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Defining the Attributes of Choice Modelling
Survey Questionnaire Using Focus Groups

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1. Introduction

As part of the research project “Sustainable Land Use Change in North West China”, the values of environmental changes resulting from the implementation of the Conversion of Cropland to Forest and Grassland Program (CCFGP) will be estimated and then integrated into a benefit cost analysis framework. The environmental values include both market values and non-market values. This research report will focus on the non-market values of the environmental impacts of the CCFGP and their estimation through the application of the choice modelling (CM) approach.

Environmental choice modelling, or choice experiments, is an emerging stated preference technique for estimating non-market environmental values. It uses people’s responses to questions regarding their willingness to pay (WTP) for hypothetical situations (Bennett and Adamowicz 2001). It differs from the better-known contingent valuation method (CVM) in that while people are asked to choose only between the ‘status quo’ situation and the ‘proposed’ situation in the CVM, CM respondents are asked to make a sequence of such choices. Each choice is between a constant ‘status quo’ situation and a number of different ‘proposed’ situations (Bennett and Adamowicz 2001). To describe the specific environmental settings in these ‘proposed’ alternatives and the financial burden they impose, attributes need to be developed and defined for a CM survey questionnaire.

CM is found to outperform CVM in a number of research studies (Adamowicz et al 1994; Boxall et al 1996; Morrison et al 1996; Bennett and Blamey 2001; Rolfe and Bennett 2001; Bennett and Adamowicz 2001). In comparing CM with CVM, there are three main advantages of CM. First, CM is consistent with attribute-based consumer theory and offers much richer information because it is based on attributes. This allows the researcher to value attributes as well as multidimensional situational changes. Second, the use of CM may decrease concerns over strategic behaviour and "yea-saying" because attribute levels change over the sets of choices and it will not be clear which choice is the "environmentally friendly" alternative. Third, CM has a high potential in minimising problems of framing and hence substitution effects can be better incorporated within the design of CM.
This research report provides some insight into the application of the CM technique in the CCFGP policy context in China by addressing some of the critical issues in developing a CM survey questionnaire, among which defining the attributes is the core. The basic principles that have been considered to define the attributes incorporated in a CM survey questionnaire designed to estimate people’s WTP for the environmental changes resulting from the CCFGP are outlined. Outcomes from the focus group meetings held to explore potential respondents’ views on the subject of the research are presented. In the next section of this research report, the value that will be estimated using the CM is defined. This is followed by an outline of the principles of developing attributes. Section 4 outlines the components of the CM survey questionnaire and the findings and implications of focus group meetings are detailed in Section 5. This leads to the defining of attributes in terms of their descriptions and the range over which their levels can vary in Section 6. The research report concludes with Section 7 in which the next steps in this research are outlined.

2. Value under Estimation

In a CM survey, respondents are asked to compare the outcome of alternative resource management strategies against the status quo. It is the change of value ‘at the margin’ from the status quo to the alternatives that the CM researcher aims to estimate. Therefore, it is important to define the value that is to be estimated. Only after the value of interest is defined can the status quo and the proposed alternatives be further described.

The primary goal of the CCFGP was to bring about environmental improvement to the Chinese people by increasing vegetation cover in marginal croplands and on barren lands. The non-market use and non-use values of the environmental improvement resulting from the implementation of the CCFGP in the North West provinces are to be estimated in this CM study. Use values refer to values related to some use, activity or traceable economic behavioural trail (Louviere et al 2000). Non-market use values may include outdoor recreation consumption or values generated from changes in scenery or aesthetic attributes of environment, and option values that even though not being enjoyed at present, may be of use in the future. Non-use values,
or passive values, have no clear behavioural trail and are derived from the mere existence of the goods or services (Louviere et al. 2000). Individuals are willing to pay for the goods or services even though they may never intend to make any active use of them. Motives for these ‘existence’ and ‘bequest’ values may include ‘concern for future generations, the adoption of some “stewardship” role with respect to nature, conferment of “rights”: to nature, and so on’ (Pearce 1998). While use value can be measured either directly by using stated preference (SP) methods or indirectly by using revealed preference methods, non-use value can be measured only directly. In this paper, both the non-market use and non-use values will be measured by using the SP method, specifically, the CM method.

The environmental benefits resulting from the land use change under the CCFGP in the North West can be both on-site and off-site, and the associated non-market use and non-use value will accrue to people in both the North West provinces and elsewhere. To test if people living proximate to the environmental impacts of concern have greater value than those who live further away, the same CM questionnaire will be used in surveying local residents in Ansai in the North West Shaanxi Province where CCFGP operations are highly visible, Xi’an, the provincial capital, as well as Beijing residents who live at a distance from the area involved in land use change under the CCFGP. This affords an analysis of how estimates of value are influenced by respondent’s distance from the site of the environmental impacts. People in Ansai and Xi’an may have more use value as compared to people in the eastern areas of China such as Beijing. However, residents in Beijing may hold higher non-use values for the results of the land use changes. Both people in Beijing and in the North West may attach option values to the environmental changes such as those enjoyed when traveling to sites in the North West where the landscape has been changed due to the implementation of the CCFGP.

3. Principles for the Selection of Attributes

People derive value from an environmental good because of the utility they draw from the properties of the good, or from the characteristics which the good possesses, rather than the good per se (Lancaster 1966). These properties or characteristics are the attributes that are used in the CM choice sets to describe the status quo situation
and the outcomes of the alternatives. To derive the most appropriate attributes, the following principles apply.

3.1 Demand and Supply Perspective

Attributes in CM questionnaires are used to describe different environmental outcomes from alternative management options. A demand perspective involves selecting the attributes that individuals consider important when making choices. A supply-driven approach involves attributes being selected primarily on the basis of what policy makers, scientists or researchers perceive to be important as factors that can be modified by policy (Blamey et al 1997). Attributes need to be selected according to both demand and supply perspectives. This is because it would be meaningless to include in CM questionnaire attributes that have no relation to the preferences of respondents and hence have no influence on choices. Similarly there is little point including attributes that are of no relevance to decision-makers. If the two perspectives do not coincide, reconciliation is required. This may involve some give and take from both perspectives.

