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THE ECOLOGICAL PRICE OF GETTING RICH IN A GREEN DESERT: A CONTINGENT VALUATION STUDY IN RURAL SOUTHWEST CHINA

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The ecological price of getting rich in a green desert: A contingent valuation study in rural Southwest China

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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 rainforests 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 these environmental costs of the economic progress in Xishuangbanna. To this end a Contingent Valuation survey is conducted to elicit local residents' willingness to pay for a reforestation program that converts existing rubber plantations back into forest. It is shown that though local people's awareness of the environmental problems caused by increasing rubber plantation is quite high their willingness to pay in order to change things is rather low. It seems that from the perspective of local residents the economic advantages of rubber cultivation outweigh the resulting environmental threats. Another explanation of the low willingness to pay stated in this survey might be the fact that many respondents consider taxes and fees already too high in China so that they are not willing to make any further contributions to whatever purpose.

Keywords: Rubber cultivation, deforestation, contingent valuation method, environmental costs, China

1. Introduction

Deforestation as a result of rising demand for agricultural land is an often reported environmental problem. In the case of tropical Southeast Asia, 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 been witnessing a rapid expansion of rubber monocultures at the expense of both the formerly undisturbed tropical rainforest coverage and traditional systems of shifting cultivation. While

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before the reform of the Chinese agricultural system in the 1980s rubber cultivation was strictly limited to socialist state farms today also smallholder 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 of 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. While it only accounts for 0.2% of the land area of the People's Republic of China (cf. figure 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.

Figure 1: Map of Xishuangbanna Prefecture and its location in China (LILAC 2006)

New rubber plantations established in the last two decades were planted almost exclusively on former forest plots on sloping hillsides, since the valley bottoms are used for the cultivation of paddy rice and other crops. It is thus 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.

Not surprisingly, this development has attracted the interest of natural and agricultural scientists. Yet, while these studies focus on the natural science perspective of the land-use changes and their environmental consequences (e.g. Ziegler et al. 2009), there is still no welfare economic assessment of these developments. 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 will be 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. To this end a contingent valuation survey was conducted in this region, namely in the city of Jinghong.

The remainder of this paper is structured as follows. Section 2 sketches the development of the rubber industry in Xishuangbanna including an overview of the environmental consequences. In section 3 the Contingent Valuation Method (CVM) and its welfare-theoretical background are shortly introduced and then information on the implementation of the survey in Xishuangbanna is provided. Section 4 presents the results of our study and section 5 provides our conclusions.

2. The development and environmental impact of rubber cultivation in Southwest China

2.1. The development of the rubber sector in Southwest China

Rubber trees are not a native species of Southern Yunnan and were introduced in Xishuang-banna only in the 1950s. Traditional land use before the founding of the People's Republic of China (PRC) in 1949 consisted of paddy rice and vegetable growing in the valley bottoms and several plains in the region. This was predominantly in the hands of the ethnic group of the Dai. Other ethnicities mainly settled in the uplands and practiced shifting cultivation or were hunters and gatherers. After the new Chinese state had been established 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 minorities were not recruited but left with their existence and subsistence farmers for mainly political reasons. 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 minorities were regarded as backward and not up to use modern production techniques (Sturgeon and Menzies 2006). Therefore, the smallholder farmers belonging to the ethnic minorities did not grow rubber trees.

It was only from the early 1980s that this clear divide started to erode. On the one hand, the remigration of state farm workers who had come to Xishuangbanna from other parts of the country in the course of the educated youth campaign in the early 1970s and the resulting labor shortage made state farm managers hire minority workers as substitutes. One the other hand, the introduction of fundamental reforms of the Chinese agricultural sector changed the economic setting by allowing smallholder farmers to cultivate rubber trees on their allocated plots. This marked the starting point for 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 state’s policy to make minority smallholder farmers plant rubber 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 was also 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 on plots below 1000 meters above sea-level. On plots

above this threshold, it is mainly the cultivation of tea and also bamboo that led to large-scale deforestation. 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 to cultivate rubber trees even on steep mountain slopes, more and more primary and secondary forest land has been transformed into rubber plantations.

On plots up to 1000 meters above sea level, rubber plantations have become by far the dominating form of land use in Xishuangbanna. With around 400,000 hectares of plantations rubber trees today cover 20% of the prefecture's surface (Qiu 2009). 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.

2.2. Economic benefits versus environmental degradation

The huge 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. Within China Xishuangbanna is a very important rubber production base delivering 35% of the total 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 increase 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.

