010, 2011; Jim and Chen 2006, 2009), groundwater resources (Wei et al. 2007), health-insurance (Bärnighausen et al. 2007), nature reserves (Han et al. 2011; Leng and Lei 2011; Xu et al. 2009), and animal welfare (Zhao and Wu 2011). The vast majority of these studies aim at the valuation of a specific environmental good rather than at an investigation of specific methodological issues.

The present survey deals with a rather complex environmental problem that might not be that obvious at first glance and might therefore be quite challenging for respondents to understand. The loss of soil, water resources, and biodiversity causes problems which might only come to their full negative effect in the future, while today the huge economic potential of this cash crop is far more evident. In a society that focuses so heavily on economic development like China, it is therefore not clear whether citizens hold values for conservation of forest land and biodiversity protection at the expense of forgone economic profits. One important task of this study was therefore to scrutinize ordinary people's awareness of the environmental problems caused by rubber plantation before we asked their WTP for a mitigation of these problems. To our knowledge, this is the first assessment of this kind with respect to rubber-related land-use change in the PRC.

The survey

Besides several waves of pretest interviews, the study employed so-called citizen expert group (CEG) meetings (Ahlheim et al. 2010) in order to design a suitable survey questionnaire. In these citizen meetings, valuable insights could be gained regarding the structure and wording of the questionnaire as well as the preferred way to contact respondents and conduct the survey interviews.

The questionnaire consisted of five sections. After an introduction to the purpose of the study, the first section contained questions regarding respondents' knowledge of and familiarity with rubber cultivation and its environmental consequences. After that, sections 2 and 3 introduced the project scenario and the payment scenario, respectively. The scenario to be valued by the respondents in this survey is a reforestation project implemented in a nearby nature reserve area, the RRFP (Fig. 1). This project was designed in analogy to the "Sloping-land-conversion program"[1] (Bennett 2008), a policy measure implemented nationwide by the Chinese government and well known to the survey population. During the survey interviews, respondents were informed that existing rubber plantations in the nature reserve area would be transformed back into forest and that the following consequences could be expected from this rehabilitation effort. Firstly, the original forest area would be partially restored, which would provide habitat for a number of rare plant and animal species. Secondly, reforestation would lead to better water quality in local rivers because less pesticide would have to be brought out. This would further result in less pesticide contamination in agricultural food products and the whole local ecosystem. This information had been collected through in-depth interviews with local authorities and other experts in the agricultural sector.

After this description of the project scenario, the payment scenario, consisting of the payment rule and the implementation rule, was conveyed to the respondents. As a payment rule, they were informed that in case of a practical implementation of the RRFP a fund would be set up by the local government to which all citizens would have to contribute. The payments would have to be made every 3 months over a time span of 5 years. WTP statements had to be marked on a PC. Following this explanation of the payment rule, the implementation rule was introduced stating that the RRFP could be implemented only if the sum of all contributions covered the project cost. The implementation rule is considered to set incentives for respondents not to understate their WTP for strategic reasons. Such an understatement carries the risk for a respondent that the project might not be elected for implementation because of the wrong WTP statement, in spite of the fact that she would like it to be realized.[2] In the fourth

[1] This program is also known under the name "Green for Grain."

[2] We are aware that devising a truly incentive-compatible payment rule takes more than this simple remark but empirical tests in earlier CVM projects conducted in Thailand showed that average respondents are not able to understand the mechanism and the rationality behind an incentive-compatible implementation rule like, e.g., the Clark-Groves mechanism (Heinke 2013, p. 100 and 183 ff.). Therefore, we confined ourselves to the simple implementation rule as described above.

section of our questionnaire, eventually the elicitation question was asked. Respondents were presented the PC and asked to indicate their households' maximum WTP for the proposed reforestation project in terms of a contribution to the RRFP fund mentioned before. The fifth section consisted of a series of demographic and attitudinal questions aiming at the assessment of potential determinants of WTP.

A representative household sample for this survey could be drawn based on population data provided by the local authorities. For 11 out of the 14 urban districts of Jinghong, the respective administrations made available complete lists of all housing units including number of residents for their jurisdictions. For three districts consisting of suburbanized villages, such lists were not available, so maps were drawn for each village indicating the location of each house. While drawing the maps, the number of residents of each house was recorded by simple door count. This procedure yielded a list of all addresses (housing units in the 11 urban districts and single- and multi-family houses in the suburban villages) in Jinghong with the respective number of residents. A list of 44,392 households could be constructed from which a random sample of desired size could be drawn.[3] It should be noted that this was a unique opportunity to conduct a representative CVM household survey in China since such fine-grained population data is usually very hard to obtain. Firstly, the survey sample was drawn from detailed and comprehensive population statistics provided by the local authorities, which are usually extremely difficult to obtain. Secondly, all interviews were conducted in respondents' homes with sufficient time and privacy to provide responses. Thirdly, the high number of responses (see next section) in a small town in rural China offers opportunities for in-depth analysis of WTP and its determinants. This gives our survey results a special significance as compared to other CVM studies in China, which are sometimes limited in sample size (e.g., Jin et al. 2013; Xu et al. 2009) or sample respondents only from a part of the resident population (e.g., Xu et al. 2014a).