3.2 Cognitive Burden

CM researchers have discussed the cognitive burden that respondents face in choosing among alternatives (Dellaert et al 1999; Swait and Adamowicz 2001; Deshaozo and Fermo 2004). These studies show that increases in cognitive costs increase choice inconsistency and are correlated to increases in the random component of logit models built to explain choices. Cognitive requirements increase dramatically as the number of attributes in a CM exercise increases. Hence, fewer attributes can produce more reliable results. However, results may be inaccurate if the omitted attributes are highly relevant to respondents. There needs to be a trade-off between including all relevant attributes and complexity (Blamey et al 1997). Selection of the most relevant attributes is one key to ensuring reliable results.
3.3 Causal Relationships of Attributes

Selecting environmental attributes involves translating biophysical characteristics into benefits that matter to people. In the CM survey, some respondents may consider causal relations among attributes when assessing the meaningfulness of alternatives and the relative importance of the attributes. This is the “causal heuristic” strategy that respondents may adopt in formulating their responses. Greater weight may be assigned to attributes of a more fundamental, causally prior, nature. Ways to reduce the use and/or influence of causal strategies include reframing the choice exercise so that respondents no longer employ causal strategies, or simply omitting either the causally upstream or downstream attributes from the exercise altogether (Blamey et al 1998). In principle, causally related attributes should be avoided so as to remove the bias resulting from respondents attaching greater value to causally prior attributes.

It is also crucial to link the attributes closely to perceived benefits as individuals may then find it easier and potentially more meaningful to make choices (Blamey et al 1997). However, the link between such attributes and the object of valuation can be weakened because of the scientific uncertainty in building up the links. For instance, a reduction in CO$_2$ level can be considered as a “physical attribute” and is relatively easier to monitor. The consequent reduced probability of respiratory diseases can be considered as an “effect attribute”, which although more closely linked to people, may be less accurately measured compared to the reduction in CO$_2$ level. Using “physical attributes” instead of “effect attributes” may ensure scientific certainty, yet may create another problem as respondents are left reaching their own conclusions about changes in benefits. There needs to be some trade-off in this regard.

3.4 Quantitative VS Qualitative Levels

Attribute levels can be expressed either quantitatively or qualitatively. In general, quantitative expression of levels has distinct advantages in terms of the modeling and valuation potential afforded and should be more preferred to qualitative expression in most circumstances (Bennett and Adamowicz 2001). The range of attribute levels should be chosen to encompass the full range of possibilities. Even though these possibilities do not necessarily correspond to those actually occurring under policy
options, the variation of the levels of attributes characterizing the different options permits the estimation of the relative importance of these attributes.

4. Other Components of CM Survey Questionnaire

Although choice sets with combinations of different scenarios described by attributes occurring at varying levels form the core part of a CM survey questionnaire, there are other elements in the questionnaire. In general, a CM questionnaire is comprised of the following other components (Morrison et al 1997):
- a description of the study site;
- details of the proposed changes; and,
- a series of socioeconomic and attitudinal questions.

The description of the issue under consideration and proposed changes can be based around the attributes to be used in the choice sets. Framing of the issue under consideration in the questionnaire is crucial. This will make respondents aware of the array of substitute and complementary goods to the environmental good under consideration and the competing demands for public fund hence their budget constraints (Bennett and Adamowicz 2001). The way in which choices about substitutes and budgetary constraints are framed has significant effect on resulting value estimates. The process of framing is partly done using the choice sets: choices can encompass a range of both substitute goods and opportunity costs. In addition, framing needs to be done in a broader context that is not only restricted to the attributes of the environmental good under consideration. The issue at hand should be framed in the context of competing interests and different spending schemes.

5. Focus Group Discussions

In order to design a draft of the CM survey questionnaire which contains the above components, inputs from prospective respondents are crucial. For example, feedback from respondents can help identify which attributes are regarded as important and the simplicity with which information needs to be presented. To generate sound feedback, focus group meetings were held. A focus group is defined as ‘a group of individuals selected and assembled by researchers to discuss and comment on, from personal
experience, the topic that is the subject of the research’ (Powell and Single 1996). Focus groups are used to reveal many of the factors which drive people’s decision making process. The attitudes, feelings and beliefs of the people are more likely to be revealed via the social gathering and the interaction between participants.

Two focus group meetings were held in Beijing in December 2004 to tackle the key issues in the design of the CM survey questionnaire. Specifically, the focus groups were designed to gain an understanding of:

- The environmental issues that are considered to be important (to frame the issue under consideration and identify the attributes to be used in the choice sets).
- The causes of these environmental problems (to understand peoples’ perceptions of cause-effect relations among attributes).
- People’s knowledge of policies or activities undertaken by the government or individuals to tackle these environmental problems (to frame the CCFGP in a series of policies, programs and other activities).
- The extent of knowledge that people have about the CCFGP and its environmental impacts (to decide how much information needs to be included in the questionnaire, how the information needs to be presented, and to identify the attributes to be used to describe the environmental good provided by CCFGP).
- Potential (form and amount) of payment to improve the environment (to define the attribute based on which WTP for the environmental good can be derived).

5.1 Sampling Frame and Group composition

Participants in the focus groups were recruited primarily by using the ‘friends of friends’ approach. In order to diversify the socio-economic coverage of the participants, the social classification of the Chinese society was taken as a reference for stratifying the sample. According to CASS (2004), people in China are categorised into the following ten groups:

- Government employees
- Managers
- Private entrepreneurs
- Professionals and technicians
- Clerks
- People involved in small family business
- Employees in the service sectors
- Workers/labours
- Farmers
- Unemployed people

Based on the above categories and considering the specifics of the situation in Beijing, participants for the focus groups were chosen to include:
- Government employees
- Professionals of foreign company/organisation (senior level)
- Employees of private company (junior level)
- Researchers in a research institute or university
- Clerks in an organisation (state enterprise/joint-venture company/community service)
- Family business owners (small shop owner)
- Employees of the service sectors (taxi driver)
- Workers in the production sector
- Students/retired persons
- Unemployed people

The two focus group meetings were held in the same afternoon for two hours each. The groups’ compositions are set out in Table 1. The samples included 10 females and 8 males. This compares with the recent statistics of gender distribution in Beijing, which is 52 per cent male and 48 per cent female. About 78 per cent of the Beijing residents are between age 15 and 64. Around 13.6 per cent are younger than 14 and 8.4 per cent are over 65 years old (Zhang 2002). All the focus group participants were aged between 20 and 64.
Table 1: Age and sex statistics for the two focus groups in Beijing

<table>
<thead>
<tr>
<th></th>
<th>Focus Group 1</th>
<th></th>
<th>Focus Group 2</th>
<th></th>
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<td>Proportion</td>
<td>No.</td>
<td>Proportion</td>
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<td>100%</td>
<td>18</td>
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</tbody>
</table>

5.2 Findings and Implications

A number of questions were discussed in the focus group meetings. These discussions lead to the following findings.

