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The Social Value of Environmental Improvements in the Tarim Basin – toward a Comprehensive Assessment in a Heterogeneous Setting

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Abstract

The benefits of environmental restoration projects are frequently underestimated because decision makers tend to ignore the non-use values of such projects. Using data from a representative contingent valuation survey conducted in Beijing in 2013 and of information gathered during five focus group workshops in Xinjiang, we show that environmental improvements in the Tarim Basin in Northwest China would not only enhance the wellbeing of the local population but also of people living in other parts of the country. In both study sites we find similar preferences for various ecosystem services and the mitigation of environmental problems. Furthermore, respondents from Xinjiang and Beijing were willing to contribute approximately equal shares of their income to a prospective environmental project aimed at the restoration of the Tarim Basin's natural ecosystems. We conclude that government representatives should consider the preferences of people from all parts of China when deciding on future land and water management strategies in Northwest China.

Keywords: environmental protection, Tarim River Basin, cost-benefit analysis, non-use values, contingent valuation method

1. Introduction

The Tarim Basin owes its name to Central Asia's longest inland river, which is the Tarim River. Because of the extremely arid climate, little precipitation and high evaporation humans and nature in the Tarim Basin strongly depend on water provision by the Tarim River (Thevs, 2011). The Tarim Basin is located in the southern part of Xinjiang Uyghur Autonomous Region in Northwest China. In spite of its enormous size of almost one million km^2, the basin is scarcely populated. This is because a large part of the Tarim Basin is covered by the Taklimakan Desert or mountains and therefore uninhabitable. About half of the eight million inhabitants live in the basin's oasis cities along the Tarim River (Huang et al., 2010).

Unique but highly vulnerable dryland ecosystems, which are of great significance for local people's livelihoods, can be found in the Tarim Basin. Due to an increasingly intensive land use in that area the quantity and quality of natural ecosystems has been decreasing. The still existing riparian poplar forests, reed beds, grasslands and shrub vegetation provide essential ecosystem services (ESS) to the local population. Among other things, local farmers use the riparian forest and the grasslands as pasture for hay-making to feed sheep and goat. Some native plants are traditionally used as natural medicines. The riparian forests and shrubs protect the oasis cities from sandstorms and dust. The flooded areas of the riparian forests and reed beds facilitate the recharge of groundwater with fresh river water. Since groundwater is a main freshwater resource, local households directly

benefit from this service of the riparian ecosystems. Furthermore, the poplar forests along the Tarim River are an attraction for Chinese and international tourists. Most importantly, these forests build a 'green corridor' which separates the Taklimakan Desert from the southern part of the Gobi Desert (Halik et al., 2005).

However, the importance of the natural ecosystem for local people's livelihoods has been recognized only lately by the Chinese authorities. For a long time, environmental protection played a minor role for water and land management decisions in the region. Since water was mainly allocated to industry, households and man-made ecosystems like cotton fields, the natural ecosystems continuously deteriorated. Without doubt, one of the reasons for overlooking the benefits from natural ecosystems is that nature provides them for free so that none of the usual indicators of value, like e.g. market prices, exist to inform decision makers about the actual value and the increasing scarcity of natural ecosystems and the services they provide to society. For Chinese policy makers managing the ecosystem services in the Tarim region it is, however, essential to have a valid measure of the social value of such services at hand.

In the present study we make use of the Contingent Valuation Method (CVM) – one of several nonmarket valuation techniques – to assess the social value of more sustainable water- and land-management strategies in the Tarim Basin which would lead to a restoration and long-term protection of the natural vegetation along the Tarim River. Unlike previous studies, which made use of market-price based approaches to assess the use value of natural ESS (e.g. Xu et al., 2014), the present paper aims to derive a more comprehensive value assessment, including both use and non-use values of the natural environment along the Tarim River. Following Ahlheim et al. (2013), it is argued that not only the benefits accruing to the local population but also those accruing to people living in other parts of China should be assessed. In the present study we combine the results of a nonmarket valuation study carried out in Xinjiang with those of an exemplary comprehensive CVM survey conducted in Beijing. We show that, for the case of ecosystem services of nationwide importance, both regional and long-distance values need to be thoroughly accounted for in order to obtain a comprehensive value estimate of such services. An important contribution of this paper is the joint analysis of environmental values based on methodologically different valuation studies adapted to their specific survey contexts in a heterogeneous country.

2. Background and Purpose of the Present Study

2.1 Degradation of Natural Ecosystems in the Tarim Basin

Until the 1950s mainly Uighur farmers lived in the Tarim Basin and the region was hardly developed economically. The economic development of Xinjiang has been successfully driven forwary by the Chinese government since the 1950s. More and more Han Chinese workers settled down in the Tarim Basin. One of the main drivers of Xinjiang's economic development and population growth is the cotton industry. Today one sixth of China's total cotton output is produced in the Tarim Basin (Hirji & Davis, 2009). Along with the population growth, GDP and income levels have been increasing in the region. The oasis cities along the Tarim River have been growing and local firms as well as households have benefited from public investments into the region's economy and infrastructure. At the same time, the growth of the population, intensive agricultural activities, especially the water-consuming cotton production, and industrial development have contributed to permanent water shortage in the lower reaches of the Tarim River thereby causing severe environmental deterioration (Zhang et al., 2010). The environmental consequences of the progressing deterioration of the natural riparian ecosystems caused by the reduced runoff of the Tarim River include, to list but the most severe problems, more sandstorms than in the past, an increasing number of dust days, desertification of the landscape and dramatic loss in biodiversity (Thevs, 2011). Obviously, the economic development of the region has been realized at the cost of a degrading environment. Natural degradation is likely to become even more serious under the impact of global warming, at least in the long run. Chen et al. (2013) and other climate experts predict increasing temperatures, changes in seasonal precipitation and melting of glaciers. Under these circumstances the Tarim River may desiccate completely. This would imply the merger of the Taklimakan Desert and the southern part of the Gobi Desert. In other words, the Tarim Basin would not be habitable anymore and unique dryland ecosystems would be lost forever.

Since the 1990s the degradation of the natural ecosystems in the Tarim Basin has gained increasing attention, both at the Chinese and the international level. The impact of land and water management decisions on the state of the environment has been readily understood and China's Central Government has undertaken a number of measures to restore and protect the natural vegetation along the Tarim River. With the support of the World Bank institutions responsible for the water allocation in the upper, middle and lower reaches of the Tarim River have been created. According to Lu et al. (2010) the Chinese government has invested approximately 11 billion RMB into water management projects aiming at a restoration of the natural ecosystems in the Tarim Basin. Furthermore, scientists have contributed to a better understanding of how water and land use affect

environmental conditions in the region (cf. e.g. Xu et al., 2008, Zhang et al., 2010, Huang et al., 2010). In spite of an increasing awareness of the water-related environmental issues, the integration of natural ecosystems into land and water management decisions appears to be difficult and insufficient – the deterioration of the natural environment in the lower reaches of the Tarim River continues.

2.2 Objectives of the Present Study

As highlighted above, the natural ecosystems along the Tarim River contribute to the wellbeing of the local population in multiple ways. Furthermore, natural scientists have developed sophisticated methods and models to predict and analyze the impact of changes in the water allocation on the state and quantity of the natural ecosystems (e.g. Xu et al., 2007, Huang et al., 2010). Moreover, several researchers have made concrete proposals to the responsible authorities concerning the technical and political measures needed to restore, preserve and protect the natural vegetation along the Tarim River in the long term (cf. e.g. Zhang et al., 2010, Chen et al., 2013). Based on this information the costs of different water distribution and land management schemes can be determined rather straightforwardly on the basis of market prices like wages, capital costs and material costs. However, to weigh these costs against the benefits, the value of the restoration of the natural ecosystems through more sustainable land and water management strategies needs to be quantified and monetized as well. Obviously, there are no market prices available for environmental goods such as wildlife, landscape beauty, improved air quality, etc. However, such data is indispensable for a comprehensive cost-benefit analysis of alternative water- and land-management policy options. Before implementing a particular environmental project, decision makers should verify whether society would be better off subsequent to the implementation of this project. In other words, they should ensure that the social benefits accruing from the environmental project in question outweigh its costs.

