Valuing the ecosystem service losses from land reclamation by contingent valuation in Zhoushan, China

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Abstract. The process of formulating reclamation strategies is a complex and multi-disciplinary process. In life, the characteristic of relevant policy formulation is the lack of information related to the economic value of ecosystem services, which involves the consequences of losses caused by land reclamation. This article presents a present in order to introduce a willingness to pay (WTP) valuation method based on an easy-to-understand questionnaire for the loss of ecosystem services. A sample of 750 residents chooses and uses a hypothetical open payment card question, the purpose is to ask the interviewee WTP to be interviewed face to face. The results showed that the respondents, overall 88.7%, produced a positive WTP (WTP>0), while the average WTP was 362.19 yuan (RMB) per household year.

1. Introduction
Coastal ecosystem services are especially important to humankind. They provide a wide array of goods and services, these services can be divided into four categories [1]: provisioning services (fish and other seafood, materials, fuel), regulating services (regulation of climate, natural hazards and water quality), cultural recreational and spiritual services, and supporting services (photosynthesis, and nutrient cycling). In order to solve the problem of insufficient land supply, reclamation from land and sea has become a common method in many parts of China. In fact, reclamation can cause negative impacts on coastal ecosystems and the services they provide. Land reclamation may affect the water quality of adjacent seas, threaten the vigorous development of fish populations and habitats in coastal waters, and bring risks to animals and plants [2], all of which will directly or indirectly damage their supply. Regulation, cultural and support services provided by coastal ecosystems.

Faced with growing cares for marine environment from the community, governmental officials in charge of managing coastal resources are often make a difficult decision about how to tradeoff between the economic development and environmental protection. In order to measure the direct and indirect impact of human activities on coastal ecosystems, an ideal method is the economic valuation of its services. Therefore, economic valuation can be a useful tool, by providing a way for official to make these types of decisions. There has been a growing interest in the valuation of the multiple benefits provided by coastal ecosystem services [3-5]. By directly investigating individual samples in relevant populations, experimental market methods are used to construct pseudo-markets. This method is usually called contingent valuation method (CVM). In order to do this, a CV survey constructs scenarios that present respondents with hypothetical market by asking people about their willingness to pay (WTP) for public goods and elicits, Therefore, it is similar to the choices made by consumers in the actual market to analyze the respondents' choices [6]. Although still controversial, CVM is widely
accepted among scholars and policy makers. For more than 35 years, CVM has been used to evaluate various environmental goods and services in more than 50 countries/regions, and more than 2,000 papers and studies have been conducted using this method, most of which are from developed countries [7] [8]. For this study the hypothetical market good in question is valuation of coastal ecosystem services losses caused by land reclamation and a case study in Zhoushan city in China.

2. Method

2.1. Study area
Zhoushan is located between latitude 29°32' to 31°04' N and longitude 121°30' to 123°25' E and is the largest archipelago city in China. It consists of 1394 islands of all sizes with 1,250 of them uninhabited. Our study survey was carried out in the city's main island, Zoushan Island. It is the fourth biggest in China. Zoushan city includes 20,800 km2 of marine territory, but only 1,440.12 km2 of land. Since 1951, implemented 372 reclamation projects, converting 165.97 square kilometers of water into land. With the development of Zhoushan Marine Economic Development Zone which was approved by The State Council, Chinese’s cabinet, in early March in 2011 and the urbanization of surrounding areas. The government officials urged the development zone to make the marine economy an important element of the eastern China coastal region. The reclamation demand will continue to grow. The city's 12th Five-Year Plan (2011-2015) showed that Zhoushan aims to reach more than 115 reclamation projects in areas over the 116.80 km2 by the end of 2015. Such planning decisions are usually driven by short-term direct economic benefits, without considering the long-term loss of coastal ecosystem services caused by land reclamation. The main important reason is that coastal ecosystems services are often under-estimated; in many cases its services were given a value of zero [9] [10].

2.2. The elicitation format
One focus of the CVM debate is to choose a specific format to obtain information about the preferences of the interviewee. CVM is produced in a variety of formats in surveys: binary discrete choice, bid game, direct (open-ended) question, (polynomial) choice experiment, joint analysis based on selection, contingent rating, double boundary binary choice, paired comparison, payment Card, and the question of referendum. The Elicitation format is the crucial point in CVM survey[11-13], especially in China which has a very different political environment, social, cultural and economical from developed countries where the CVM was developed. The open payment card question format is used to elicit the respondents’ willingness to pay (WTP). The main reasons for choosing this method are as follows: First, the open format CVM can use data more efficiently, without starting point and bias [14], and more accurately estimate other forms of heuristics than actual payments [15] [16]. Second, because there is no research related to the respondents' willingness to pay for the coastal ecosystem services after the reclaimed case cities, it will be very difficult to design other forms of problems. Finally, the most important reason is that most Chinese respondents are unfamiliar with according a monetary value to non-market goods and services. In order to overcome this limitation, an open payment card method was used to directly remind the respondents of their willingness to pay (WTP), select their willingness to pay, and if they are not satisfied, they can directly state their preferred amount. With the given choice. This method can give respondents more choices. We use the payment card format, in which the respondent checked the list of amounts and was asked to indicate whether they were willing to pay each amount.