5.2.1 Framing of the Issue

The focus group meetings started with general discussions regarding the environmental issues that are of concern to Beijing residents. These included local issues in Beijing and issues across the region in North China. This was followed by discussions on the problems that people considered to be the most important. This helped to get some idea of the ranking of these issues. This information is useful in framing the issue in the survey questionnaire. In other words, this discussion revealed how people position the environmental impacts associated with the CCFGP in an array of environmental goods that they value. Information revealed by participants can also be used to determine which attributes should be included in the choice models. In this section, environmental problems that people identified together with their perceptions on the solutions will be described and analysed based on the ranking of these problems.

Geographical Boundary of Environmental Problems

All the participants expressed their concern about environmental problems in both Beijing and across the region in North China because environmental quality impacts on their lives. However, they did not perceive the necessity to discuss the environmental issues in Beijing and across the region in North China separately. In
their opinion, environmental problems in the two places are inseparable and interrelated. They gave the example that if air quality in North China was not good, air quality in Beijing would definitely be affected in a negative way. Another example they gave was that most of the sandstorms that Beijing had suffered originated from other parts of North China. Following this clarification, discussions about environmental problems were held from the perspective of Beijing residents in a more general sense rather than site-specific.

**Air Quality**

Participants were more concerned about environmental issues that are more closely related to their daily lives. Most people expressed their concern about the bad air quality including increasing level pollutants and dust and sandstorms. Poor air quality increased probability for respiratory diseases and severely threatened the health of people in Beijing. Dust and sandstorms made life inconvenient. People had to spend a lot of time everyday cleaning the dust at home and also to reduce their travels during sandstorm or dust storm days. Participants believed that pollution control efforts had been made to improve air quality. These included reducing pollution emissions from both factories and vehicles through technical upgrading of equipment. To reduce dust and sandstorms, afforestation and sand control programs had been implemented for many years, with greater effort being made in recent years. However, no one in the focus groups mentioned the CCFGP explicitly in tackling the dust and sandstorm issue.

**Sanitation, Congestion and Heavy Traffic**

The urban sanitation problem was raised. Based on their personal experiences and observations, people discussed various kinds of sanitation problems such as inappropriate garbage disposal due to irresponsible behaviour or bad habits. To tackle this issue, participants noted that education and awareness-raising activities had been undertaken, inspections had been conducted, and regular cleaning in the public places had been organised by the communities. Participants also considered heavy traffic and congestion in the city as an environmental problem that lowered life quality, and was therefore of great concern to them. These environmental issues might not seem
relevant in the CCFGP context because they were human environment rather than natural environment problems. However, discussions over these issues were crucial in the ‘framing’ exercise as they gave some indication of people’s preferences in terms of environmental protection.

*Landscape Aesthetics*

A decreased level of urban landscape aesthetics with less trees and grassland was also on the list of the participants’ environmental concerns. People compared the current urban landscape with that of ten years ago and believed their living environment had deteriorated. A lack of landscape aesthetics made life less pleasant. They noted that effort had already been made in increasing urban green areas by growing trees and grass, but also suggested that building construction need to be stopped or at least slowed down.

*Water Quality*

The last issue of concern brought up directly by the participants was poor water quality. Many people suggested that decreased drinking water quality severely damaged people’s health. Discussions about this topic revealed that people were informed of decreased drinking water quality from the news media rather than experiencing it themselves. This has implications for the CM survey in Beijing because Beijing residents might attach some value to the water quality improvement in the North West even though they might not use the water directly and immediately. Some participants in the focus groups experienced poor water quality from direct use of some of the rivers in Beijing for swimming. They confirmed that they were no longer able to swim in those rivers because of poor water quality. Participants were aware of various pollution control efforts such as reducing sewage discharge into the rivers. Only a few participants mentioned the impact of afforestation on water quality, although none explicitly referred to the CCFGP.
**Water Shortages**

With some prompts from the facilitator, participants also showed their concern over water shortages. Water shortages are severe in Beijing and the water price has already been increased. Even though Beijing suffers from water shortages, people’s daily lives have not yet been severely impacted. Furthermore, Beijing residents in the focus groups were largely insensitive to the water price increase possibly because of their affordability.

Participants agreed that water shortages would have a negative impact on life quality. Lack of water made life inconvenient in terms of direct consumption and also had a negative impact on tourism. They talked about some popular tourist sites around Beijing where rivers stopped flowing in recent years. They believed that would reduce the number of tourists. People suggested that the government had developed water saving technologies and adopted policies to encourage water saving such as increasing water prices. However, none of the participants mentioned the role that forests play in regulating run-off and changing the water flow.

**Biodiversity Loss**

Also with some prompts, participants showed their concern over the decreasing numbers of animal and plant species. They observed the loss especially of animal species from their own daily lives and believed that this would break the ecological balance and eventually threaten the survival of human beings. Focus group respondents suggested that afforestation programs and the establishment of nature reserves were useful government undertakings for biodiversity conservation. Avoiding human disturbance was also considered to be a good strategy to protect animal and plant species.

In summary, participants of the focus groups identified a wide range of environmental problems that were of concern. Some are directly associated with the CCFGCP and can be regarded as its environmental attributes. This demand side perspective can be examined against the supply side perspective. This will be discussed later in this report to determine the attributes to be used in the CM study. Insight has also been
provided by the focus groups into how people link these environmental problems to available solutions. Even though people acknowledged the role of afforestation in tackling some of the environmental problems such as dust and sandstorm, decreased landscape aesthetics, poor water quality and biodiversity loss, other government initiatives and programs were considered of equal or even more importance or at least prominence. It is also worth noting that the CCFGP was not explicitly specified as one of the policies designed to tackle the environmental problems.

5.2.2 Causal Links

The next topic for focus group discussion was the causes of these environmental problems. This was aimed at helping gain an appreciation of how people perceive the causal links between the CCFGP and the attributes as well as any causal links between the attributes.

People believed that bad air quality was mainly caused by industrial pollution, the growing number of vehicles and the expansion of construction. Sandstorm as an attribute of air quality were seen to result from the dry climate and devegetation and land degradation in the North and West where the sand and dust arose. According to participants, the deteriorating landscape which negatively affects people’s comfort was a result of less greening in cities and surrounding areas, and was also due to human disturbance such as tourism. People believed that poor water quality could be attributed to industrial pollution. Water shortages were thought to be caused by population growth and wasteful use of water resources. Biodiversity loss was believed to be caused by urban expansion and tourism that damages the habitats for fauna and flora. Since sanitation, congestion and traffic problems are not relevant in the context of the CCFGP, discussions on the causes of these problems will not be mentioned here.