Huang et al. (2010) made a first attempt to estimate the change in value of the ecosystems in the lower reaches of the Tarim resulting from changes in water allocation. The authors computed unit prices for the cropland, forest, grassland, wetland and desert ecosystems for the period 1970-2005. Market prices of the outputs of these ecosystems served as the basis for the valuation approach. The unit price for croplands, for example, is based on natural grain output of croplands and market prices for crops. Huang et al. (2010) showed that the value of forest, grassland and wetland had been gradually shrinking due to decreases in the total area covered by these ecosystems and diminishing capacities in ESS supply. The results of Huang et al.'s (2010) market-price based evaluation are a suitable reference for the evaluation of environmental projects implemented in the Tarim Basin in the past. Nevertheless, these results are hardly helpful for cost-benefit assessments of prospective environmental projects. In addition to that, market price based methods generally underestimate the true social value of ecosystems. This is because so-called non-use values accruing from the restoration and preservation of an ecosystem, which are not reflected by market prices, are likely to alter its social value (cf. Nunes, 2002).

In the present study a different approach for determining the monetary value of the natural ecosystems along the Tarim River will be introduced. We make use of the contingent valuation method (CVM) to assess the social benefit of a prospective environmental restoration project in the Tarim Basin. This survey-based technique aims at determining the value of an environmental improvement by eliciting households' maximum willingness to pay (WTP) for a hypothetical environmental restoration project. In economics, the overall benefit of an environmental project is commonly computed as the sum of the WTP of all individuals affected by that project (cf. section 3.1). The results of a comprehensive CVM survey implemented in different Chinese cities in 2013 regarding common people's perceptions of the degradation of the natural ecosystems along the Tarim River as well as their WTP for an environmental restoration project will be presented and analyzed in the following.

Until now hardly any comparable CVM study has been published. Firstly, the assessment of 'long-distance benefits' of environmental projects by means of the CVM has attracted the attention of only a few researchers (cf. e.g. Jørgensen et al., 2013; Ahlheim et al., 2013). Secondly, survey studies from Xinjiang in general, and CVM studies in particular, are extremely rare. The political and social circumstances in Northwest China are likely to be one of the reasons for this lack of research. Ethnic unrest, increased security measures and mistrust towards social scientists complicate the conduct of interviews with Xinjiang's population. However, a few researchers successfully implemented surveys on environmental topics in this region. Deng et al. (2011) and Deng et al. (2012), for example, investigated how a number of climate change adaptation measures, such as public water-saving programs, were perceived by residents in the Urumqi River Basin and the Aksu River Basin. However, they did not aim to assess the social value of a particular ecosystem or environmental restoration project. Xu et al. (2014) conducted a CVM survey with Han Chinese farmers working in the State Farms at the upper, middle and lower reaches of the Tarim River to assess the social value of the protection of the local poplar forests. Most interviewed farmers expressed a favorable opinion concerning the protection of poplar forests, but

relatively few were willing to make a financial contribution to it. In contrast to Xu et al. (2014), who exclusively focused on the preferences of a particular group of local residents (Han-Chinese farmers employed by the state farms), in a pilot study Ahlheim et al. (2013) addressed the question how the degradation of the natural ecosystems along the Tarim River was perceived by people living far away from the Tarim Basin. Based on an intercept CVM survey in the city of Beijing, they showed that also people who are only indirectly affected by the environmental problems in the Tarim Basin were willing to make financial contributions to the realization of an environmental restoration project in this region. They stressed that decision makers should not only consider the preferences of people living at a particular environmental site but also of people living in other parts of the country when determining the value of environmental projects of national importance, like the Tarim project. In this pilot study, of course, it was not possible to conduct a comprehensive assessment of use and non-use values to be expected from such an environmental restoration project. With only 300 individuals interviewed it was necessary to employ a second-best elicitation question format like the payment card instead of the incentive compatible but less efficient dichotomous choice format. Further, no suitable validity tests could be carried out with this small sample size. Finally, the pilot study exclusively focused on Beijing citizens' preferences but did not include the question as to how the local population in Xinjiang perceives the environmental deterioration of the Tarim Basin. To overcome these limitations of the pilot study, a more comprehensive and sophisticated CVM study was carried out in 2013.

In this study, we make use of a refined WTP question and a larger sample to assess the 'long-distance value' of an environmental restoration project in the Tarim area. Using econometric techniques, the validity of the WTP estimate will be tested. Furthermore, the preferences of people indirectly affected by the public project in question will be compared to the preferences of the local population, including Han Chinese residents and also residents with other ethnic backgrounds.

3. Method

3.1 The Contingent Valuation Method

In economics the social value of a particular environmental improvement is measured as the change in wellbeing of all households affected by the improvement in question. The change in wellbeing, or utility, of a single household can be written in terms of the indirect utility function $\upsilon_h(.)$, which describes the maximum utility a household can reach given its income (I_h), market prices (p) and the state of the environment (z).

$$\Delta U_h = U_h^1 - U_h^0 = \upsilon_h(p, z^1, I_h) - \upsilon_h(p, z^0, I_h), \tag{1}$$

where z^0 is a vector of environmental parameters that refer to the state of the environment in the initial situation and z^1 a vector of environmental parameters describing the state of the environmental subsequent to the environmental improvement. The indirect utility function is monotonically increasing in environmental quality z. Thus, in the case of an environmental improvement ($z^1 > z^0$), the change in utility ΔU_h is positive (Stephan & Ahlheim, 1996).

The utility change described in equation (1) can also be expressed in terms of the expenditure function $e_h(.)$, which describes the minimum (monetary) expenditures a household has to make to reach a particular utility level. The expenditure function is monotonically increasing in utility, i.e. higher utility levels are reached by an increase in consumption. Taking the new state of the environment (z^1) as reference (assuming that prices stay constant) we obtain the Hicksian Compensating Variation (HCV) for a household h:

$$HCV_h = e_h(p, z^1, U_h^1) - e_h(p, z, U_h^0) = I_h - e_h(p, z^1, U_h^0), \tag{2}$$

Assuming that the household spends its entire income on consumption goods, the HCV_h just equals the household's income minus the (fictional) expenditure it would have to make to get back to its initial utility level U_h^0, given constant market prices p and the new state of the environment z^1. In the case of an environmental improvement, the HCV_h is positive because the household's income exceeds the minimum expenditure necessary to reach the initial utility level. The HCV_h can also be included in the indirect utility function, leading to the following expression:

$$\upsilon_h(p, z^1, I_h - HCV_h) - \upsilon_h(p, z^0, I_h) = 0, \tag{3}$$

As can be seen in equation (3), the HCV_h is the maximum amount of money that can be taken away from the household's income without making it worse off than in the situation before the environmental improvement. It

is typically interpreted as the household's maximum willingness to pay (WTP_h) to obtain the environmental improvement (Carson & Hanemann, 2005).

The sum of individual HCVs yields a measure of the overall value or social benefit (B^{soc}) of all households H affected by the environmental improvement in question. In practice, it is approximated by summing up the individual WTP_h amounts, i.e.

$$B^{soc} = \sum_{h=1}^{H} HCV_h \approx \sum_{h=1}^{H} WTP_h . \quad (4)$$

The obtained value can then be compared to the cost of an environmental project, for example, the public funds needed to realize an environmental restoration project.

Over the past decades several methods for the assessment of people's WTP for environmental improvements have been developed (cf. e.g. Ahlheim & Frör, 2003, Atkinson & Mourato, 2008). The present study makes use of the Contingent Valuation Method. The CVM is an interview-based technique where a market for an environmental good is simulated and the good's social value is inferred from respondents' choices on this contingent market. Randomly selected households are presented an environmental project that is expected to increase their wellbeing. Subsequently, they are asked to directly state whether they would be willing to pay for this environmental project, for example by accepting or rejecting a particular policy that would imply a tax increase and hence higher household expenditures. Ideally, the obtained sample is representative for all households affected by the environmental improvement in question so that the sample's average WTP reflects the average WTP of all affected households. If this is the case the social benefit can be computed by multiplying mean (or median) WTP of the sample by the total number of households affected by the environmental improvement.