Along with the undeniable economic benefits for the rubber farmers and the whole region this trend entails many negative ecological and environmental consequences. First and foremost, 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 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 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 in forest cover on species composition and

biodiversity. This is especially important since Xishuangbanna and the surrounding area constitute a biodiversity hotspot of global importance.

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. On the one hand, this is due to the fact that the trees have to compensate for the tapped latex. On the other hand, the lack of the cooling effect of rain forest vegetation results in increased 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 production in monocultures requires the use of high amounts 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. As a consequence, this land use change 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 (ESS) resulting from large-scale rubber cultivation can be found in Hu et al. (2008). The authors find that except for raw material production all other types of ESS such as nutrient cycling, climate regulation and the provision of habitat decrease when rain forest is converted into rubber monocultures.

2.3. Contribution of this study – The anthropocentric perspective

From these considerations it follows that rubber cultivation in Xishuangbanna constitutes "a classic standoff between economics and ecology" (Mann 2010, p. 565). Yet, while natural scientific assessment draws a very clear picture of the ecological decline resulting from large-scale rubber cultivation, it is still an unanswered question how these changes are perceived by the population. Are local citizens aware of the trade-off between fast economic development on one hand and the preservation of the environmental heritage of the region on the other? Therefore, the present study aims at the quantification of the social costs in terms of a decline in the wellbeing of the population which follows from the large-scale rubber cultivation in Xishuangbanna Prefecture. Unlike the work of Hu et al. (2008) who employ the more natural science-based valuation approach of Costanza et al. (1997), this study takes a strictly anthropocentric and preference-based perspective towards the economic valuation of environmental goods. In this anthropocentric study based on the

Contingent Valuation Method the heterogeneous environmental consequences of rubber plantation (biodiversity loss, deterioration of water supply, change of microclimate etc.) are aggregated to a single number, i.e. people's willingness to pay (WTP) for an amendment of these negative consequences. To this end, the perception of environmental degradation by urban residents of Jinghong is investigated and their willingness to pay to remedy part of the damage is assessed.

3. Methodology

3.1. Willingness to pay for improvements in environmental quality – The Contingent Valuation Method

As explained above 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 wellbeing 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 the household's income and z^0 and z^1 are two vectors of characteristic environmental parameters describing the state of the environment before and after the environmental improvement, respectively. Equation (1) shows how with this anthropocentric approach of economics the changes of various different environmental characteristics like water quality, biodiversity etc. are aggregated to a single number $U_h = v_h(p, z, I_h)$ which describes the maximum utility the household can attain with prices p, income I and the state of the environment characterized by the vector z. This aggregation of heterogeneous environmental attributes via people's preferences is one of the most decisive differences between the economic approach to environmental valuation and the natural science approach. One of the consequences of this approach is that in the world of environmental economics there is no such thing as an intrinsic value of some plant or animal. For economists only those things count that are perceived and valued by man.

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 get the environmental improvement from z^0 to z^1 realized. This amount equals their WTP for the environmental improvements according to

$$v_h(p, z^1, I_h - WTP_h) - v_h(p, z^0, I_h) = 0 \quad (2)$$

This kind of monetary valuation of environmental changes underlines the trade-off between material wealth on the one hand and environmental quality z on the other which is characteristic of developments like those observed in Xishuangbanna: higher incomes of households are reached at the cost of environmental deterioration. If this development is reversed e. g. by reforestation of rubber plantations, this will lead to improved

environmental quality and income losses. In order to assess how much people value these environmental improvements we ask them the maximum income loss to which they would agree in order to get these improvements realized. This would be the income variation that would exactly compensate the positive environmental change from z^0 to z^1 in terms of utility, i. e. the Hicksian Compensating Variation. This is shown in (2).
The overall social value SOC of the environmental improvement from z^0 to z^1 is then measured by adding up the individual WTP_h of all H households affected by this change, i. e.

$$SOC = \sum_{h=1}^{H} WTP_h. \quad (3)$$

This value can then be compared to the overall income losses that would come along with the realization of such an environmental improvement, e. g. a reforestation program for rubber plantations. Since those households who would benefit most from such a program have the highest WTP for its realization, such a WTP analysis can also highlight the redistributive effects of an environmental enhancement policy.

There are many different valuation methods aiming at the assessment of people's willingness to pay for environmental improvements (cf. e. g. Ahlheim / Frör 2003). In this study here we use the Contingent Valuation Method. The CVM is an interview-based valuation method where households from a representative sample are asked directly their WTP for a certain environmentally enhancing project. The selected survey sample should be representative of the whole population affected by the change in environmental quality, so that the survey results can be extrapolated to calculate society's aggregate WTP, which is interpreted as the social value of the positive change in environmental quality.