Some conclusions can be drawn from the discussion. First, dust and sandstorms, decreased landscape aesthetics and biodiversity loss were considered to be caused or partly caused by vegetation loss, which is the main issue addressed by the CCFGP. This implies that vegetation cover would be perceived as a causally prior attribute and ideally should not be included as an attribute in the CM questionnaire. Even though
the focus groups did not identify vegetation cover as an attribute in an explicit way, landscape aesthetics in the context of CCFGP could be mainly caused by changes in vegetation cover. This leads to the question of how to describe landscape aesthetics if it is going to be included as an attribute. Secondly, all other attributes (except the vegetation cover) were in parallel and there was no causally prior attributes. This poses another challenge to the design of survey questionnaire. If these attributes are perceived to move together with one common factor, which is the vegetation cover change, people will tend to think that these attributes should always move in the same direction. It would be difficult to convince respondents that opposite movements in attribute levels in the CM choice sets would occur. However, the levels of these attributes can change at different rates and in different directions. For instance, biodiversity could increase at a lower rate than sandstorm prevention. Thus it is possible that attributes move in different directions under different management options. Respondents need to have this explained clearly in the survey questionnaire.

Thirdly, the causes of the environmental problems were consistent with the solutions to these problems mentioned by participants. For instance, participants talked about afforestation programs and sand control programs to tackle dust and sandstorm problem, and growing trees and grass to increase greening areas in cities and surrounding areas (see Section 5.2.1). This shows the consistency of the responses obtained from the focus group discussions and justifies the results from the discussions.

5.2.3 Knowledge of the CCFGP

It is important to get some understanding of people’s knowledge of the CCFGP including its current and potential environmental impacts. This helps to determine how much information is needed and how the information needs to be presented in the CM survey questionnaire. During the focus group meetings, the majority of participants did not relate the environmental problems they identified earlier to the CCFGP as one of the mitigation strategies. Instead, they talked about other policy measures undertaken by the Chinese Government in solving these environmental problems.
Most participants had heard of the CCFGP from newspapers and other news media, but few people knew the details of the Program. For instance, they understood that the CCFGP was about afforestation, but were not well aware of the conversion of cropland part of the Program and the subsidies involved. This implies that details of the CCFGP will be needed in the CM survey questionnaire.

Once introduced, participants believed that the CCFGP would have positive impacts on the environment as a whole if it could be implemented as planned. However, they did not perceive a direct link between the implementation of the CCFGP and environmental improvements in Beijing. First, they talked about the distance between the CCFGP sites and Beijing, suggesting that the environmental benefits could hardly be felt by people in Beijing. Secondly, they mentioned that the potential reduction in dust and sandstorms in Beijing might be due to other afforestation and sand control programs around Beijing instead of being a result of the CCFGP. Thirdly, they worried about the survival rate of trees being planted under the CCFGP, questioning the potential environmental impact of the CCFGP. This discussion showed that it would be difficult to convince the Beijing residents of any causal link between the CCFGP and environmental improvement in Beijing even with specific scientific data. This justifies the constraining of the geographical boundary of this CM exercise that will be discussed in Section 6.2.

5.2.4 Payment

The last topic discussed was the payment issue. The goal was to gain an understanding of peoples’ willingness to pay for environmental improvements, the form of payment that they would be comfortable with, and the amount that they would be likely to pay. Payment is a key component in any CM study. The trade-offs that respondents make in selecting between the status quo situation and proposed alternatives are measured in monetary terms via the payment vehicle. As the payment issue was being discussed, participants were made aware of other spending commitments they might have such as helping poor children going to school or making donations to areas struck by natural disasters.
According to the focus groups participants, it is important to keep the CCFGP in place even if it meant continual financial support to farmers to help them convert their cropland to forest and grassland. Participants understood that the financial support had been provided by the Government over the past few years, but also noted that part of the money paid was from themselves as tax payers. Participants did not reach agreement on their WTP for the environmental improvement induced by the CCFGP. Some participants felt reluctant to contribute some amount of money to the CCFGP in addition to the tax they had already paid for four main reasons. First, the environmental improvement brought about by the CCFGP is public good, hence should be provided by the government through existing tax revenue without charging extra money from individuals. Secondly, they believed that people have a right to enjoy a good environment without having to pay for it. They commented that those entities damaging the environment should pay to clean up or pay for the environmental damage they cause. Thirdly, they did not perceive a direct link between the implementation of the CCFGP and the environmental improvement around themselves in Beijing. They would rather make donations to other ecological programs that have more direct bearing on the environmental improvement in Beijing such as the sand control program. They even mentioned that they would like to spend the money on things that were more approachable and believable, such as helping poor children going to school or making donations to areas struck by natural disasters. Fourthly, they were not confident in the credibility of the monitoring system for the management of the funds that would be raised.

In contrast, other participants perceived that the environmental improvements brought about by the CCFGP are important and believed that would have an indirect impact on Beijing. They expressed their willingness to pay some amount of money to share the financial burden for the continuing implementation of the CCFGP. However, they suggested that there was a lack of knowledge among themselves and many other people as well on where to pay that money. They were not well informed of different kinds of fund raising activities and also did not know much about the organisations that were responsible for fund raising. These participants did suggest different forms of payment, including making donations to various Greening Funds or Environmental Funds, investing in the environmental security market, and buying environmental protection lotteries. Also they preferred donation to being taxed. As environmental
securities and lotteries are investment activities from which purchasers hope to gain some financial return as well as an environmental improvement, they are not appropriate forms of payment in the CM study context. Participants also implicitly mentioned the maximum amount that they would like to pay: about 0.1 per cent of their net annual income (after tax).

The discussion on the payment issue has implications for the CM survey questionnaire. Even though some participants rejected the idea of paying for the environmental improvements that seemed to have no direct relationship to them, there were participants who would like to pay some money for these environmental benefits. There would be some WTP among the Beijing residents for the environmental benefits resulted from the CCFGP.

6. The Supply Side

Through the focus group discussions, the demand side perspective has been obtained regarding the environmental impacts induced by the CCFGP and how that is framed in an array of environmental goods. The supply side perspective will be discussed in this section. This will be followed by identifying and defining the attributes proposed for use in the CM survey questionnaire.

6.1 Policy Objectives of CCFGP

To find out the supply perspective of the environmental impacts resulting from the CCFGP, the policy objectives of the CCFGP need to be well understood. This has been achieved through discussions with policy makers and their advisers as well as searching government documents in which the policy objectives of the CCFGP are detailed.

The CCFGP was implemented on the basis of accelerating rates of soil erosion and desertification in China, especially in the North West provinces. These problems led to increasing frequency of flooding and serious sandstorms. Deforestation and degradation of grassland is considered to be the main immediate biophysical cause of the deteriorating natural environment (CCICED 2002). In addition, the planting of
annual crops and the grazing of livestock on devegetated lands with a slope of over 25 degrees have led to accelerated rates of soil erosion (SFA and SDPC 2000).