Unlike revealed preference methods (travel cost method, hedonic pricing, etc.) not only use values but also non-use values can be assessed by means of the CVM. This makes the CVM particularly attractive in the context of the present study which aims to assess the social benefit of an environmental project that is supposed to generate mainly non-use values (cf. section 3.2). At the same time, as a stated preference technique which relies on people's answers to survey questions rather than drawing inference from actual market behaviour, this method is frequently critisised. Critics point to the possibility that WTP statements are systematically biased and doubt that CVM surveys are a suitable tool for the assessement of environmental values (cf. Hausman, 1993; Hausman, 2012). The list of potential errors and biases inherent to WTP estimates is long and includes issues like the hypothetical bias (i.e. the divergence between actual and stated WTP), strategic behaviour (i.e. respondents' tendency to over- or understate their true WTP for strategic reasons), embedding effects (i.e. the insensisivity of WTP to the scope or scale of environmental improvements) as well as information effects (i.e. the systematic influence of the information provided by a survey on WTP). The latter and additional factors that threaten the validity of the results of CVM studies have been comprehensively reviewed elsewhere (c.f. e.g. Venkatachalam, 2004; Carson, 2005). Even though the usefulness of CVM for the assessment of environmental values can be questioned, the shortcomings of this method have been extensively studied and are today relatively well understood. Hence, like many other CVM practioners, we believe that a carefully designed CVM survey and an attentive analysis of the gathered data, combined with validity testing, is a useful tool to assess the benefits of propspective environmental projects. Conducting CVM surveys in People's Republic of China goes along with the challenge of adapting the CVM to the particular cultural and social context of this country. For example, Chinese people's distrust of government may be an obstacle for obtaining valid WTP statements for public investement projects in China (Chen & Hua, 2015). However, CVM is increasingly used by Chinese scholars to inform decision makers of the the value of environmental goods (cf. Zhang & Zhou, 2012).

3.2 The Social Value of Environmental Projects

A crucial step in any environmental valuation study consists of identifying the population actually affected by the environmental project in question. This is because the magnitude of the social value of an environmental project critically depends on the number of households whose WTP is taken into account. Since the social benefit is approximated as the sum of individual WTP values (cf. equation 4), the chances that an environmental project passes the cost-benefit test increase with the magnitude of individual WTP measured and also with the number of individuals considered when aggregating individual WTP values.

Most obviously, households living close to the area where a prospective public project ought to be implemented are affected by the environmental consequences of this project. Taking the environmental restoration project in the Tarim Basin as an example, people living in the oasis cities along the Tarim River are the direct beneficiaries

of the resulting improved environmental conditions. These people would be better off because of future water supply security, less frequently occurring sandstorms, a more enjoyable climate, etc. Since these benefits arise from the utilization of water, ambient air, local climate and other local environmental goods, they are summarized as the project's *use values* in the following. Furthermore, local people might also be happy about several more indirect effects of the environmental restoration project such as the protection of native plants and animals and enhanced living conditions for their descendants. Following Krutilla (1967), this second group of benefits shall be summarized as *non-use values*, because people can enjoy an environmental good without actively using it. In addition to bequest values (benefits for future generations) and existence values (benefits accruing from the pure knowledge about an environmental resource), option values accruing from preserving the option of actively using the environmental good in the future and altruistic values arising from the satisfaction of knowing that other people can enjoy an environmental improvement fall into the category of non-use values (cf. Ahlheim et al., 2013, Nunes, 2002). Since people can enjoy non-use values without actively using an environmental good it is speculated that not only local people's utility would change but that also the wellbeing of people living far away would be affected when a particular environmental good's quality or quantity changes. Accordingly, also people living at a distance might be willing to give up part of their income for the realization of public projects like a restoration of the natural ecosystems along the Tarim River. Not accounting for this 'long-distance value' would lead, as exemplarily shown by Ahlheim et al. (2013), to a substantial underestimation of the benefits of an environmental project for society as a whole.

The above argument implies that CVM surveys on environmental projects should be conducted nation-wide whenever the project in question is expected to generate considerable non-use values. The environmental restoration project in the Tarim Basin is a good example for such a project because, apart from its rather immediate features like water supply security, most environmental effects accruing from this project will affect the living conditions of future generations. Naturally, conducting interviews with a representative sample of all Chinese households was out of the scope of the present study. Furthermore, it can also be questioned that conducting a nation-wide survey would be reasonable. In view of China's large population, researchers would have to conduct interviews with an impressively high number of individuals in order to generate a representative sample. Furthermore, it is expected that a large share of China's population would have a zero WTP, for example because of the low education level of the rural population which may impede the perception of the environmental project's non-use level; or, even more obviously, because many Chinese households are too poor to contribute any money to an environmental project.

Given our limited budget, we opted for implementing a CVM survey at two exemplary sites, namely in several cities in Xinjiang to assess the perceptions of people directly affected by the environmental restoration project and in the city of Beijing to scrutinize the opinions of people indirectly affected. Beijing serves as an example for a Chinese megacity; we expect that the comparatively affluent and well-educated inhabitants of megacities are particularly likely to perceive the non-use values of environmental projects.

While conducting CVM interviews with Beijing residents went relatively smoothly, realizing a large-scale survey in Xinjiang turned out to be highly sensitive due to the political and social situation in this region. Due to these issues, a large and representative sample from Beijing but only a considerably smaller sample from Xinjiang was obtained. In the following we explore and compare local people's preferences for the environmental project in question to the preferences of people living at large distance from the project site.

3.3 The Survey

In 2013 standardized CVM interviews were conducted in Beijing and Xinjiang. The questionnaires employed in both study sites were broadly identical and consisted of the following parts: 1) an introductory section where the survey's topic and purpose were briefly presented; 2) several warm-up questions concerning a respondent's characteristics (age, education, marital status, etc.); 3) a presentation of the Tarim River and its environment, including maps and pictures, followed by several questions referring to a respondent's acquaintance with the project area, his or her perception of several ESS and environmental problems in the Tarim area; 4) the project scenario, i.e. a text passage introducing the 'Tarim Environmental Preservation Plan', a hypothetical environmental project; 5) a payment scenario describing the kind of contributions individuals would have to make to finance the environmental restoration project followed by the WTP elicitation question; 6) debriefing questions to scrutinize a respondent's motivation for (not) paying; 7) follow-up questions concerning a respondent's household (disposable income, number of household members, etc.) and attitudes towards several aspects of life.

Prior to the WTP question we informed the respondents that the 'Tarim Environmental Preservation Plan' could not be financed out of existing funds alone. Therefore, the Central Government would have to collect additional

resources through a tax increase. However, the project would only be realized if the majority of Chinese households tolerated an increase in their monthly expenditures. In Beijing, respondents obtained the information that the monthly expenditures of an average household in Beijing would increase by a particular amount. Afterwards, we asked them whether or not they would support the environmental project, given that their monthly expenditures would increase. In the economic literature, this kind of WTP question is discussed as the dichotomous choice or referendum format. The participants of dichotomous choice surveys are randomly assigned to different amounts of money (so-called bids) and asked whether or not they would be ready to pay this amount of money to finance a particular environmental project. In the present study six predefined bids, reaching from 10 to 200 RMB, were employed. The bid design was based on the results of 200 pretest-interviews and followed a distribution that is recommended in the relevant literature (following Kanninen (1995), we made sure that the minimum bid of 10 RMB was accepted by approximately 85% and the maximum bid of 200 RMB was rejected by 85% of the pre-test participants).