Practical CVM surveys typically start with a set of questions regarding the respondents' knowledge of and awareness for the respective environmental problem. Then a thorough description of the policy scenario (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. This could be a tax, a fee or any other type of monetary payment. Thereupon the so-called elicitation question follows where respondents are asked their maximum WTP for the project in question. There are different elicitation question formats. In this study we employed the so-called payment card (PC) approach where respondents are asked to select the amount of their household's WTP from a list of different payment intervals. Additionally, CVM questionnaires often include extensive sets of attitudinal and socio-demographic questions. These aim at an assessment of the motives and determinants of the individual WTP statements.

3.2. Contingent valuation in China

The CVM has a rather short history in the People's Republic of China. Most CVM studies in China reported in the literature were conducted 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, Wang and Zhang 2009, Wang et al. 2007), 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, Xu et al. 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. An exception is Xu et al. (2006) who compare different forms of the elicitation question. In another study, Du (1998) compares valuations for an urban lake derived from a CVM survey to the results gained from a travel cost study.

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. Although the negative environmental effects of rubber cultivation are undisputed from a scientific point of view this might be less obvious from the perspective of citizens living in the area. One reason for this discrepancy might be the fact that rubber plantations still constitute a type of forest. To the eye of a layman the plantations look very neat and quiet and green and they are also officially classified as forest cover by local authorities (Sturgeon and Menzies 2006). Furthermore, the loss of soils, water resources and biodiversity cause 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 as 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.

3.3. The survey

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

The questionnaire used for this survey consists of five parts. After an introduction to the purpose of the study the first part contains questions regarding the respondents' knowledge of and familiarity with rubber cultivation and its environmental consequences. After that, parts two and three introduce the project scenario and the payment scenario, respectively. The scenario to be evaluated by respondents is a reforestation project implemented in a nearby nature reserve area (cf. figure 1). This "Return-Rubber-into-Forest" project as it was called in the survey was designed to resemble the sloping-land-conversion program[4] (Bennett 2008), a policy measure implemented nationwide by the Chinese government and well known to the survey population. During the survey interview, respondents were

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

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 renaturation 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 pesticides 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.

Subsequently, the payment vehicle was introduced. Respondents were informed that 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 three months over a time span of five years. WTP statements had to be made on a payment card (PC). These payment specifications were the result of the in-depth interviews and the CEG meetings. Part four, the elicitation question, formed the core of the interview, in which respondents were presented the PC and asked to indicate their households' maximum WTP for the proposed reforestation project. The fifth part consisted of a series of demographic and attitudinal questions aiming at the assessment of potential determinants of WTP.

A representative 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. Overall, by means of this procedure a list of 44,392 households could be constructed from which a random sample of desired size could be drawn.

4. Results and analysis

4.1. Sample characteristics

Out of the 2,606 completed questionnaires 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 1.

Table 1: Demographic characteristics of the survey sample

Variable	Mean	Standard deviation
Male	.466	.499
Age	35.9	12.1
Household size	3.19	1.44
Monthly income (in RMB)	2959.88	3123.65

Average reported monthly household income amounts to 2,960 RMB.[5] 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.

4.2. Level of awareness and understanding of the environmental problem

The first part of the questionnaire contains a set of questions regarding the level of awareness of the environmental problem of respondents. 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 pre-test phase of the survey, respondents were asked to name both positive and negative consequences of rubber cultivation. Those environmental effects 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 5-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. 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.

[5] At an exchange rate of approx. 9.6 RMB/Euro when the survey was conducted this equals 308.33 Euros.