[3] It should be noted that although local authorities were aware of the survey work in their jurisdiction, there was no attempt whatsoever to influence the selection of the households or the survey results.

Results and analysis

Sample characteristics

Out of the 2,606 questionnaires completed between June and August 2009, 54 were discarded because they were completed by respondents below the age of 18 or lacking age statement. This resulted in a sample of 2,552 valid questionnaires, out of which 2,517 contained a completed WTP question. This yields a very high response rate for the elicitation question of 98.6 %. Of all respondents, 46.6 % are male, which is a slightly lower share than the 51.6 % indicated in the 6th National Census of 2010 (Jinghong 2011). Average household size in the sample amounts to 3.19 people. This conforms to the number of 3.20 people in an average household elicited in the 2010 census (Jinghong 2011). These figures are summarized in Table 2.

Average reported monthly household income amounts to 2,960 RMB.[4] This figure is slightly higher than the average household income for urban Jinghong as reported in the 2007 Statistical Yearbook, which is at 2,700 RMB (Jinghong 2008). Taking into consideration that the survey was conducted in mid-2009, this difference is likely to reflect the increase of household incomes resulting from the fast economic development also in this part of China. These figures show that based on the procedure outlined above this study succeeded in selecting an overall sample representative of the resident population of urban Jinghong. The results derived below can thus be interpreted to hold for the entire urban population.

Awareness of the environmental problem and protest attitudes

When asked whether they have noticed the rapid expansion of rubber cultivation in Xishuangbanna, 83.9 % of respondents answer in the affirmative. A *t* test shows that respondents ignorant of the large dimension of rubber cultivation are significantly less educated and have lived in Jinghong and Xishuangbanna for a significantly shorter period of time.

In the pretest phase of the survey, respondents were asked to name both positive and negative consequences of rubber cultivation. Those environmental effects

[4] At an exchange rate of approximately 9.6 RMB/euro when the survey was conducted this equals 308.33 euros.

Table 2 Demographic characteristics of the survey sample

Variable	Mean	Standard deviation
Male	0.466	0.499
Age	35.9	12.1
Household size	3.19	1.44
Monthly income (in RMB)	2,959.88	3,123.65

which turned out to be viable from a scientific point of view were included in the questionnaire of the main survey. Respondents were asked to rate the seriousness of each consequence on a five-point Likert scale or indicate that they do not think that this problem is caused by rubber cultivation. Although the differences are not significant, the highest average level of seriousness is attached to the destruction of forest. Regarding the relationship of the listed consequences with rubber cultivation, virtually all respondents see this link, as indicated by the low fractions of respondents who answer "Not a consequence of rubber" for most items (Table 3). Merely the relationship between rubber and the fact that urban Jinghong has become much dustier in recent years is doubted by 13.2 % of respondents. This appears plausible as also a booming construction sector and increasing traffic severely affect air quality in Jinghong.

Table 3 Rating of seriousness of environmental consequences of rubber cultivation

Consequence	Mean[a]	"Not a consequence of rubber cultivation"
Loss of water resources	3.67	2.5 %
Longer dry season/drier climate	3.63	3.0 %
More dust in Jinghong	3.46	13.2 %
Loss of soil/soil erosion	3.31	2.9 %
Destruction of forest	3.97	0.6 %
Massive reduction of plant species	3.65	0.8 %
Massive reduction of animal species	3.64	1.4 %
Food safety endangered by polluted groundwater	3.50	2.9 %
Air and water pollution by rubber processing	3.70	0.7 %
Fewer foggy days	3.44	2.1 %

[a] On a five-point scale from "1—Not serious at all" to "5—Very serious"

The data further reveal that 81.5 % of respondents think that these consequences have an impact on their personal living conditions. *t* tests indicate that those who notice that impact have lived in Xishuangbanna longer and are better educated. Yet, it is obvious that rubber cultivation has also brought an unprecedented economic development to the region. It turns out that 88.6 % of respondents perceive an improved economic situation in Xishuangbanna (Fig. 3), whereas 78.5 % think that the environmental situation has deteriorated. This finding reflects very clearly that the price of rubber-fuelled economic development from the perspective of Xishuangbanna citizens is a life in a "green desert" as several of the pretest respondents had put it. Based on these findings the question whether the population is aware of the environmental consequences of rubber cultivation can be answered in the affirmative. Despite the rather complex nature of the detrimental environmental impact of large-scale monocultures, the level of awareness and understanding of these relationships is very high for the vast majority of respondents.