Respondents of CVM surveys generally perceive dichotomous choice questions as simpler than alternative elicitation formats, such as open-ended WTP questions ('What would be the maximum amount you would tolerate to pay (…)?'). This is because the choice task resembles everyday purchase situations, i.e. thinking of paying a given price for a desired commodity. During pre-test interviews we also observed that respondents who were confronted with the dichotomous choice question completed the choice task much faster than those who had to answer open-ended WTP questions. Furthermore, as highlighted by Carson & Groves (2007), single-bounded dichotomous choice questions do, in contrast to other elicitation formats, give the respondents an incentive to give a truthful answer rather than under- or overstate their actual WTP. One of the main drawbacks of the dichotomous choice format is, however, that rather large samples are needed. This is because the estimation of average WTP involves econometric techniques which only yield valid and reliable results when the sample size is sufficiently large (a sample size of at least 1 000 observations is recommended in literature, cf. Arrow & Solow, 1993). Since only a much smaller number of interviews could be conducted in Xinjiang due to restrictions regarding social-science research in that area an alternative elicitation format had to be employed. The version of the questionnaire used in Xinjiang contained a two-step elicitation question. In a first step respondents were asked whether or not they would support the environmental restoration project and the related payment in general. Those who answered 'yes' had to indicate their maximum WTP on a payment card ranging from 5 RMB to 100 RMB.

To draw inference from the sample a CVM survey should be representative for the population in question. Representativeness is typically ensured by random sampling. Furthermore, face-to-face interviews at people's homes are the preferable interview mode regarding the overall response rate, item non-response rate as well as the quality of the collected data (Bateman et al., 2002). Unfortunately, we had to deviate from these guidelines in both study sites. In Xinjiang safety reasons were a main obstacle. Social instability, separatism and terrorism are alleged to be major issues in Xijiang. Under these circomstances it has become next to impossible to obtain a research permission, even for the experienced Chinese scholars involved in our research team. Since we could not obtain an official permission for conducting household interviews, we organized five workshops in different cities, namely in Ürümqi, Lop Nor, Korla and Kuche. Participants were recruited by our local research partners who informed their local network about the workshops. Naturally, it was impossible to obtain a large representative sample like this; however, we managed to recruit people with diverse socio-demographic characteristics, including young and elderly people, Han Chinese and ethnic minorities, farmers and scholars, etc. At the beginning of each workshop the CVM questionnaire was read out question by question in Mandarin or Uighur and the participants filled it in by themselves. The completed questionnaires were collected immediately and debates about water-related environmental problems in the Tarim Basin were opened up only when all participants had handed in their questionnaires. Compared to standard CVM interviews, the workshop-method has several shortcomings including sample selection bias, lack of anonymity of the participants and the possibility that a respondent's answers to several survey questions are influenced by other participants' presence and/or comments. Nevertheless, conducting interviews during workshops was the only possibility for getting WTP data from the local population at all. In the literature the idea of using a workshop setting for environmental valuation has featured quite prominently (e.g. Lienhoop et al. 2007, Macmillan et al., 2002). While our workshop approach, however, explicitly excluded group discussions prior to completing the questionnaires in order to ensure a comparable situation with the Beijing survey, we consider the joint presentation of the scenario information in the group and the presence of other respondents busy at completing the questionnaires as helpful for the motivation of respondents to take the valuation task seriously and complete the questionnaire thoroughly. Using the workshop valuation method described above, we consulted a total of 70 residents from Xinjiang during five workshops in July 2013. 61 valid questionnaires were gathered and all of them contained a valid WTP statement.

In Beijing things went more smoothly, however, a random household sample could not be drawn either because household registration lists turned out to be inaccessible. In addition to that, local experts experienced in market and opinion research advised against household interviews due to the difficulty of entering people's apartments. In the urban areas of Beijing people mostly live in large compounds with guarded entrances. Furthermore, even if an interviewer manages to pass the security guards it is unlikely that the suspicious residents let him enter their apartments. In view of these issues and after consultation with Chinese experts in this field we decided to conduct intercept interviews in the six urban districts of Beijing. A quota sampling approach ensured the representativeness of the intercept survey, thereby controlling for gender, age and education when approaching the survey participants. 50 students from the Minzu University conducted personal interviews. All of them had been trained in conducting standardized CVM interviews prior to the main survey. Interviewers were assigned to multiple locations in different parts of the city in order to represent the population of the six urban districts proportionally to their actual sizes. The interviewers were told to stop people randomly, but had to take account of a number of selection criteria, namely that the persons who agreed to participate in the interview had been living for at least five years in Beijing, that she was currently living in one of the six urban districts and that she fulfilled the required quota. A total of 2472 interviews were completed in August and September 2013. 34 questionnaires had to be discarded because they lacked relevant information, like a respondent's age, home district or because the respondent did not fulfill one or several of the selection criteria. All but 7 of the 2438 valid questionnaires contained an answer to the referendum question, yielding an impressively high response rate for the elicitation question of 99.7%. Also, the overall survey response rate (relation of the number of people willing to be interviewed to the number of people contacted) of 40% is quite acceptable for an intercept survey in a busy megacity.

4. Results and Analysis

4.1 Sample Characteristics

55.7% of the respondents from Xinjiang are male. They are on average 40 years old and 75.4% of them have minority nationalities (mainly Uighur). 73.8% hold a university degree and their average disposable household income amounts to 4 721 RMB per month. Although the sample is quite diverse in terms of the socio-demographic characteristics of the respondents, it is not fully representative of the population of Xinjiang. Men, ethnic minorities and people with higher education are overrepresented. However, the average household income of the survey participants comes close to the official figure for urban households in Xinjiang reported in the Statistical Yearbook (Statistics Bureau of Xinjiang Autonomous Region, 2012). 37.7% of all respondents in the sample live in Lop Nor, a city located at the lower reaches of the Tarim River with approximately 100 000 inhabitants; 24.9% live in Kucha or Korla (middle reaches) and 8.2% are from Aksu (upper reaches). 26.2% of the respondents are from Ürümqi, Xinjiang's capital situated at approximately 400km north of the Tarim Basin. Table 1 and Figure 1 summarize these figures.

Table 1. Demographic characteristics of the survey samples

	Xinjiang N=61	Beijing N=2438
Variable	Mean (std. deviation)	
Gender	0.557	0.504
(1=male, 0=female)	(0.500)	(0.500)
Age	39.7	40.2
(years)	(8.9)	(15.4)
Han	0.350	0.919
(1=yes, 0=otherwise)	(0.481)	(0.273)
Native	0.754	0.366
(1=yes, 0=no)	(0.434)	(0.482)
Higher education	0.738	0.382
(1=yes, 0=no)	(0.044)	(0.486)
Disposable monthly income (in 1000 RMB)	4.721	8.485
	(3.700)	(8.485)

Regarding the Beijing sample, 50.4% of the respondents are male, on average 40 years old and 38.2% hold a university degree. These figures are very similar to the official numbers in the Statistical Yearbook (Beijing Municipal Bureau of Statistics, 2013). Merely 36.6% of the respondents are originally from Beijing, but this figure exactly corresponds to the official share of non-native residents. Han Chinese residents are slightly

underrepresented in the sample (-4%). This might be due to both the survey's topic (environmental restoration in a region which is mainly populated by ethnic minorities) and also the ethnic background of the interviewers (28.8% were ethnic minorities). Furthermore, the average income of the sample is significantly higher than the average income in urban Beijing of 7 640 RMB as measured in the 2011 household census (ibid). However, this difference may simply reflect a general raise in income since 2011. The representation of the six urban districts in terms of their population is displayed in the second histogram in Figure 1. Very similar to the official figures, most respondents live in the two largest urban districts, Chaoyang and Haidian. Residents from Dongcheng and Xicheng are slightly overrepresented (+4% and +2% respectively), while residents from Fengtai and Shijingshan are underrepresented (-2% each). Taken together, the quota-based sampling procedure has yielded a sample that reflects the characteristics of Beijing's urban population very closely.

With the exception of average age the two samples differ significantly in all demographic characteristics listed in Table 1. These dissimilarities have to be kept in mind when comparing and analyzing the results from both survey sites. The most striking differences include the respondents' levels of education and household income. The income of respondents from Beijing is on average twice as high as the income of respondents from Xinjiang. At the same time, the likelihood of holding a university degree is much greater in the case of the local sample as compared to the long-distance sample. The latter issue demonstrates a biased selection of respondents; since the participants of the Xinjiang survey were contacted by word-of-mouth, people with academic backgrounds had a higher probability to enter the sample.