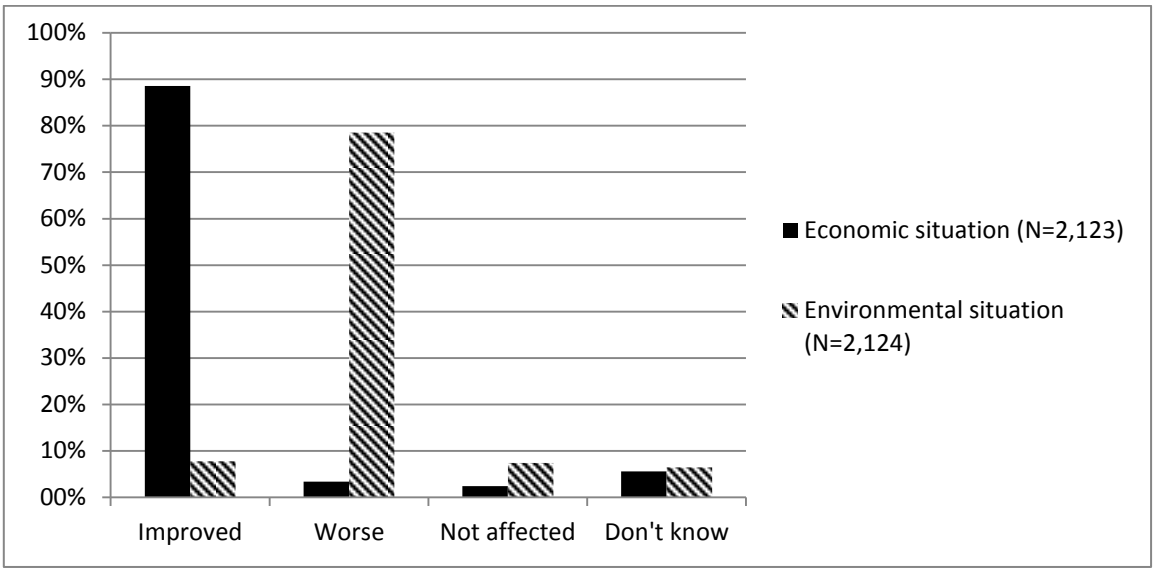
Table 2: Rating of seriousness of environmental consequences of rubber cultivation.

Consequence	Mean*	"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%

* On a 5-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. Again, 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. How respondents judge the economic and environmental development in recent years is displayed in figure 2. It turns out that 88.6% of respondents perceive an improved economic situation in Xishuangbanna. At the same time, 78.5% of respondents 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 pre-test respondents had put it. Thus, the antagonism of economic development and environmental conservation is very obvious to the large majority of respondents. 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.

Figure 2: Responses to the questions: "How do you think the … situation of people in Jinghong has been affected by rubber cultivation in Xishuangbanna?"



After the presentation of the reforestation program and the WTP question respondents are asked to answer a set of attitudinal questions. The results of four key questions covering reasons to give so-called protest responses are displayed in table 3. The most striking result is the high share of respondents who agree to statements ACCEPT and TAXES. Responses to the first question reveal that almost 6 out of 10 respondents oppose the idea to value 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 he deems the financial burden caused by taxes and fees in China to be too high.

Table 3: Responses to attitudinal questions indicating protest beliefs

Variable	Question wording	Agree	Don't know	Don't agree	N
ACCEPT	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

4.3. WTP for reforestation of rubber plantations

In a next step respondents' evaluation of the proposed reforestation program in the form of WTP statements is analyzed. When the effects of the different treatments are controlled for by dummy variables respondents in the overall sample are willing to pay on average 40.96

RMB every three months, which equals an annual WTP of 163.84 RMB[6]. 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 five 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. If this figure is interpreted as an indicator of the environmental cost of rubber cultivation in the Nabanhe National Nature Reserve it can be compared to the overall economic performance of the region. With a GDP of 5.414 billion RMB in Jinghong Municipality in 2007 (Jinghong 2008), the total environmental cost resulting from the confined area in the nature reserve over five years amounts to 0.13% of GDP. Regarding the GDP contribution of the forestry sector of 1.697 million RMB, of which rubber cultivation is part, it accounts for 0.43% of the GDP of forestry. In order to get a better understanding of these figures we have to scrutinize the determinants of WTP using a regression analysis.

4.4. Determinants of WTP

In order to detect the major determinants of WTP interval regression models are computed. Table 4 gives coefficient estimates for explanatory variables. In Model 1 dummies for the experimental treatments and basic socio-demographic variables are included. Several of the latter variables have a significant influence on WTP statements. Both the age of the respondent and the fact that he is Han Chinese negatively affect WTP. Similarly, married respondents have a significantly lower WTP than unmarried respondents. In contrast to this the levels of education and household income have a significantly positive effect on WTP statements. Except for HAN and MARRIED, these effects are robust throughout the two models displayed in table 4, in which different sets of explanatory variable are employed.

In the second model factors describing respondents' level of satisfaction with certain aspects of life as well as potential protest beliefs are included. While the level of overall life satisfaction (SATIS) and satisfaction with one's job (SATJOB) affect WTP in a positive way this effect is significantly negative for satisfaction with one's health (SATHEALT). The latter effect indicates that respondents who are dissatisfied with their health status are willing to pay more in order to benefit from the positive consequences of the reforestation program.