After the presentation of the reforestation program and the WTP elicitation question, respondents are asked to answer a set of attitudinal questions. Four of these questions refer to so-called protest beliefs of respondents. There has been a long-running debate in the CVM literature on protest beliefs and how protest answers to the elicitation question should be treated in CVM studies (see among many others, e.g., Halstead et al. 1992, Jorgensen and Syme 2000 or Meyerhoff and Liebe 2006). Protest beliefs are negative attitudes towards certain aspects of a CVM survey for the valuation of an environmental project which have nothing to do with the project itself. A respondent might resent the idea of attaching a monetary value to the environment or she might think that she has a right to live in a sound environment without having to pay for it or she might find that the taxes and fees she has to pay in her everyday life are already too high without this additional payment for the project or she might find the payment vehicle (e.g., a tax) unsuitable or unfair. So she might state a zero WTP for the project in question although she appreciates the project taken for itself. Other consequences of protest beliefs could be the statement of excessively high WTP amounts (outliers) or the refusal to answer the WTP question at all (Halstead et al. 1992, p. 160). Any of these different kinds of protest behavior might bias the result of a CVM study. Therefore, it is

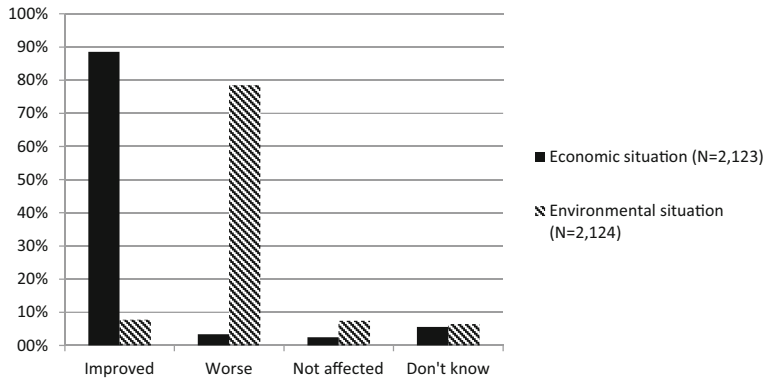

Fig. 3 Responses to the questions: "How do you think the…situation of people in Jinghong has been affected by rubber cultivation in Xishuangbanna?"

important to identify potential protesters among the respondents.

In the CVM literature, it is also discussed how the WTP statements of protesters should be treated after they have been identified. The obvious thing to do is to eliminate their statements from the sample. This makes, of course, only sense if it can be taken for granted that the protesters are representative of the whole sample and of the population addressed in the survey. Otherwise, the remaining sample after the elimination of the protesters would not be representative of the target population anymore. Since protesters are typically very special characters, they are unlikely to be representative of the whole population of the survey so that their elimination is not a recommendable strategy for dealing with this problem. Other strategies are to assign adjusted WTP amounts to them based on their sociodemographic characteristics or to simply take their zero WTP statements at face value and leave them unmodified in the sample (Halstead et al. 1992, p. 162). The latter view is adopted, e.g., by Meyerhoff and Liebe (2006) who show in a CVM study using a two-part econometric model that protest beliefs have a negative influence not only on stating a positive WTP at all but also on the WTP amounts stated by respondents with protest beliefs. Therefore, it would not be enough to eliminate only the protest zeroes from the sample. One would also have to correct positive WTP statements of protesters—but how? In our study, we try to identify the influence of protest beliefs on respondents' behavior, i.e., stating zero WTP instead of a positive WTP or simply stating a lower than their true WTP using a two-step Heckman sample selection model (Heckman 1979) in order to learn more about these characteristics and their potential influence on survey results. Such a characterization of attitudes towards the good in question and its provision mechanism can be important information for policy makers in case a PES system is implemented. Consequently, we do not eliminate them from our sample when it comes to calculating the overall WTP for the RRFP and its determinants.

In the questionnaire, we suggest the following four protest statements and ask respondents if they agree with these statements:

- "I think it is not acceptable to value nature in terms of money." (*variable* UNACCEPT)
- "I have a right to live in a sound environment and should not have to pay extra for it." (RIGHT)
- "I don't think that the Return-Rubber-into-Forest-Project will have the expected effects." (DOUBT)
- "Taxes and fees of residents of Jinghong are already so high that there should be no additional financial burden." (TAXES)

As shown in Table 4, the most striking result is the high share of respondents who agree with statements UNACCEPT and TAXES. Responses to the first question reveal that almost 6 out of 10 respondents oppose the idea of valuing nature in terms of money. Nevertheless, they were willing to take part in this study which served exactly this purpose. It is also surprising that approximately every second respondent openly declares that she deems the financial burden caused by taxes and fees in China to be already too high. Therefore, the statement by Jorgensen and Syme (2000, p. 264) certainly applies also to our study: "While WTP might reflect the value of an attitude object, it may also reflect the value of the measurement process itself." We will have to accept this fact since there does not seem to be an obvious and straightforward way of correcting CVM results for protest

Table 4 Responses to attitudinal questions indicating protest beliefs

Variable	Question wording	Agree (%)	Don't know (%)	Don't agree (%)	N
UNACCEPT	I think it is not acceptable to value nature in terms of money.	58.6	13.3	28.1	2,498
RIGHT	I have a right to live in a sound environment and should not have to pay extra for it.	26.1	9.2	64.8	2,483
DOUBT	I don't think that the Return Rubber into Forest Program will have the expected effects.	26.1	35.9	38.0	2,480
TAXES	Taxes and fees of residents of Jinghong are already so high that there should be no additional financial burden.	51.7	19.0	29.3	2,481

behavior. These considerations lead to our first research hypothesis:

H1: Respondents who agree with the statements UNACCEPT, RIGHT, DOUBT, or TAXES

(a) are less likely to state a positive WTP and
(b) if their WTP is positive, they state a lower WTP than respondents who do not agree with these statements.