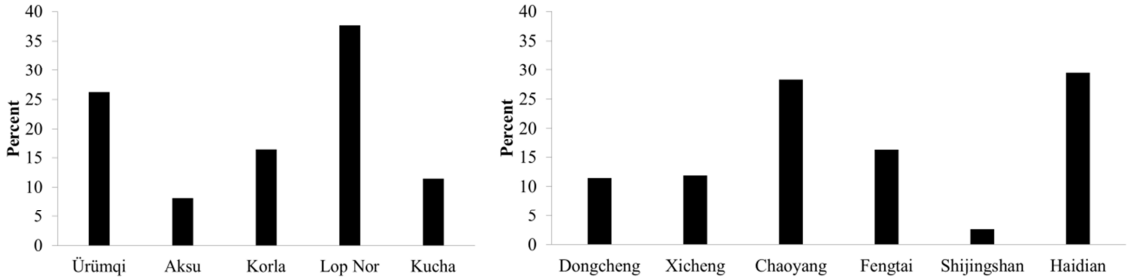

Figure 1. Respondents' residence (town or district)

4.2 Acquaintance with the Project Area and Environmental Perceptions

The second part of the questionnaire contained a number of questions regarding respondents' familiarity with the area along the Tarim River. 95.1% of the respondents from Xinjiang had already been to the Tarim River; merely three respondents from Ürümqi had never been there. Most of them had been there as tourists, many went there for work and some had visited relatives living in the area along the Tarim River. In Beijing merely 4.4% of all respondents had been to the Tarim River, however, a broad majority of 72.2% said that they had already heard of the river and 42.2% had heard of environmental problems in the region. Like in Xinjiang, those who had already travelled to the Tarim River mostly mentioned tourism or business trips as reasons.

All respondents obtained detailed information about the key ESS provided by the natural vegetation along the Tarim River. Afterwards, we asked them to express their preferences concerning these ESS by selecting the two ESS they considered most important. Based on this choice task we derived ESS-rankings for both samples. As displayed by the first chart of Figure 2, the rankings are very similar for both samples. Both groups of respondents considered 'mitigation of dust and sandstorms' as most important. However, while almost all respondents from Xinjiang listed this ESS as 'most important' only two thirds of the respondents from Beijing shared this opinion. The largest difference regarding the perceptions of local people, on the one hand, and people living far away on the other, can be observed for 'stabilization of soils'. While approximately half of the respondents from Beijing selected this ESS as 'most important', only a third of the respondents from Xinjiang did so. Similarly, 'beauty of landscape' and 'provision of useful herbs' were more frequently perceived as important in Beijing than in Xinjiang.

Subsequent to the ranking task, respondents were informed about the reasons and consequences of the degradation and destruction of the natural ecosystems in the Tarim area. Afterwards, we asked them which environmental problem they considered most serious. Again, the results from Xinjiang resemble the results from Beijing; 'desertification of the landscape' ranks first, followed by sandstorms and dust (cf. right chart in Figure

2). Only a small number of respondents said that the extinction of animals and plants was the most serious issue. However, comparatively more people from Beijing (18.5%) than from Xinjiang (10.0%) shared this opinion. Little surprisingly, sandstorms and dust, i.e. environmental problems immediately affecting the living conditions in the cities along the Tarim River, were considered as more serious by locals (42.0%) than by people living in Beijing (29.1%). Regarding the ranking of ESS and environmental problems we conclude that environmental perceptions of the population directly affected and the population indirectly affected are quite similar. However, environmental impacts which directly and immediately affect the livelihood of local people, namely sandstorms and dust and the associated ESS, matter more to people from Xinjiang than to people in Beijing.

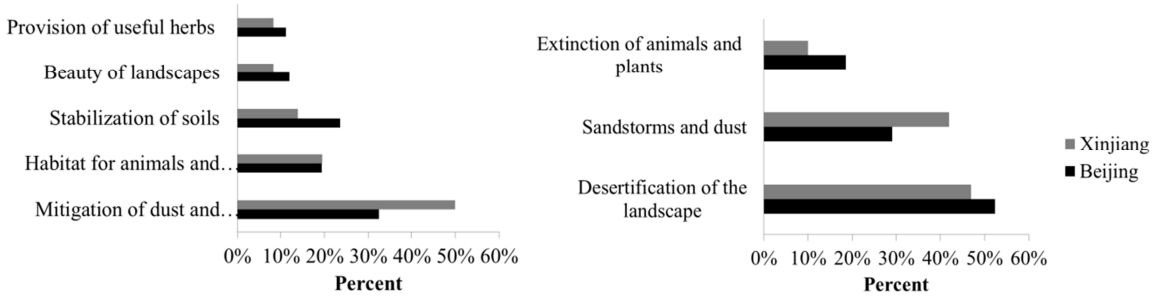

Figure 2. Ranking of ecosystem services (l.) and environmental problems (r.) (Rumbaur et al. 2015)

Table 2. Responses to debriefing questions

Item wording	Xinjiang	Beijing	p-value derived from t-test of equal means
	Agreement		
Environmental conditions in the Tarim area will improve through the TEPP.	93.0%	74.7%	0.000
Not households, but central government alone should pay for the TEPP.	75.0%	76.2%	0.162
Did you consider your chances of spending time at the Tarim area some day in the future? (Option value)	28.3%	38.6%	0.000
Did you consider the TEPP's positive effects for other people's livelihood? (Altruistic value)	41.7%	46.2%	0.000
Did you consider the TEPP's positive effects for future generations? (Bequest value)	90.0%	61.3%	0.000
Did you consider the TEPP's positive effects for plants and animals? (Existence value)	60.0%	52.7%	0.000

After having listened to the presentation of the project scenario and answered the WTP question respondents were presented a number of debriefing questions. These questions covered reasons for supporting or not supporting the environmental restoration project financially. Particular attention was paid to the issue whether or not respondents had taken into account the non-use values of the environmental restoration project before answering the WTP question. Some selected results are displayed in Table 2. We find that an impressively high share of respondents reported that they believed in the positive effects of the 'Tarim Environmental Preservation Plan'. Xinjiang residents' answers reveal that the population directly affected by the prospective environmental improvement was even more optimistic than the population indirectly affected. The t-test of equal means indicates that respondents from Xijiang were more likely to agree with the statement 'Environmental conditions in the Tarim area will improve through the TEPP' with a significance level of < 0.001%. Given this result, we conclude that most respondents perceived the environmental project to be valued as realistic and expect that they answered the related payment question seriously as well. At the same time, approximately two quarters of the respondents in both samples opposed the idea that households should bear the costs of the project in question.

This result is somewhat surprising in view of the results presented in the next sections regarding respondents' WTP. However, overall agreement with this protest statement may simply reflect people's mostly sceptical opinion towards government representatives' ability to manage existing funds efficiently rather than respondents' rejection of the payment scenario. Furthermore, non-use values were perceived differently in both study sites with a significance level of 0.0%. The share of respondents who took into account the option value of the natural vegetation along the Tarim River is relatively low in both samples, compared to other value components. The non-use value which respondents considered most frequently is the project's benefit for future generations. The answers to the associated question reveal that the bequest value mattered comparatively more for the WTP statements of people interviewed in Xinjiang than for respondents from Beijing.

4.3 WTP for the Restoration of Natural Ecosystems

In a next step respondents' answers to the WTP question shall be analyzed and compared. As displayed in Table 3, respondents in the Xinjiang sample are willing to pay on average 57 RMB[1] per month. This corresponds to approximately 1.2% of their household's disposable income. It is to be noted that the maximum amount displayed on the payment card employed in Xinjiang was 100 RMB. Given the fact that average income in Xinjiang is about half as high as in Beijing, this overall cap seemed to make sense when designing the questionnaire. Surprisingly, a considerable number of respondents, namely 29.6%, selected the 100 RMB bid from the payment card when asked about their WTP. It is speculated that some of these people had a WTP of even more than 100 RMB but could not express their preferences because of the limited range of the payment card. Thus, the estimate of 57 RMB is likely to underrate the actual WTP of the respondents from Xinjiang. In Beijing average WTP amounts to 108 RMB[2] which corresponds to 1.3% of an average household's disposable monthly income (cf. second column of Table 3). The t-test indicates that mean WTP is higher in Beijing that in Xinjiang with a significance level of 0.0%. However, when taking into account the income differences of the two samples and the methodological weaknesses of the payment card employed in Xinjiang, the WTP of the population directly affected by the environmental restoration project is very similar to the WTP of the population indirectly affected. Furthermore, the share of respondents who agreed with the highest bid – 100 RMB in the case of the Xinjiang survey and 200 RMB in Beijing – is equal with a significance level of 98.9%.