Hence the CCFGP has land improvement and the provision of environmental services as its top priorities and was implemented across the whole country. In the north west where the main river systems in China originate, the CCFGP is planned to bring soil erosion under control, combat desertification, increase biodiversity and mitigate water shortage and drought (SFA and SDPC 2000; CCICED 2002; State Council 2002).

6.2 Identification of Attributes

The geographical boundary for the environmental improvements due to land use change under the CCFGP that are to be valued in the CM exercise will be confined to the Loess Plateau. The Loess Plateau lies in the north and central west of China, in the middle reaches of the Yellow River. It has an arid to semi-arid climate and covers large parts of the Gansu, Shaanxi, Shanxi provinces and Ningxia Autonomous Region. It also covers parts of Qinghai and Henan provinces and the Inner Mongolia Autonomous Region (McVicar 2002; Sun and Zhu 1995). Having an area of 630,000 sq km, it is a heavily dissected landscape consisting of unique loess hills, sand-loess hills and loess tableland, with many gullies (Sun and Zhu 1995). The Loess Plateau is one of the most ecological fragile areas in China and is the place where the pilot phase of the CCFGP was implemented.

The selection of the Loess Plateau is based on the scientific uncertainties and difficulties in establishing the large-scale biophysical links. The biophysical links between revegetation activities in the North West provinces and their impact on the environment elsewhere are difficult to establish. The impacts depend on interactions among a large number of land uses, vegetation and geological characteristics that occur within heterogeneous landscapes over a range of spatial and temporal scales. Very little research has been done in up-scaling site-specific biophysical monitoring results. The selection of the Loess Plateau can also be justified by the focus group discussions. The focus group discussions show that Beijing residents could hardly be convinced of any causal link between the CCFGP and environmental improvement in Beijing. However, focus groups did show some WTP for the environmental benefits
resulted from the CCFGP. Thus the exploration of the non-use value of the environmental good provided by the CCFGP among the Beijing residents in the CM study can be justified. Therefore, values attached by people in Beijing, Xi’an and Ansai to the environmental impacts of the CCFGP on the Loess Plateau will be explored, given that Xi’an and Ansai respondents are more likely to experience direct use and indirect use values.

Based on the definition of the value that is to be estimated, the availability of scientific studies, the supply and demand perspectives as well as the other principles mentioned in Section 3, four attributes have been broadly identified. These general attributes are:
- Air quality
- Landscape aesthetics
- Water quality
- Biodiversity
These attributes have been designed to cover general environmental issues that are of concern to people living in both Beijing and the North West. This is important as the same survey questionnaire will be used in both places.

6.3 Defining the Attributes

The next stage is to develop descriptions of the attributes and the range over which attribute levels can vary. This work was based on the above findings and the theories mentioned earlier in this paper and included a literature review and discussions with experts. The range of the attributes is between the projected level in the ‘without CCFGP’ scenario\(^1\) and the best level that could be achieved under the CCFGP. The unit to measure these attributes has also been developed. It is also important to note that the CCFGP has an implementation plan from 2000 on to 2010 only. Definitions of attributes and their ranges will be detailed in the following sub-sections. A summary table can be found in Appendix I.

\(^1\) Assumption has been made that farmers will revert to prior land use management once the subsidy stops in 2007. Thus under the baseline scenario, which is the ‘with subsidisation under the CCFGP for 8 years’, projected levels of the attributes will be no worse than the ‘without CCFGP’ scenario. In other words, projections made under the ‘without CCFGP’ scenario can well represent the worst possible level of the attributes.
6.3.1 Air Quality

Sandstorm frequency is used to describe air quality. Specifically, the annual sandstorm days in the Loess Plateau area has been developed as the unit of measurement. Xu (2004) has analysed the relationship between land use change and sandstorm frequencies in the vicinity of the Erdos Plateau, which covers the sandy area in the North Loess Plateau and the surrounding sandstorm-struck area mainly in the Loess Plateau. In the first stage of the analysis, the effect of land desertification on sandstorm frequencies has been investigated. A non-linear relationship has been established between sandstorm frequency and the index of land desertification ($I_{ld}$), which is defined as the percentage of the area of desertified land of the total. The relationship indicates that when $I_{ld}$ is less than 30 per cent, the sandstorm frequency did not change with an increasing $I_{ld}$. However, when $I_{ld}$ is greater than 30 per cent, the sandstorm frequency increased rapidly.²

In the second stage of Xu’s study, the time series of annual sandstorm days in the neighboring area of the Plateau has been related to the time series of annual strong wind days and the area of cultivated land. A multiple regression equation was estimated, based on which the relative contribution of changes in land use was 59.7 per cent and in the number of strong wind days was 40.3 per cent.³ This result indicates that the frequency of sandstorms may be effectively decreased by reducing the area of cultivated land and restoring steppe ecosystem in the ecologically fragile areas in arid and semi-arid climates. Since the soil erosion area is greater than 30 per cent in both the ‘with CCFGP’ and ‘without CCFGP’ scenario, the relationship can apply. Specifically, the area of cultivation that has been converted to vegetation would make a contribution of 59.7 per cent to sandstorm reduction on the Loess Plateau.

In order to estimate sandstorm frequency changes with and without the CCFGP, it is important to understand the land use change on the Loess Plateau under these two scenarios. According to Asian Development Bank (2003), desertification in China is occurring on about 2.62 million sq km, with an annual expansion of 24,600 sq km. At

² The equation of the relationship is: $D_{ss} = 13.144 \ln I_{ld} - 38.828$, where $D_{ss}$ denotes annual sandstorm days, $I_{ld}$ denotes the percentage of the area of desertified land of the total.

³ The multiple regression equation is: $\ln D_{ss} = 0.368 \ln D_{sw} + 0.546 \ln A_a$, where $D_{ss}$ denotes annual sandstorm days, $D_{sw}$ denotes annual strong wind days, and $A_a$ denotes area of cultivated land.
the current rate of desertification, the total desertification area in China will increase by 18.8 per cent in 20 years time by 2020\(^4\).

Since almost 90 per cent of desertification area is located in the North West part of China and the Loess Plateau is within the region, an assumption can be made that the desertification rate, and hence the sandification rate, on the Loess Plateau is the same as that of the Northwest. Thus without CCFGP, there will be 18.8 per cent more desertification area on the Loess Plateau in 2020 compared to 1999. Increased area of desertification on the Loess Plateau would lead to higher sandstorm frequency according to Xu (2004). Using the relationship between land use change and sandstorm frequencies identified earlier in the study, i.e. desertification area contributes to 59.7 per cent of occurrence of sandstorm, the level of sandstorm days on the Loess Plateau is thus estimated to be 11.2 per cent more than the 2000 level by year 2020 in the ‘without CCFGP’ scenario\(^5\). Based on meteorological data collected in 83 counties on the Loess Plateau during 1971-2000 (China Meteorological Bureau 2005), the annual sandstorm days in areas with severe soil erosion is around 20 days. An increase of 11.2 per cent in sandstorm frequency without CCFGP in place means that there would be 22 annual sandstorm days on the Loess Plateau by 2020.