WTP for the reforestation of rubber plantations

In a next step, respondents' evaluations of the proposed reforestation program in the form of WTP statements are analyzed. The distribution of the 2,517 WTP responses is displayed in Fig. 4. The different WTP intervals from which respondents had to choose the interval with "their" personal WTP for the RRFP are shown in this figure. Like in many other CVM studies using the PC format, the most frequent response is a WTP of zero. Four hundred seventy-three respondents (18.5 % of the sample) stated they are not willing to pay anything to support the reforestation program. Within the range of positive payment intervals, the frequency of choosing one of these intervals shows a rough tendency to decrease with increasing WTP amount except for the intervals 46–55 and 81–110 RMB. These intervals contain the "round" amounts 50 and 100 RMB, which obviously worked as an anchor.

Mean WTP is estimated following the maximum likelihood approach of Cameron and Huppert (1989). However, for our estimations, we chose to use the linear probit specification following recommendations by Crooker and Herriges (2004). On average, respondents are willing to pay 40.96 RMB per household every 3 months, which equals an annual WTP of 163.84 RMB.[5] This figure corresponds to about 0.46 % of the average annual household income. Taking into account that this amount has to be paid over a period of 5 years, this estimate yields a total mean WTP per household of 819.02 RMB. Considering that 44,392 households live in urban Jinghong at the time of the survey, we arrive at a social value of the reforestation project equal to about 36.37 million RMB. With a GDP of 5.414 billion RMB in Jinghong Municipality in 2007 (Jinghong 2008), the total value of the social benefits accruing from RRFP would amount to 0.13 % of the local GDP. Regarding the GDP contribution of the forestry sector of 1.697 million RMB, of which rubber cultivation is part, it would account for 0.43 % of the GDP of forestry. In order to get a more differentiated understanding of these figures, we have to scrutinize the determinants of WTP using regression analysis.

Determinants of WTP

The assessment of the determinants of WTP has two main purposes: one is to check the economic plausibility of the collected data and the other is to assess the distributional consequences of an environmental project. According to economic theory, people's WTP for any non-inferior commodity should increase as income increases. Therefore, WTP statements should at least not be lower for high income households than for low income households, other things being equal. Further, there are things we learned from experience with earlier studies. Typically, since better educated people have a higher awareness of environmental problems, WTP for environmental improvements increases with the level of

[5] At an exchange rate of approx. 9.6 RMB/euro when the survey was conducted, this equals 17.07 euros.

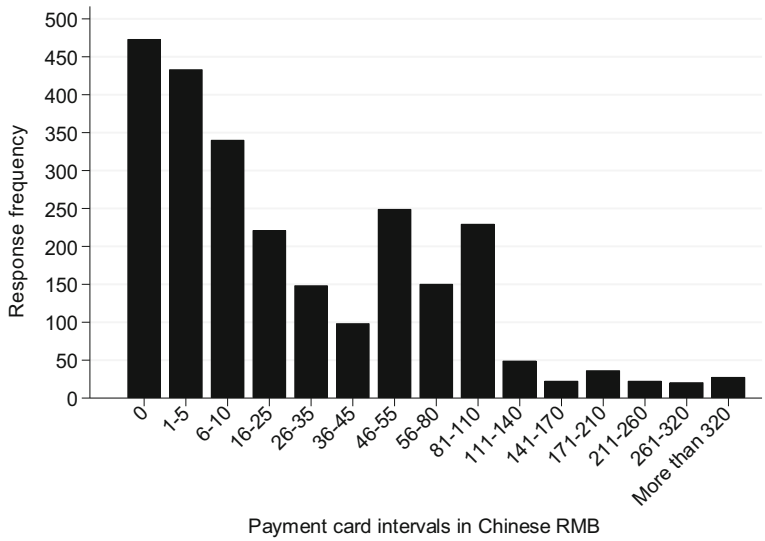

Fig. 4 Distribution of WTP responses on the payment card (N=2,517)

education of respondents (Choi 2013; Jin et al. 2013), i.e., with everything else being constant, better educated respondents are expected to state a higher WTP. It often decreases with age since older people have less time left to enjoy the environmental improvements to be valued. From the literature, it is known that men mostly state a lower WTP for environmental improvements than women (Ahlheim et al. 2010; Choi 2013) and are also expected to have a higher likelihood to state a zero WTP. Being married has often a positive influence on individual life satisfaction and, thus, on stated WTP (see H13 below), so we expect married respondents to be more likely to state a positive WTP and to state a higher amount *ceteris paribus*. Household size has an ambiguous influence on WTP for environmental improvements. It makes sense that having children increases WTP because most people show some degree of intergenerational altruism, especially when it comes to their own children. On the other hand, having a bigger family often means that there is less money left for things beyond the basic needs of the family, which tends to lower people's WTP. The net outcome of this conflict might depend on household composition, i.e., on the share of children of the total number of household members. We therefore expect a higher WTP from respondents with children but a lower WTP for larger households. These considerations lead us to another set of hypotheses for our CVM survey which are stated in analogy to H1 and are summarized in Table 5 (H2–H8):