Table 3. WTP results

	Xinjiang	Beijing	p-value derived from t-test of equal means
Mean WTP			
- absolute value (in RMB per month and household)	57.361	107.61	0.000
- % of income	1.2%	1.3%	
Agreement with highest bid (100 RMB in Xinjiang; 200 RMB in Beijing)	29.6%	33.3%	0.989

As explained above, we employed different elicitation formats in the two study sites. Due to the individual features of the dichotomous choice format on the one hand and the payment card format on the other, the two estimates for average WTP are not strictly comparable. However, some more insights concerning the WTP of the population directly affected and the population living far away from the project site can be gained when looking at the share of respondents who agreed with the different bids and who selected a particular amount from the payment card, respectively. For example, if a respondent from Xinjiang selected 'max. 50' RMB on the payment card it is supposed that this respondent would also have agreed with the dichotomous choice question whether he or she would support the environmental project, although it would increase his or her household's expenditures by 50 RMB monthly. Hence, it makes sense to compare the share of respondents who agreed with each bid in the Beijing sample to the share of respondents who indicated a WTP of the same amount or higher on the payment card in the Xinjiang sample. As displayed in Figure 3, the proportion of respondents with a WTP of at least 10 RMB is approximately 8% higher in Xinjiang than in Beijing. The proportions of respondents with a WTP of at least 25 RMB and 50 RMB do not significantly differ in the two samples. Only in the case of 100 RMB, the proportion of respondents from Xinjiang who would have been willing to pay this amount is significantly lower than in Beijing. The latter result is very plausible, given that respondents from Xinjiang dispose of an income which is about half of an average Beijing resident's income. Hence, the 'Tarim Environmental Preservation Plan' seems to be greatly welcome at both research sites.

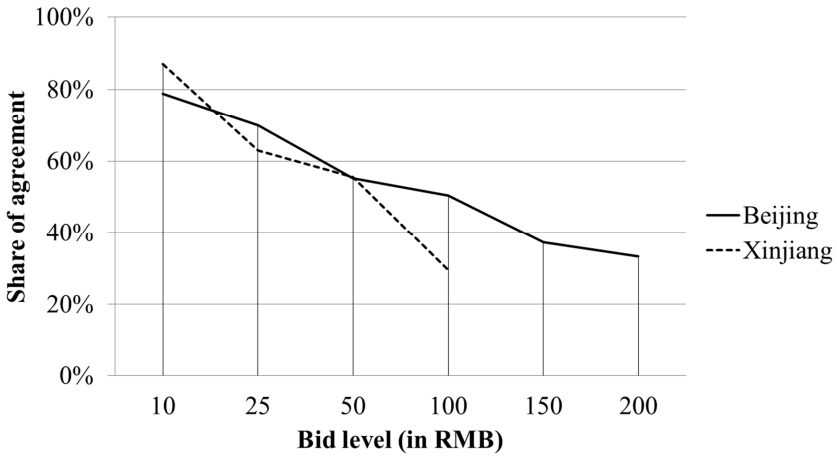

Figure 3. Agreement with bids

4.4 Validity of 'Long-Distance' WTP

As shown in the previous paragraph not only the population directly affected is willing to make considerable financial contributions to the environmental restoration program but also people living far away from the Tarim River would tolerate an increase in their monthly expenditures in exchange for implementing this project. The question arises how plausible these WTP estimates actually are. A major criticism against assessing the benefits of public projects by means of survey questions is that respondents merely give an answer to a hypothetical question but do not effectuate an actual payment. Hence, stated WTP is necessarily higher than actual WTP, according to the critics. Since people's actual WTP for prospective environmental improvements is unknown, the plausibility of the obtained measure is commonly tested by checking whether answers to the WTP elicitation question systematically vary with a number of variables which are expected to affect a respondent's WTP. For example, the probability of answering 'yes' to the dichotomous choice question should be negatively related to the bid level; it should increase with a household's income; and it should be the higher the more favorable a respondent's attitudes towards the project and the related payment are. In line with most CVM practitioners we make use of multiple regression models to identify the determinants of WTP. Due to the small number of interviews conducted in Xinjiang, the analysis of the main determinants of WTP is limited to the Beijing sample.

The results of a probit model, where the dichotomous choice variable is regressed against the bid and several explanatory variables, are shown in Table 3. Coefficient estimates, standard errors as well as the marginal effects of each control variable are displayed. A description of all variables can be found in the appendix. Model 1 merely includes bid, dummies for experimental treatments[3] and some standard demographic variables. As expected, the magnitude of the bid negatively affects the likelihood of answering 'yes' to the referendum question. Furthermore, holding other factor fix, men are more likely to agree with the referendum question (i.e. have a higher WTP) than women. WTP increases with a respondent's level of education and with the respondent's disposable household income. These effects remain robust when additional explanatory variables are added to the regression model (cf. Model 2 in Table 3). Similar effects were also identified in other CVM studies conducted in China, pointing to the validity of our WTP data. A positive relationship between WTP and income was reported in several studies (c.f. e.g. Wang et al., 2013, Ahlheim et al., 2015, Day & Mourato, 2002). In line with the results of the present study, Ahlheim et al. (2015) identified being male and a respondent's education level as predictor variables for WTP. The results of the second regression model provide further evidence for the WTP estimate's plausibility. In Model 2 a dummy variable indicating whether a respondent has already been to the area along the Tarim River (BEEN_TARIM), two attitudinal variables and a variable accounting for the number of non-use value components (i.e. option, bequest, existence and altruistic values) considered before answering the WTP question are included. Plausibly, respondents who have already been to the Tarim River, i.e. those who experienced the harsh environmental conditions in this area, have a higher WTP. In addition to that, those who believe that environmental conditions will improve through the environmental project in question (NODOUBTS) state a higher WTP, while those who think that government alone should pay for this project (GOVPAYS) state a lower WTP. The latter effect adds to the relevance of an argument made in a recent paper by Chen & Hua (2015): Distrust of government in terms of manageing tax revenue efficiently and

appropriately affects Chinese people's WTP for environmental goods substantially. Finally, the consideration of several non-use values alters the probability of agreement. The marginal effect of NONUSE is also comparatively strong. If one more non-use value component is considered, the likelihood of stating 'yes' increases by 16.2%, ceteris paribus on other factors. This finding indicates that people's WTP for environmental projects that provide mainly non-use values to them depends on a person's awareness of such non-use values. Taken together, the effects of the four additional variables are fully plausible, which is an indicator for the validity of the WTP data collected in urban Beijing.