The CCFGP has an implementation plan from 2000 to 2010 only. According to the implementation plan, about 121,000 sq km of water and wind-induced soil erosion area on the Loess Plateau will be brought under control under the CCFGP (Gao, Yan and Liu 2003). Among this reduction in soil erosion area, about 17,900 sq km will be the reduced desertification area. Compared to the desertification area on the Loess Plateau in 1999 which was 60,600 sq km, the ‘with CCFGP’ scenario represents a decrease in desertification area by 29.5 per cent on the Loess Plateau (see Appendix II for the derivation of these results). This land use change would lead to a decrease of 17.6 per cent in sandstorm frequencies in the Loess Plateau area by 2020. Thus with the CCFGP in place, there would be 16 sandstorm days per year by 2020. This is the best level that could be achieved in the ‘with CCFGP’ scenario.

\(^4\) This prediction is made by the following calculation: \(\frac{24600 \text{ KM}^2}{2620000 \text{ KM}^2} \times 20 \text{ years} = 18.8\%\).

\(^5\) This result is derived by: \(18.8\% \times 59.7\% = 11.2\% \). It should be noted that the interaction of strong wind days and the change in land cover has already been captured by the multiple regression equation based on which the
6.4.2 Landscape Aesthetics

The definition of landscape aesthetics is a challenge because vegetation cover, which will best describe landscape aesthetics, has been identified as a causally prior attribute earlier through the focus group discussions. Careful consideration should be given to the information presented to respondents to ensure that landscape aesthetics are best captured while at the same time not being perceived as a causal attribute for other attributes. For instance, explanations can be made in the survey questionnaire that vegetation cover is only one factor causing the change in sandstorm frequency, water quality and plant species diversity. The distribution and type of trees also has an impact. Post-survey tests should also be conducted to check for the causal effect (Rolfe and Windle 2005). Even though landscape aesthetics of the Loess Plateau can be described either qualitatively or quantitatively in terms of its levels, quantitative expression is more preferred to qualitative expression because of its modelling and valuation potential. Vegetation cover will be used as the descriptor of landscape aesthetics in the draft survey questionnaire for further pre-test in the focus groups.

The Loess Plateau has the most severe ecological deterioration in north western China, with 70 per cent of its area being eroded by wind and water (PTFDSSD 2003). It is also one of the key areas for ecological rehabilitation under the Great West Development Strategy that has been undertaken by the Chinese Government. The CCFGP and the Natural Forest Protection Program are the two key programs to implement this Strategy. As an important component of the Strategy, landscape in the North West provinces will be changed from gully and hilly barren lands to green lands and hills through revegetation activities. Thus the terms ‘gully and hilly barren hills’ and ‘green lands’ could be considered as the basis for further qualitative descriptions of the landscape attribute as an alternative if vegetation cover is finally dropped out as a result of the pre-test of the draft survey questionnaire.

Projection need to be made on the vegetation cover on the Loess Plateau by 2020 in the ‘without CCFGP’ scenario. There have been very few aggregate data on the total vegetation cover in the Loess Plateau region as forest and grassland management in

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contribution ratio is derived. Unless extreme climate conditions apply, predictions made about future sandstorms frequency by using the contribution ratio of land cover change should be considered valid.
China falls into the jurisdiction of two administrative agencies, i.e. the State Forestry Administration and the Ministry of Agriculture. There have been, however, data available on forest cover in the region. Several studies show that forest cover in the region remains around 7 per cent throughout the 1990s (Sun and Zhu 1995; Peng 2001; Cheng and Wan 2002), despite the fact that great afforestation effort has been made in the region during this period. This is mainly because of the low rate of survival for trees due to the low precipitation level and poor soil quality on the Loess Plateau. Furthermore, places suitable for afforestation were already used for cultivation activities. Even though ecological rehabilitation under different programs has been undertaken, no big change would take place without returning cropland to forests at a large scale.

Very few studies can be found in the literature regarding the grass cover on the Loess Plateau and the aggregate data of forest and grass cover. However, a general trend of over-grazing and grassland degradation in the Loess Plateau region has been observed (PTFDSSD 2003; ADB 2003; Shi and Ya 2002). About 97 per cent, 59 per cent and 45 per cent of grassland is degraded respectively in Ningxia, Shaanxi and Gansu autonomous region and provinces on the Loess Plateau (Shi and Ya 2002). An overall of 60 per cent of grassland degradation is observed on the Loess Plateau (Gao et al 2003), and this percentage will be used to make projections of grassland cover by 2020. Projection has been made that vegetation cover on the Loess Plateau including both forest and grassland cover would drop to 9.6 per cent by 2020 without the CCFGP in place.

According to the ecological rehabilitation plan under the CCFGP, vegetation cover on the Loess Plateau will reach 40 per cent by 2010 (Hu and Wang 2000). The improvement of technical component in planting trees and grass has been emphasised in the CCFGP implementation plan to increase the rate of survival. Soil erosion would decrease from 70 per cent to 50 per cent by then (Gao, Yan and Liu 2003). As there would be no further implementation plan for the CCFGP beyond 2010, and seedlings planted before 2010 will grow into forests by 2020, it can be concluded that forest and

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6 According to Yan et al (1998), forest and grass cover on the Loess Plateau was 13.6%. Forest cover on the Loess Plateau remained 7% throughout the 1990s and is projected to remain constant over the next 20 years. Thus the vegetation cover including both forest and grassland cover would drop to: 7%+(13.6%-7%)*60% = 9.6%
grass cover on the Loess Plateau will be 40 per cent by 2020. This is the best level that could be achieved under the CCFGP.

6.4.3 Water Quality

Water quality is described in terms of grades of water based on which different uses of water are defined. In China, the Environmental Quality Standard for Surface Water was established to implement the Environmental Protection Law and the Law on Prevention and Control of Water Pollution. Surface water is divided into five grades according to uses and the aims of protection (SEPA 2002):

- Grade I: mainly suitable for water sources and State Nature Reserves;
- Grade II: mainly suitable for first class protection areas of concentrated drinking water sources, habitats of precious aquatic species, spawning areas for fishes and shrimps, and feeding areas for juvenile fishes;
- Grade III: mainly suitable for second class protection areas of concentrated drinking water sources, winter ground for fishes and shrimps, aquaculture production and swimming areas;
- Grade IV: mainly suitable for the common industrial water sources and areas used for recreation where water does not directly touch human bodies;
- Grade V: mainly suitable for agricultural use and water areas in common landscape areas.