There are also other, more complex psychological contexts that might play a role in the determination of stated WTP. Respondents who show a higher general concern about environmental issues can be expected to state a higher WTP for environmental improvements than respondents who do not care emotionally about environmental problems (Kotchen and Reiling 2000; Aldrich et al. 2007). In order to detect them, we use a set of attitudinal statements based on the New Ecological Paradigm scale (Dunlap et al. 2000) and factor analyze the responses. Three distinct factors are used in the analysis. The first of these, labeled EMOCARE, identifies "those respondents who care" and loads high on statements like:

- "I like to be in nature because I love the natural environment."
- "I don't care about environmental problems." (negative)
- "It makes me sad to see natural environments destroyed."

Resulting from the content of these highly emotional and pro-environmental statements, we expect respondents scoring high on this factor to be more likely to state a positive WTP and to be willing to pay a higher amount (H9). On the contrary, respondents who are not worried about environmental threats, no matter if they like nature or not, can be expected to state lower WTP

amounts for the rescue of the environment *ceteris paribus* (H10). These are covered by the second factor, UNCONCERN, loading high on the statements:

- "Environmental threats arising from deforestation are not as serious as it is often said; this problem has been exaggerated."
- "In my opinion, ecological conservationists are pessimistic and somewhat not normal."
- "The problem of natural resource depletion is not as bad as some people say."
- "We don't need to worry about environmental problems because science will solve them in the future."
- "Most environmental problems will solve themselves given enough time. So we don't need to take an effort to protect the environment."

When thinking of people who are interested in the state of the environment, we mainly think of those who feel emotionally attached to the environment and who feel that the environment has a value in its own. Those respondents we identify as high scorers on the EMOCARE factor. Besides these "true" environmentalists, there are also people who find environmental protection important, but not for its own sake (like those scoring high on the factor EMOCARE) but for the sake of humans. Those people support environmental protection only because they believe that a sound environment is important for mankind, i.e., the environment is seen as an instrument for the enhancement of human well-being. The third factor, called INSTRUMENT, loads high on:

- "The only reason for environmental protection is to maintain a high quality of life for humans."
- "Nature is only important because it can contribute to the well-being of humans."

Respondents scoring high on this factor support environmental conservation measures and are therefore expected to be more likely to state a positive WTP. It is also expected that these respondents state higher WTP amounts (H11). In summary, respondents scoring high on EMOCARE and INSTRUMENT should state a higher WTP than others, whereas those who score high on UNCONCERN should state a lower WTP. These hypotheses (H9–H11) are summarized in Table 5.

Another composite variable is SOC_APPROVAL, a psychological indicator of the respondent's need for social approval constructed from a 14-item question inventory.[6] It indicates a respondent's propensity to answer survey questions in a socially desirable manner. Since respondents might typically think that the interviewer is in favor of the suggested project, we expect that a high score on this variable is associated with a high WTP (H12). For the same reason, we also expect that respondents scoring high on this social desirability variable are more likely to state a positive WTP (Lindhjem and Navrud 2011) (H12). Eventually, everything else constant, we expect that people who are satisfied with their lives in general (variable name SATIS), their health (SATISHEALTH), or their job (SATISJOB) show a higher willingness to contribute personally to environmental improvements, respectively (H13).

In order to detect the major determinants of WTP and to test our hypotheses, a Heckman two-step regression model is used for the statistical estimation. This model assumes that the respondent selects a specific WTP amount in a two-step decision process. She decides first whether to state a positive WTP or to state zero. In case the respondent is generally willing to pay for the proposed project, she subsequently selects the specific amount on the PC. The idea behind this model is that the determinants of the decision to either select a positive amount or not might be different from the ones driving the specific WTP amount so that assuming a one-step decision would lead to biased parameter estimates. Employing this model, both decision steps can be integrated within one model so that the determinants of the two steps can be estimated simultaneously. The model can be written as follows (Heckman 1979; Greene 2003):

$$z_i^* = \boldsymbol{\alpha}' \boldsymbol{w_i} + u_i \tag{3}$$

with

$$z_i = \begin{cases} 1 \ if \ z_i^* > 0 \\ 0 \ if \ z_i^* = 0 \end{cases} \tag{4}$$

$$y_i = \boldsymbol{\beta}' \boldsymbol{x_i} + e_i \, if \, z_i = 1 \tag{5}$$

where

$$e_i, \ u_i \sim N\left[0, 0, \sigma_e^2, \ \sigma_u^2, \ \rho\right] \tag{6}$$

[6] The propensity of a respondent to answer to survey questions in a socially desirable manner is assessed by a modified version of the Balanced Inventory for Desirable Responding (BIDR) (Paulhus 1991) according to Börger (2012, 2013).