Regarding protest beliefs the coefficients of two beliefs, RIGHT and TAXES turn out to be significantly negative. That means that respondents who think that they have a right to live in a sound natural environment without paying and those who feel that there are already too many taxes and fees for Jinghong residents state a significantly lower WTP. In contrast to this, the effects of a general opposition to the economic valuation of nature (ACCEPT) and doubts whether the reforestation project will really produce the promised benefits (DOUBT) are not significantly different from zero.

[6] At an exchange rate of approx. 9.6 RMB/Euro when the survey was conducted this equals 17.07 Euros.

Table 4: Interval regression models displaying determinants of WTP

	Model 1		Model 2	
	Coef.	s.e.	Coef.	s.e.
CONSTANT	22.16***	7.68	11.30	11.19
Control variables	X		X	
AGE	-0.27**	0.11	-0.66***	0.15
MALE	2.37	2.34	1.19	2.57
HAN	-4.67*	2.43	-3.29	2.64
CHILD	3.14	2.95	4.54	3.29
HHSIZE	-0.10	0.94	-0.58	1.05
MARRIED	-9.19***	2.84	-5.57*	3.22
EDUCATION	7.76***	1.00	6.20***	1.13
INCOME	+0.00***	0.00	+0.00***	0.00
SATIS			7.35***	2.24
SATHEALT			-4.45***	1.68
SATJOB			6.31***	1.88
ACCEPT			1.39	1.44
RIGHT			-4.38***	1.52
DOUBT			-1.28	1.60
TAXES			-6.24***	1.51
Observations	2,236		1,713	
Chi-squared	0.000		0.000	

*** means significant at the 1%-level, ** 5%-level, * 10%-level.

5. Conclusions

The increasing cultivation of rubber in Xishuangbanna and the accompanying deforestation of rainforests in this area have triggered an impressive growth of economic wealth on the one hand while leading 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 rainforests, 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 while their willingness to contribute personally to an improvement of the situation turned out to be astonishingly low. The reasons for this contradiction might be due more to the nature of Contingent Valuation studies than to people's attitude towards environmental deterioration following the increasing rubber cultivation in Xishuangbanna. From our survey we found that significant reasons for low WTP statements were (1) that people think that they have the right to live in an intact environment without having to pay for it and (2) that they feel that taxes and fees are already too high in China. The first reason aims at the very heart of the Contingent Valuation Method, which crucially depends on people's readiness to pay for environmental improvements, while the second reason questions our choice of a payment vehicle, i. e. monetary contributions to an environmental fund in addition to already existing taxes and

fees. It was also disturbing that nearly 60% of the respondents agreed with the statement "I think it is not acceptable to value nature in terms of money" though the approval of this statement turned out not to be significantly correlated with lower WTP statements.

Since it will be difficult to find a credible payment vehicle that does not remind people of other money payments they have to make for government services and since money payments for environmental goods are intrinsic to CVM studies, our findings question the reliability of CVM results in societies like the one we surveyed in Xishuangbanna. In the case of the present study where a high percentage of respondents stated that they found the ecological consequences of increasing rubber cultivation rather serious, while their stated WTP for an amendment of these consequences was rather low on average, it is to be suspected that their true appreciation of a program where rubber plantations are reconverted into rainforest is much higher than expressed by their stated WTP. The question arises if and, if yes, how this true appreciation could be elicited within the framework of Contingent Valuation studies. This will be an important topic of future research in this field.

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Appendix

Table A.1: Description of variables used in the regression models

Variable	Description	Mean	Std. dev.
AGE	Age of the respondent	35.87	12.071
MALE	Gender of the respondent (1 = male, 0 = female)	.47	.499
HAN	Respondent is Han Chinese (1 = yes, 0 = no)	.64	.481
CHILD	Does the respondent have a child (1 = yes, 0 = no)	.66	.474
HHSIZE	Number of household members	3.19	.674
MARRIED	The respondent is married (1 = yes, 0 = no)	.62	0.485
EDUCATION	Level of education of the respondent	3.88	1.207
INCOME	Monthly household income	2,960	3,124
SATIS	Level of satisfaction with live in general	3.24	.660
SATHEALT	Level of satisfaction with the current health status	3.26	.813
SATJOB	Level of satisfaction with the current job	3.10	.780
ACCEPT	"I think it is not acceptable to value nature in terms of money." (1 = agree, 0 = don't know, -1 = don't agree)	.30	.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)	-.39	.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)	-.12	.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)	.22	.872

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