Table 4. Probit regression models displaying determinant of supporting the environmental project

Dependent variable: WTP	Model 1			Model 2		
	Coef.	s.e.	dy/dx	Coef.	s.e.	dy/dx
CONSTANT	0.171	0.155		-0.058	0.234	
BID	-0.006***	0.000	-0.002	-0.006***	0.000	-0.002
TREATMENT	x			x		
MALE	0.127**	0.055	0.045	0.103*	0.058	0.034
AGE	-0.001	0.002	0.000	-0.002	0.002	-0.001
EDUCATION	0.055**	0.023	0.020	0.051**	0.024	0.017
CHILD	0.040	0.059	0.014	0.096	0.061	0.031
INCOME	0.008**	0.004	0.003	0.009**	0.004	0.003
BEEN_TARIM				0.288*	0.150	0.094
NODOUBTS				0.286***	0.031	0.093
GOVPAYS				-0.267***	0.028	-0.087
NONUSE				0.496***	0.084	0.162
Observations	2244			2244		
Log likelihood	-1411			-1289		
Pseudo R^2	0.089			0.168		

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

5. Conclusions and Recommendations

This study adds to the evidence that many environmental projects are not only beneficial for people living at the project site but also for those living far away. We found that residents from Xinjiang as well as Beijing residents, which serve as an example of the population living at a distance, have a positive WTP for a prospective public project that would enhance the environmental conditions in the Tarim Basin. Based on a small sample gathered in Xinjiang, local people's WTP for the environmental project in question amounts to 57 RMB per month. The results of a representative CVM survey implemented in Beijing reveal that the residents living in this megacity are willing to contribute approximately 108 RMB per month to the same environmental project. In absolute terms, the WTP of Beijing residents is substantially higher than the WTP of the local population. This result is somewhat surprising because people in Xinjiang would experience both use and non-use-values while people in Beijing would merely benefit from the non-use values accruing from the environmental project in question. However, the validity of the 'long-distance WTP' estimate is supported by its plausible determinants identified econometrically. Furthermore, when accounting for income differences in both survey sites, relative WTP is approximately the same in both samples. We also find that people at both survey sites perceive the importance of several ecosystem services and the seriousness of environmental problems caused by the deterioration of the natural ecosystems along the Tarim River in a similar way. Finally, based on our analysis of the non-use values of a more sustainable water and land management in the Tarim Basin, we conclude that most Chinese people are concerned about the consequences of environmental mismanagement for future generations.

Naturally, the present study has a number of limitations. The standards of best practice for the conduct of CVM surveys could not be followed in Beijing and even less in the politically sensitive region of Xinjiang. None of our two samples is random, i.e. some degree of sample selection is present in both samples, so that the results cannot easily be generalized. Furthermore, the CVM survey implemented in Beijing can merely serve as an example to demonstrate that also people living far away from the Tarim Basin would enjoy the consequences of a more sustainable policy in this region. The validity and reliability of our results should be further explored by assessing people's WTP in other Chinese megacities. This would allow a generalization of non-use values to a broader scope of the Chinese population affected by the project. We suppose that researchers would find similar results when assessing the social benefit of other environmental projects of national importance in China or in other countries. It would be interesting, for example, to explore whether Chinese people's WTP for other environmental projects significantly differs from the figures assessed in the present study or whether WTP is just an expression of some positive environmental attitudes that does not vary with the kind, scope and scale of different environmental improvements.

In spite of these limitations, this study demonstrates that it is possible to obtain a valid measure of 'long-distance WTP' by means of the CVM in the context of China while the scientific assessment of such values in a region like Xinjiang remains very difficult in practice. An environmental valuation study focused on the benefits of local people only would clearly underestimate the social value of a more sustainable land and water management in the Tarim Basin. The present study conducted both in Xinjiang, a region where hardly any data on the preferences of the local population for preserving ecosystem services exist, and in Beijing proves to be of special scientific and practical interest since it can serve as the starting point for a rigorous comparison of environmental values of the broad and heterogeneous Chinese population for environmental goods of national importance. For this reason, on the basis of our study we recommend that decision makers interested in the social benefit of a more sustainable land and water management in the Tarim Basin should initiate an environmental valuation study that covers both the preferences of Xinjiang's population and of the inhabitants of metropolis such as Beijing, Shanghai, Guangzhou, etc. Ideally, a random household sample should be drawn so that the overall social value of a more sustainable land and water management in the Tarim Basin can be assessed based on the sample's average WTP. While it has turned out impossible to obtain such a completely representative sample for the CVM study by scientific researchers, government or administrative institutions in China possess the necessary means to conduct such high quality surveys. Of course, the latter recommendation does not only apply to the particular case of the Tarim Basin considered here. The social benefit of other environmental projects - in China or elsewhere - of similar scope, scale and national importance, should be comprehensively assessed as well.

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References

Ahlheim, M., Börger, T., & Frör, O. (2015). Replacing rubber plantations by rain forest in Southwest China—who would gain and how much? *Environmental monitoring and assessment, 187*(2), 1-20. http://dx.doi.org/10.1007/s10661-014-4088-8

Ahlheim, M., & Frör, O. (2003). Valuing the non-market production of agriculture. *Agrarwirtschaft, 52*(8), 356-369. http://dx.doi.org/10.1093/erae/19.3.351

Ahlheim, M., Frör, O., Luo, J., Pelz, S., & Jiang, T. (2013). How do Beijing Residents Value Environmental Improvements in Remote Parts of China. *Advances in Climate Change Research, 4*(3), 190-200. http://dx.doi.org/10.3724/SP.J.1248.2013.190

Arrow, K., & Solow, R. (1993). Report of the NOAA Panel on Contingent Valuation. Washington, DC: Resources of the Future. Retrieved from http://www.darrp.noaa.gov/library/pdf/cvblue.pdf

Atkinson, G., & Mourato, S. (2008). Environmental cost-benefit analysis. *Annual review of environment and resources, 33*, 317-344. http://dx.doi.org/10.1146/annurev.environ.33.020107.112927

Bateman, I., Carson, R. T., Day, B., Hanemann, M., Hanley, N., Hett, T., ... Swanson, J. (2002). Economic Valuation with Stated Preference Techniques : a manual. Cheltenham: Elgar.

Beijing Municipal Bureau of Statistics. (2013). *2012 Beijing Statistical Yearbook*. Beijing: China Statistics Press.

Carson, R. T., & Hanemann, W. M. (2005). Contingent Valuation. In K.-G. Maler, J. R. Vincent (Ed.), *Handbook of Environmental Economics* (Vol 2). Valuing Environmental Changes (pp. 821-936). North-Holland: Elsevier.

Chen, Y., Xu, C., Chen, Y., Liu, Y., & Li, W. (2013). Progress, Challenges and Prospects of Eco-Hydrological Studies in the Tarim River Basin of Xinjiang, China. *Environmental Management, 51*(1), 138-153. http://dx.doi.org/10.1007/s00267-012-9823-8

Chen, W. Y., & Hua, J. (2015). Citizens' distrust of government and their protest responses in a contingent valuation study of urban heritage trees in Guangzhou, China. *Journal of Environmental Management, 155*(0), 40-48. http://dx.doi.org/10.1016/j.jenvman.2015.03.002

Day, B., & Mourato, S. (2002). Valuing river water quality in China. In D. Pearce (Ed.), *Valuing the enviroment in developing countries*. Cheltenham: Elgar.

Deng, M., Qin, D., & Zhang, H. (2011). Public Perceptions of Cryosphere Change and the Selection of Adaptation Measures in the Ürümqi River Basin. *Advances in Climate Change Research, 2*(3), 149-158. http://dx.doi.org/10.3724/SP.J.1248.2011.00149

Deng, M., Qin, D., & Zhang, H. (2012). Public perceptions of climate and cryosphere change in typical arid inland river areas of China: Facts, impacts and selections of adaptation measures. *Quaternary International, 282*, 48-57. http://dx.doi.org/10.1016/j.quaint.2012.04.033

Halik, Ü., Küchler, J., & Kleinschmit, B. (2005). Bevor die Erde zur Wüste wird. *TU International, 57*, 34-37. Retrieved from https://www.alumni.tu-berlin.de/fileadmin/Redaktion/ABZ/PDF/TUI/57/halik.pdf

Hanemann, W. M. (1989). Welfare evaluations in contingent valuation experiments with discrete response data: reply. *American journal of agricultural economics, 71*(4), 1057-1061. Retrivied from http://www.jstor.org/stable/1242685

Hausman, J. A. (Ed.). (1993). Contingent valuation : a critical assessment. Amsterdam: North-Holland.

Hausman, J. (2012). Contingent Valuation: From Dubious to Hopeless. *The Journal of Economic Perspectives, 26*(4), 43-56. http://dx.doi.org/10.1257/jep.26.4.43

Hirji, R., & Davis, R. (2009). Environmental flows in water resources policies, plans, and projects: case studies Environment Department Papers. *Natural Resource Management Series* (Vol. P. 117). Washington, D.C.: The World Bank Environment Department.