Table 5 Summary of hypotheses

Hypothesis	Meaning/factor variable	(a) Exp. effect on stating pos. versus zero WTP	(b) Exp. effect on amount of **WTP** if **WTP**>0
H1	Protest beliefs (cf. Table 4)	−	−
H2	INCOME	+	+
H3	EDUCATION	+	+
H4	MARRIED	+	+
H5	AGE	−	−
H6	Gender (male=1, female=0)	−	−
H7	CHILD	+	+
H8	HHSIZE	−	−
H9	EMOCARE ("Responses to attitudinal questions indicating emotional care for environmental issues")	+	+
H10	UNCONCERN ("Being unconcerned with respect to environmental problems")	−	−
H11	INSTRUMENT ("Regarding nature as instrumental to supporting human well-being")	+	+
H12	Need for social approval	+	+
H13	Life satisfaction	+	+

Equation (3) is the selection equation and models whether respondent i chooses a positive WTP (z_i= 1) or zero WTP (z_i=0). The vector $\boldsymbol{w_i}$ denotes the variables explaining the selection process and $\boldsymbol{a}$ the respective coefficients (determinants). Equation (5), the outcome equation, models the specific (positive) WTP amount y_i stated by respondent i, the vector $\boldsymbol{x_i}$ denotes the explanatory variables and $\boldsymbol{\beta}$ the respective coefficients of this process. ρ stands for the correlation coefficient between the error terms in both equations: e_i and u_i. Expected WTP given that it is positive can then be modeled jointly and be expressed as

$$E\left[y_i \middle| z_i^* > 0\right] = \boldsymbol{\beta}' \boldsymbol{x_i} + \rho\sigma_e \lambda_i\left(-\boldsymbol{\alpha}' \boldsymbol{w_i} \middle/ \sigma_u\right) \qquad (7)$$

with $\lambda_i(-\boldsymbol{\alpha}'\boldsymbol{w_i}/\sigma_u)=\phi(\boldsymbol{\alpha}'\boldsymbol{w_i}/\sigma_u)/\Phi(\boldsymbol{\alpha}'\boldsymbol{w_i}/\sigma_u)$ denoting the inverse Mill's ratio. Estimating Eq. (5) yields both the coefficient estimates $\boldsymbol{\beta}$ of the outcome equation as well as the coefficients $\boldsymbol{\alpha}$ of the selection equation in a joint estimation process. While for the coefficients $\boldsymbol{\alpha}$ marginal effects could be computed, this is not necessary for the outcome equation. These coefficients, $\boldsymbol{\beta}$, are the result of an ordinary least squares regression and their amounts can therefore be interpreted straight away.

Table 6 shows the results of the regression analysis. This model estimates the coefficients of the explanatory variables of the selection and the outcome equation. To test for the robustness of our results, we estimate models of different complexity. Model 1 is the basic model which contains only some basic sociodemographic variables. Some of them have a significant influence in the selection equation. In model 2, potential protest beliefs with respect to the proposed reforestation program and respondents' general environmental attitudes are included. In model 3, further explanatory variables describing some general psychological traits of the respondent like SATIS, SATHEALT, and SATJOB and SOC_APPROVAL are added to the model.

Starting with the decision to state a positive WTP or not (modeled in the selection equation), we find that hypothesis H6(a) is confirmed in all three models: men are less likely to state a positive WTP than women. Also, hypothesis H2(a) regarding the influence of income on the decision to state positive WTP is confirmed for all three models at a 1 % significance level. We find that also our expectations with respect to the influence of education (H3(a)), having a child (H7(a)), and household size (H8(a)) on the decision to state a