In general, water quality in the main stream of the Yellow River is better than that in the tributaries. Even so, the water quality at 63.1 per cent of the monitored sections along the main stream of the Yellow River was Grade V and worse than Grade V in 1999 (SEPA 1999). Only 18.4 per cent of the monitored sections showed a water quality between Grade I and Grade III. The main tributaries of the Yellow River including Fen River, Wei River, Huangshui River and Yiluo River which are located on the Loess Plateau were severely polluted (SEPA 1999). In 2003, the water quality at 47.8 per cent of the monitored sections along the main stream of the Yellow River was Grade V and worse (SEPA 2003). Almost all the tributaries in the Middle and Lower Reaches of the Yellow River had a water quality of worse than Grade V all through the year, with most of the tributaries in the Middle Reach running through the Loess Plateau.
Specific monitoring indices have been set up to measure water quality. They include the hardness of water, the level of ammonia nitrogen (NH$_3$-N), biological oxygen demand (BOD), and chemical oxygen demand (COD) level in the water, and so on (SEPA 2002). For this research study, NH$_3$-N level has been used as the index to find out the changes in the grades of water on the Loess Plateau in the ‘with CCFGP’ and ‘without CCFGP’ scenarios. NH$_3$-N level has been chosen as the indicator for three reasons. First, NH$_3$-N level is one of the main indicators to classify water into different grades. Secondly, NH$_3$-N level in the water can be reduced through vegetation rehabilitation in the watershed. Therefore it will be affected by the revegetation activities under the CCFGP. Thirdly, NH$_3$-N is one of the main pollutants in the Yellow River and its tributaries according to the 1999 Environmental Communique in China (PRC). Table 2 shows the national quality standard for each grade of water in terms of its NH$_3$-N level.

<table>
<thead>
<tr>
<th>Grade of Water</th>
<th>Level of NH$_3$-N (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>≤ 0.15</td>
</tr>
<tr>
<td>Grade II</td>
<td>≤ 0.5</td>
</tr>
<tr>
<td>Grade III</td>
<td>≤ 1.0</td>
</tr>
<tr>
<td>Grade IV</td>
<td>≤ 1.5</td>
</tr>
<tr>
<td>Grade V</td>
<td>≤ 2.0</td>
</tr>
</tbody>
</table>

Source: SEPA 2002.

Empirical research in the Loess Plateau area shows that vegetation can reduce the level of NH$_3$-N in the rivers (Sun and Zhu 1995). Table 3 below demonstrates the difference in NH$_3$-N level in rivers with different landscapes on the Loess Plateau.

7 Tributaries of the Yellow River on the Loess Plateau have two main pollution sources: industrial sewage and domestic waste disposal, and the runoff from barren slopes which brings chemicals into the tributaries. It is worth noting, therefore, that even though vegetation has a potential to reduce the NH$_3$-N level in the river, hence to improve the water quality from Grade V or worse to Grade III, it cannot decide water quality ultimately. In other words, chemicals brought into the tributaries can be filtered by vegetation cover on the slopes, but vegetation in the watershed cannot do much about industrial sewage being discharged into the rivers.

The water quality attribute can also be described by the amount of annual sediment discharge into the Yellow River from the Loess Plateau region. This descriptor seems to be more relevant in the CCFGP context in the sense that soil erosion will be brought under control through revegetation activities. However, sediment discharge is more of a “physical attribute” than an “effect attribute” as discussed earlier in Section 3.3. Both these two descriptors of the water quality attribute will be pre-tested in the focus groups.
The NH$_3$-N level in rivers running through barren slopes coincides with the threshold level of national standard for water quality of Grade V (about 2.0 mg/L). In contrast, rivers that are sheltered by vegetation have much lower NH$_3$-N level (less than 1.0 mg/L) defined as better than Grade III according to the national standard. It is worth noting that the shrub and arbor species shown in Table 3 are the two main species used for revegetation on the Loess Plateau under the CCFGP.

Table 3: NH$_3$-N level in rivers with different landscapes

<table>
<thead>
<tr>
<th>Source</th>
<th>Level of NH$_3$-N (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural precipitation</td>
<td>0.42</td>
</tr>
<tr>
<td>Barren slopes</td>
<td>2.02</td>
</tr>
<tr>
<td>Shrub (Ostryopsis davidiana)</td>
<td>0.94</td>
</tr>
<tr>
<td>Chinese pine (Pinus tabulaeformis)</td>
<td>0.72</td>
</tr>
</tbody>
</table>

Source: Adapted from Table 7.10.4 in Sun and Zhu 1995.

Monitoring results in 1999 and 2003 have shown some improvement in the water quality of the main stream of the Yellow River partly due to the pollution control effort, but the level of water pollution in the tributaries further deteriorated and the situation is likely to remain over the next two decades. This is because as local industries grow, more sewage will be discharged into these tributaries so that the pollution control effort cannot offset the damage within a short period of time. Thus it can be assumed that in the ‘without CCFGP’ scenario, the river sections on the Loess Plateau would have water quality worse than Grade V level, an indication that the river system would almost lose all its basic ecological functions and would be completely useless. As mentioned earlier, vegetation can potentially reduce the level of NH$_3$-N in the rivers and therefore improve the water quality from Grade V level or worse to Grade III level at which water can be processed for drinking purpose. Trees and grasses planted under the CCFGP would bring their ecological functions into full play by 2020, therefore the best level of water quality that could be achieved under the CCFGP would be that watersheds on the Loess Plateau that are sheltered by vegetation would have water quality better than the Grade III level.
6.4.4 Biodiversity

Judged from the focus group discussions, it would be ideal to include the number of both fauna and flora species to represent biodiversity change. However, no aggregate data of fauna species in the Loess Plateau region has been found. Therefore, for this research, the change in biodiversity induced by the CCFGP will be represented by the change in the number of plant species on the Loess Plateau. There are altogether 2,046 plant species on the Loess Plateau (Cheng and Wan 2002). Statistics show that around 15 to 20 per cent of plant species in China are being threatened (PTFDSSD 2003). However, hardly any information is available on the current status of the plant species on the Loess Plateau. As ecosystem deterioration on the Loess Plateau is more severe than in the other parts of China, an upper bound of 20 per cent of plant species being threatened is used as a proxy to make projections on the change in plant species on the Loess Plateau for the status quo situation. If the current deteriorating ecosystem remains without taking any mitigation actions, there would be only about 1637 plant species being protected from extinction on the Loess Plateau by 2020.