Huang, X., Chen, Y., Ma, J., & Chen, Y. (2010). Study on change in value of ecosystem service function of Tarim River. *Acta Ecologica Sinica, 30*(2), 67-75. http://dx.doi.org/10.1016/j.chnaes.2010.03.004

Jørgensen, S. L., Olsen, S. B., Ladenburg, J., Martinsen, L., Svenningsen, S. R., & Hasler, B. (2013). Spatially induced disparities in users' and non-users' WTP for water quality improvements—Testing the effect of multiple substitutes and distance decay. *Ecological Economics, 92*(0), 58-66. http://dx.doi.org/10.1016/j.ecolecon.2012.07.015

Kanninen, B. J. (1995). Bias in Discrete Response Contingent Valuation. *Journal of Environmental Economics and Management, 28*(1), 114-125. http://dx.doi.org/10.1006/jeem.1995.1008

Krutilla, J. (1967). Conservation reconsidered. *American Economic Review, 56*, 777-786. Retrieved from http://www.jstor.org/stable/1815368

Lienhoop, N., MacMillan, D.C. (2007). Contingent Valuation: Comparing Participant Performance in Group-Based Approaches and Personal Interviews. *Environmental Values, 16*(2), 209-232. http://dx.doi.org/10.3197/096327107780474500

Lu, Z., Zhao, L., & Dai, J. (2010). A study of water resource management in the Tarim Basin, Xinjiang. *International Journal of Environmental Studies, 67*(2), 245-255. http://dx.doi.org/10.1080/00207231003693274

Macmillan, D. C., Philip, L., Hanley, N., & Alvarez-Farizo, B. (2002). Valuing the non-market benefits of wild goose conservation: a comparison of interview and group based approaches. *Ecological Economics, 43*(1), 49-59. http://dx.doi.org/10.1016/S0921-8009(02)00182-9

Nunes, P. A. L. D. (2002). The contingent valuation of natural parks : assessing the warmglow propensity factor. Cheltenham: Elgar.

Rumbaur, C., Thevs, N., Disse, M., Ahlheim, M., Brieden, A., Cyffka, B., ... & Zhao, C. (2015). Sustainable Management of River Oases along the Tarim River in North-Western China under Conditions of Climate

Change, Special Issue: Climate Change and Environmental Pressure: Adaptation and Resilience of Local Communities in the Hindu-Kush-Himalaya. *Earth Syst. Dynam., 6*, 83-107. http://dx.doi.org/10.5194/esd-6-83-2015

Statistics Bureau of Xinjiang Autonomous Region. (2012). 2011 Xinjiang Statistical Yearbook. Urumqi: China Statistics Press.

Stephan, G., & Ahlheim, M. (1996). Ökonomische Ökologie. Berlin: Springer.

Thevs, N. (2011). Water Scarcity and Allocation in the Tarim Basin: Decision Structures and Adaptations on the Local Level. *Journal of Current Chinese Affaires, 3*, 113-137. Retrivied from http://hup.sub.uni-hamburg.de/giga/jcca/article/view/456

Venkatachalam, L. (2004). The contingent valuation method: a review. *Environmental Impact Assessment Review, 24*(1), 89-124. http://dx.doi.org/10.1016/S0195-9255(03)00138-0

Wang, H., He, J., Kim, Y., & Kamata, T. (2013). Willingness-to-pay for water quality improvements in Chinese rivers: An empirical test on the ordering effects of multiple-bounded discrete choices. *Journal of Environmental Management, 131*(0), 256-269.

Xu, C. Z., Li, Q., & Wang, W. X. (2014). Contingent Valuation Method Assessment of the Ecological Benefits of Populus Euphratica Forest Based on Consumer Perspective-Taking the Typical Area in Tarim River Basin as an Example. Advanced Materials Research, 962-965, 703-709. http://dx.doi.org/10.4028/www.scientific.net/AMR.962-965.703

Xu, H.-l., Ye, M., & Li, J.-m. (2007). Changes in groundwater levels and the response of natural vegetation to transfer of water to the lower reaches of the Tarim River. *Journal of Environmental Sciences, 19*(10), 1199-1207. http://dx.doi.org/10.1016/S1001-0742(07)60196-X

Xu, H., Ye, M., & Li, J. (2008). The water transfer effects on agricultural development in the lower Tarim River, Xinjiang of China. *Agricultural water management, 95*(1), 59-68. http://dx.doi.org/10.1016/j.agwat.2007.09.004

Zhang, J., Wu, G., Wang, Q., & Li, X. (2010). Restoring environmental flows and improving riparian ecosystem of Tarim River. *Journal of Arid Land, 2*(1), 43-50. http://dx.doi.org/10.3724/SP.J.1227.2010.00043

Zhang, X., & Zhou, L. (2012). Development of contingent valuation method in evaluating non-market values of resources and environment in China. *Sciences in Cold and Arid Regions, 4*(6), 536-543. http://dx.doi.org/10.3724/SP.J.1226.2012.00536

Notes

Note 1: The answers of respondents who said that they would not support the program are coded as a $WTP_n=0$. Respondents who answered "don't know" when asked to state their maximum WTP are excluded from the analysis (12% of the sample). For all others, WTP_n corresponds to the midpoint bid of the interval between the value a respondent ticked on the payment card and the next higher one. In the case of the highest value on the payment card (100 RMB), WTP_n is set to 125 RMB. Average WTP is computed as the mean of all valid WTP statements, i.e.

$$\overline{WTP}_{sample} = (WTP_1 + WTP_2 + ... + WTP_N)/N .$$

Note 2: As shown by Hanemann (1989) dichotomous choice data can be modelled by the following linear utility model: $\overline{\Delta v_h} = \alpha + \beta BID_h$, where α is a constant integrating all observable and unobservable household characteristics, BID_h is the randomly assigned bid and β the corresponding parameter. A respondent is expected to agree with the dichotomous choice question whenever the change in utility is greater or equal to zero. The probability to answer 'yes' can be modelled by a probit model and maximum WTP can be estimated based on the corresponding parameter estimates, namely as $\overline{WTP}_h = -\alpha/\beta$. In the present work the parameters of a probit model with the binary choice variable as dependent and the bid as the only independent variable have been estimated with the econometric software package STATA, resulting into Prob (yes)=0.642-0.006BID.

Note 3: We employed three treatments to test the effect of monetary incentives for participating in the survey and different WTP answer formats on WTP. Several of these treatments have significant effects on the probability of agreeing with the WTP questions. However, the analysis and interpretation of these effects is outside the scope of this summary paper.

Appendix

Description of variables used in the regression models

Table A1. Description of variables used in the regression models

Variable	Description	Mean	Std. dev.	Min.	Max.
WTP	"Considering that your monthly household expenditures would increase by approximately [BID] RMB through the program would you personally be willing to support it?" (1=yes, 0=no)	0.537	0.499	0	1
BID	Bid amount	89.730	68.248	10	200
MALE	Gender of the respondent (1=male, 0=female)	0.509	0.500	0	1
AGE	Age of the respondent	39.890	15.315	18	84
EDUCATION	Level of education of the respondent (1=did not graduate from primary school, 7=master degree or higher)	4.332	1.321	1	7
CHILD	There are children living in the respondent's household (1=yes, 0=no)	0.346	0.476	0	1
INCOME	Monthly disposable household income in 1000 RMB	8.557	7.686	1	50
BEEN_TARIM	The respondent has already been to the Tarim area (1=yes, 0=no)	0.045	0.208	0	1
NODOUBTS	Level of agreement with the statement "Environmental conditions in the Tarim area will improve through the TEPP" (1=strongly disagree, 5=strongly agree)	4.134	0.967	1	5
GOVPAYS	Level of agreement with the statement "Not households, but central government should pay for the TEPP" (1=strongly disagree, 5=strongly agree)	4.105	1.081	1	5
NONUSE	Number of non-use aspects considered (0=none, 0.25=one out of four aspects, (…) 1=all four aspects)	0.497	0.355	0	1