Table 6 Interval regression models displaying determinants of WTP

	Expected sign	Model 1		Model 2		Model 3	
		Coefficient	s.e.	Coefficient	s.e.	Coefficient	s.e.
Outcome equation: dependent variable: WTP interval midpoint							
CONSTANT	○	35.010***	(13.205)	26.733	(17.694)	21.913	(18.350)
Control variables		X				X	
MALE	−	7.180*	(3.837)	3.054	(4.920)	6.495	(4.204)
AGE[a]	−	−0.240	(0.180)	−0.335*	(0.193)	−1.131***	(0.249)
CHILD	+	4.892	(4.721)	8.216	(5.258)	4.755	(5.171)
HHSIZE	−	−0.027	(1.525)	−0.817	(1.722)	0.008	(1.704)
MARRIED	+	−16.263***	(4.536)	−14.136***	(4.641)	−6.869	(4.964)
EDUCATION[a]	+	7.660***	(1.749)	8.174***	(1.994)	6.087***	(1.890)
INCOME[a]	+	0.003***	(0.001)	0.002***	(0.001)	0.001*	(0.001)
UNACCEPT	−			2.150	(2.276)	2.798	(2.299)
RIGHT	−			−2.202	(3.096)	−2.194	(2.746)
DOUBT	−			1.154	(2.623)	0.049	(2.571)
TAXES	−			−4.210	(3.503)	−3.223	(2.533)
UNCONCERN	−			0.571	(2.489)	0.723	(2.296)
INSTRUMENT	+			−1.721	(1.990)	−3.441*	(2.095)
EMOCARE	+			1.725	(3.104)	−1.916	(2.600)
SATIS[a]	+					8.243**	(3.557)
SATHEALTH	+					−8.250***	(2.708)
SATJOB[a]	+					10.143***	(2.997)
SOC_APPROVAL[a]	+					1.933***	(0.710)
Selection equation: dependent variable: posWTP							
CONSTANT	○	0.687***	(0.210)	1.032***	(0.232)	1.240***	(0.387)
Control variables		X				X	
HAN	○	−0.227***	(0.069)	−0.213***	(0.076)	−0.330***	(0.097)
MALE[a]	−	−0.195***	(0.065)	−0.214***	(0.071)	−0.171*	(0.091)
AGE	−	0.000	(0.003)	−0.002	(0.003)	−0.006	(0.005)
CHILD[a]	+	0.067	(0.082)	0.154*	(0.089)	0.125	(0.115)
HHSIZE[a]	−	−0.034	(0.025)	−0.052*	(0.028)	−0.051	(0.035)
MARRIED	+	−0.003	(0.079)	−0.015	(0.086)	0.019	(0.111)
EDUCATION[a]	+	0.151***	(0.028)	0.082***	(0.031)	0.047	(0.039)
INCOME	+	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
UNACCEPT	−			−0.048	(0.041)	−0.069	(0.050)
RIGHT[a]	−			−0.138***	(0.040)	−0.202***	(0.050)
DOUBT	−			−0.073	(0.044)	−0.055	(0.056)
TAXES[a]	−			−0.216***	(0.044)	−0.218***	(0.055)
UNCONCERN[a]	−			−0.077**	(0.034)	−0.040	(0.044)
INSTRUMENT	+			0.019	(0.036)	0.049	(0.045)
EMOCARE[a]	−			0.151***	(0.031)	0.187***	(0.042)
SATIS[a]	+					0.161**	(0.079)
SATHEALTH	+					−0.057	(0.059)
SATJOB	+					−0.099	(0.066)
SOC_APPROVAL	+					0.019	(0.015)

Table 6 (continued)

	Expected sign	Model 1		Model 2		Model 3	
		Coefficient	s.e.	Coefficient	s.e.	Coefficient	s.e.
rho		−0.027	(0.130)	0.289		−0.013	(0.231)
Observations		2,236		2,048		1,451	
Log-likelihood		11,630		10,205		7,552	
Pr(chi2)		0.000		0.000		0.000	

***, **, and * indicating 1-, 5- and 10 %-level of confidence

[a] Respective hypothesis (partially) supported

positive WTP can be confirmed, though not for all models in Table 6. The protest beliefs RIGHT and TAXES have a significantly negative effect on the decision to state a positive WTP, as expected in H1, while the protest items UNACCEPT and DOUBT yield no significant results. However, contrary to the findings by Meyerhoff and Liebe (2006), our data do not show that respondents holding protest beliefs state a significantly lower WTP than other respondents. Thus, protest respondents are only found in the group of zero responses. Respondents who care emotionally for the state of the environment (EMOCARE) are significantly more likely than others to state a positive WTP, as predicted in H9(a). Also, a high level of general satisfaction with one's life (H13(a)) promotes the decision to contribute to the RRFP, while satisfaction with health or job does not have a significant effect on this decision. Our hypothesis H10(a) is also confirmed in models 2 and 3: people who are not concerned about the state of the environment (UNCONCERN) do not see the necessity to contribute financially to public projects aiming at an improvement of environmental quality. All of these results that were derived from the selection equation are plausible from a psychological as well as an economic point of view and, thus, emphasize the validity of our data. An interesting result is that Han Chinese respondents are significantly less likely to state a positive WTP for the RRFP than members of the other ethnicities in Xishuangbanna. This confirms the general impression that the Han who were either forced to migrate to Xishuangbanna during the Cultural Revolution or came later for mainly economic reasons did not develop a strong emotional attachment to this region.

Looking now at the results gained from the outcome equation in Table 6, we find that again the influence of income (H2(b)), education (H3(b)), and age (H5(b)) conform to our expectations, while marriage has a significantly negative effect on the amount of the WTP, which contradicts our expectations stated in hypothesis H4(b). Marriage might make the responsibility for the household and children more prevalent from the perspective of the respondent. Therefore, the household's budget constraint might appear tighter, which in turn could explain lower WTP statements of married respondents. While the influence of sex (H6) has the expected sign in the selection equation, the effect of being a woman on the amount of WTP in the outcome equation is now negative, although only in model 1. This contradicts the general notion of women having a "green heart" according to hypothesis H6(b). Respondents who consider the environment only an instrument to enhance people's happiness have a significantly lower WTP for the RRFP than others, which contradicts hypothesis H11(b). An explanation for this result could be that while these people accept that nature is at least a useful "tool" to enhance their quality of life, they consider the environment a poor substitute for market consumption. Therefore, they are not willing to sacrifice as much market consumption (in terms of income) as others in order to improve environmental quality.