Research at Zhifanggou watershed in Ansai County, Shaanxi Province shows the changes in composition and structure of plant communities after vegetation rehabilitation (Wang et al 2002; Wang et al 2003; Wang et al 2002). Ansai is located in the Loess hilly gully region, and this type of land makes up about 70 per cent of the Loess Plateau territory on which the CCFGP mainly takes place (Zhu 2003; Sun and Zhu 1995). Discussions with experts have also confirmed that the research results from Ansai are highly representative and can be used to extrapolate to the whole Loess Plateau area. Research results show that vegetation rehabilitation would result in an increase in plant species from 126 up to 151 in 20 years’ time (Wang et al 2002). This represents a 16.6 per cent increase in plant species. It can thus be estimated that with the CCFGP in place, there could be up to 2386 plant species being protected from extinction on the Loess Plateau by 2020.

6.4.5 Payment

Payment will be an important attribute in the choice sets. With the payment attribute, it is possible to generate estimates of the marginal value of changes in each attribute
in monetary terms. It has been concluded from the focus group meetings that to sustain the implementation of the CCFGP, people are willing to pay no more than 0.1 per cent of their net annual income (after tax) to the Greening Fund or the Environmental Fund. Even though people in the focus groups were opposed to being taxed to support the CCFGP, imposing a tax or levy seems to be the only way to ensure respondents understand that they would have to make some contribution in order to enjoy the environmental improvement brought about by the CCFGP. This is necessary to being able to estimate trade-offs between money and environmental improvement. Other payment vehicle suggested by the focus groups such as making donation would lead to strategic behaviour of respondents because of the free-riding problem. Therefore, an annual environmental levy will be adopted as the payment vehicle in the CM questionnaire. The levy will be collected for 13 years, that is, from 2007 when the Government subsidy stops till 2020 by which year the environmental projections under the CCFGP are made. Moreover, even though focus group participants were asked explicitly to state the amount of their WTP, they gave an implicit answer using a percentage of their net annual income. Given that people feel reluctant to reveal their income level, it would be difficult to ensure the validity of such a percentage of income approach.

The per capita net annual income of Beijing people in the urban areas is ¥11,578 and there is an average of 2.9 persons in one household (Zhang 2002). Therefore, the willingness to pay per household in Beijing is about ¥35. The payment attribute will be defined in terms of an annual environmental levy designed specifically for the CCFGP to be deposited into the existing Green China Fund or China Environmental Protection Fund.

7. Conclusion

The CCFGP that has been undertaken in China will bring about environmental benefits not only to the local people around the program sites but also to the wider Chinese community. In order to estimate the non-market value of the environmental changes of the CCFGP, a CM study will be conducted in Beijing as well as in Xi’an and Ansai County in the northwest Shaanxi Province to find out people’s WTP for the environmental improvements on the Loess Plateau. Four general attributes covering
the air quality, water quality, biodiversity and landscape have been identified and further defined taking into consideration the demand and supply perspectives of the policy as well as other principles of developing attributes. The range over which each attribute can vary has also been set based on scientific knowledge and experts’ projections. The payment vehicle has been identified and the range over which the payment can vary has been set based on the focus group discussions.

Since the focus group discussions were conducted only in Beijing, there might be some bias in identifying the four attributes from the demand perspective. How people in other places perceive the environmental improvements resulted from the CCFGP and the extent of their WTP as well as the form of payment are all issues that need to be further explored during the pre-testing of the CM survey questionnaire. It should also be noted that there are possible limitations associated with using the focus group meetings in the Chinese social and cultural context. Focus group meetings rely heavily on the interactions among group members. Interactions are believed to enable participants to ask questions of each other, as well as to re-evaluate and reconsider their own understandings of their specific experiences (Kitzinger 1994). The two focus group meetings in Beijing demonstrated that there were few interactions among participants. Very often comments and opinions from the most articulate person in the focus group will be supported and further elaborated by the rest of the group. People seemed to lack some critical thinking and were more concealing compared to people from a more open society. Thus the discussions might not have a true representation of what all individuals actually think and do.

In the next stage of the research, the CM survey questionnaire will be structured. An experimental design will be developed to determine the combinations of attributes at different levels which will finally form the choice sets. Site-specific benefit estimates from the CM study will later be used to extrapolate the WTP of the wider Chinese community through the benefit transfer method. The aggregate non-market environmental benefit will be integrated into the full benefit cost framework to inform the policy implications of the CCFGP to the Chinese society.
References


Kitzinger, J., 1994. ‘The methodology of focus groups: the importance of interaction between research participants’, *Sociology of Health*, 16 (1): 103-121.


### Appendix I

#### Definition of Attributes and Ranges

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Air quality</th>
<th>Aesthetics</th>
<th>Water quality</th>
<th>Biodiversity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute</td>
<td>Sandstorm frequency</td>
<td>Landscape aesthetics</td>
<td>Grade of water</td>
<td>Plant species</td>
<td>Annual Environmental levy</td>
</tr>
<tr>
<td>Description</td>
<td>Annual sandstorm days by 2020</td>
<td>The area of vegetation as a percentage of total land area by 2020</td>
<td>The grade of water in rivers sections on the Loess Plateau by 2020</td>
<td>The number of plant species protected from extinction by 2020</td>
<td>The percentage of net annual income a person would be required to donate each year</td>
</tr>
<tr>
<td>Unit of measurement</td>
<td>Days</td>
<td>Percentage</td>
<td>Grade</td>
<td>Number</td>
<td>RMB Yuan (¥)</td>
</tr>
<tr>
<td>Attribute levels</td>
<td>Status quo</td>
<td>22</td>
<td>9.6%</td>
<td>Worse than Grade V (completely useless)</td>
<td>1637</td>
</tr>
<tr>
<td></td>
<td>Best possible level</td>
<td>16</td>
<td>40%</td>
<td>Grade III (can be processed for drinking purpose)</td>
<td>2386</td>
</tr>
</tbody>
</table>
Appendix II

Change in Sandification Area and Sandstorm Frequency on the Loess Plateau

<table>
<thead>
<tr>
<th>Year</th>
<th>Soil erosion area (1,000 sq km)</th>
<th>Sandification area (1,000 sq km)</th>
<th>Decrease in sandification (%)</th>
<th>Decrease in sandstorm frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>411.1</td>
<td>60.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010/2020</td>
<td>411.1 – 121 = 290.1</td>
<td>60.6 / 411.1 *</td>
<td>(60.6 – 42.7) / 60.6</td>
<td>29.5% * 59.7% =</td>
</tr>
<tr>
<td></td>
<td>290.1</td>
<td>290.1 = 42.7</td>
<td>29.5%</td>
<td>17.6%</td>
</tr>
</tbody>
</table>
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