Interestingly, respondents' satisfaction with their lives in general and with their jobs has a positive effect on the amount of their stated WTP for the RRFP as expected, whereas satisfaction with their health has a

negative influence, which contradicts hypothesis H13(b). This result might make sense if respondents view the environment only under a health enhancing aspect, the importance of which shrinks, of course, if people are satisfied with the current state of their health. Interestingly, the effects of life and health satisfaction are of the same magnitude. Our results regarding the need of social approval show that this variable has a positive influence on WTP as predicted in H12(b), i.e., high scorers on the variable SOC_APPROVAL state a higher WTP than others, presumably in an attempt to impress the interviewer.

Regarding the distributional effects accruing from the RRFP if it would be implemented without additional cost for the local people, we find that well-educated people with high incomes would benefit most from this project. Members of the Han ethnicity, older people, and married couples on the other hand would benefit less than others.

Conclusions

The increasing cultivation of rubber in Xishuangbanna and the accompanying deforestation in this area have triggered an impressive economic growth on one the hand but also led to a severe deterioration of environmental quality on the other. Rare plant and animal species which are indigenous to this region are endangered by rubber plantations encroaching the rain forests. Groundwater quality is impaired by the extensive use of pesticides and fertilizers on the rubber plantations and even the microclimate in the region has changed. In our study, we found that local people's awareness of these negative consequences of rubber cultivation is quite high.

Based on a Contingent Valuation survey in Jinghong, we assessed local people's willingness to contribute financially to the realization of a reforestation project, where rubber plantations would be reconverted into rain forest. The sum of the individual WTP statements assessed in this survey represent the monetary value of the social benefits accruing to the local population in Jinghong from the suggested reforestation program RRFP. This study also finds certain drivers of WTP among respondents. Beyond the positive effects of level of education and household income typically found in such studies, some other drivers stand out. Satisfaction with one's job and life in general explains higher WTP, but does not affect the decision between zero and positive WTP. Similarly, satisfaction with one's health status influences WTP amounts negatively but has no impact on the question whether the respondent states a positive WTP. On the contrary, environmental attitudes elicited by means of the New Ecological Paradigm scale rather affect the decision between zero and positive WTP rather than the WTP amount. Respondents who score high on the factor UNCONCERN are less likely and those scoring high on EMOCARE are more likely to state a positive WTP for the reforestation program. On the whole, we find full support for eight and partial support for 13 out of 26 research hypotheses. These findings emphasize the plausibility of the elicited WTP statements and also indicate which groups of respondents expect to gain more, or less, strongly from the proposed reforestation measures. Looking at the determinants of WTP in such detail helps us to answer the initial question of which groups would benefit more, or less, from such a reforestation effort. Together with the social benefits accruing from a realization of RRFP to tourists in Xishuangbanna and to people living in other parts of China, which are presently being assessed in a follow-up study, the results of the present study could be used for a practical implementation of a PES system in Xishuangbanna, since the costs of such a project in terms of compensation payments to rubber farmers have already been assessed by Yi et al. (2014).

Beyond informing the creation of a PES scheme, results from this study can also be used for cost-benefit analyses of land-use policies as they show the welfare effects of conservation measures. These welfare effects typically go beyond changes in prices for market goods. When elicited by means of Contingent Valuation surveys, they can be confronted to the direct economic costs of implementing such a reforestation program and ensure that all welfare effects of land-use changes are taken into account.

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Appendix

Table 7 Description of variables used in the regression models

Variable	Description	Mean	Std. dev.
MALE	Gender of the respondent (1=male, 0=female)	0.47	0.499
AGE	Age of the respondent	35.87	12.071
HAN	Respondent is Han Chinese (1=yes, 0=no)	0.64	0.481
CHILD	Respondent has a child (1=yes, 0=no)	0.66	0.474
HHSIZE	Number of household members	3.19	1.436
MARRIED	Respondent is married (1=yes, 0=no)	0.62	0.485
EDUCATION	Level of education of the respondent	3.88	1.207
INCOME	Monthly household income in Chinese RMB divided by 1,000	2.96	3.124
SATIS	Level of satisfaction with live in general	3.24	0.660
SATHEALT	Level of satisfaction with the current health status	3.26	0.813
SATJOB	Level of satisfaction with the current job	3.10	0.780
UNACCEPT	"I think it is not acceptable to value nature in terms of money." (1=agree, 0=don't know, −1=don't agree)	0.30	0.880
RIGHT	"I have a right to live in a sound environment and should not have to pay extra for it." (1=agree, 0=don't know, −1=don't agree)	−0.39	0.871
DOUBT	"I don't think that the Return Rubber into Forest Program will have the expected effects." (1=agree, 0=don't know, −1=don't agree)	−0.12	0.792
TAXES	"Taxes and fees of residents of Jinghong are already so high that there should be no additional financial burden." (1=agree, 0=don't know, −1=don't agree)	0.22	0.872
UNCONCERN	Environmental attitude factor: no concern for environmental problems	0.00	1.000
INSTRUMENT	Environmental attitude factor: seeing primarily the instrumental value of the natural environment with respect to human wellbeing	0.00	1.000
EMOCARE	Environmental attitude factor: caring for the environment on an emotional level	0.00	1.000
SOC_APPROVAL	Psychological inventory measuring respondent need for social approval as [0,14]	6.67	3.010

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