Pre-tests and pilot interviews were conducted to assess the effectiveness of the investigation. A pre-test was conducted among college students and staff engaged in environmental sciences, and it was determined that all 20 interviewees understood the questions raised and the scope of the offer. A pilot interview was carried out a month later among forty people, which focused on the content of the WTP questions. The pre-test and pilot test are to verify whether the questionnaire is logically reasonable, the
wording is clear, and whether the respondent can correctly understand the questionnaire, so as to prepare a payment card that can be selected between 0 yuan (CNY) and 5000 yuan (CNY).

After modifying the questionnaire, the final questionnaire consists of three parts. The first includes the purpose of the research, an explanation of the answers to the questions, and the definition of two key terms (coastal ecosystem services and reclamation) to make it easier or possible for the interviewee to understand these questions. In order to obtain meaningful results, the entirely change of coastal ecosystem that occurs due to the reclamation to be introduced in questionnaire. The second part consisted of the contingent valuation survey. This part tackled willingness-to-pay to protect the coastal ecosystem services. Respondents can choose their highest willingness to pay amount from the payment card, or specify the amount in the blank box. In this part questions which inquire about the respondent's attitude towards the reclamation and the methods how to control the extension of reclamation were also followed. The third part of the questionnaire is questioned as to their individual information, such as gender, age, education and income. Such data helped to assess whether socioeconomic status affect respondents' willingness-to-pay. 750 adults who agreed to participate in the survey were randomly selected from the Zhoushan Island area.

2.3. Statistical tools and method
The Statistical packages SPSS 17.0 were applied to analyze the collected data and the effect of socioeconomic factors on willingness-to-pay. Pearson correlation analysis is used to make the association between willingness to pay and personal factors (such as gender, age, education level, and income).

3. Results and discussion

3.1. Sample characteristics
Because CVM is a survey-based approach, it creates a hypothetical market in which the respondents are directly asked their WTP for goods and services. The main factor affecting the effectiveness of CVM research is whether the concept of coastal ecosystem services can be introduced to respondents in a meaningful, accurate and consistent manner. In order to get the success results, there are a lot of information of the coastal ecosystems, the reclamation and the change of coastal ecosystem after the reclamation with both textual description and pictorial images in the first part of our questionnaire. The feedback from the interviewees in the pre-test and pilot survey indicated that most of the interviewees understood the concepts introduced. In our research, the proposed scheme was well accepted by the interviewees and achieved a 90.3% completion rate at the end of the survey. Respondents were evenly distributed between men (52.9%) and women (47.1%). About 53.3% of the respondents were between 18-30 years old, which is the most common age group. 25% of respondents have 31% and 40% fall between 31-40 and 41-50. There is large percentage of people with a university degree or hither degree (47.6%). In terms of monthly income, RMB 2001-3000 Yuan (19.0%) was the most frequent category. Responses to the attitudinal questions demonstrated that 65.4% believed that reclamation could damage the marine environment, and they had disagreed strongly with government’s policy which access to get more land from reclamation. Generally speaking, the respondents are more likely to be male, younger, more educated, and relatively low-income.

3.2. The elicitation format
In Figure 1, You can see WTP's descriptive statistics on valuation issues, the maximum value is RMB 5,000, which is expressed in CNY.
Figure 1. The frequency distribution of respondents WTP amount.

Overall, 88.7% of the respondents had a positive WTP (WTP>0), and only 11.3% of the zero WTP responses were classified as protest votes. In other words, respondents who did not report real economic reasons and were unwilling to pay any fees, but still refused or had a market. These protesting voters have been removed from the WTP analysis. The 543 respondents with a positive WTP value (WTP>0) were divided into 30 groups according to the amount they were willing to pay. According to the payment response (WTP>0), the average value of WTP is 362.19 yuan and the median is 100 yuan. In many cases, the average WTP is significantly higher than the median WTP, which illustrates a common finding in CVM. In our survey, we have the same result. Some studies have suggested that the median, rather than the mean, should be as a better indicator of the central tendency of WTP, median WTP measures was argued to be more robust than the mean WTP [17] [18]. They discussed that the average value can estimate that the average interviewee may be WTP, but because the distribution of WTP is often skewed, it will exceed the maximum WTP of the majority of the population. Therefore, they suggest that the median as a reference point may be more appropriate. Average WTP is usually used for cost-benefit analysis [19], while median WTP is a standard public selection criterion, and median WTP corresponds to a fixed amount that will be approved by the majority. For the decision of the government officials that wish to make a choice based on efficiency criteria, the mean is then the appropriate point [20]. In order to determine the ecosystem service losses from reclamation for governmental environmental policy it seems more appropriate to take the strength of each response into account, and it is realized by using the mean WTP. So, in our study, the mean WTP were measured as tendency measures of WTP. Pearson's correlation analysis shows that among socioeconomic factors, gender, age, education level, and income do not seem to affect willingness to pay. Unexpectedly, the factors proposed by other authors that are believed to increase the likelihood of positive WTP, such as gender, age, education level, and income, are not statistically important in our results.

Table 1. According to socioeconomic factors, the willingness to pay is proposed. Female respondents have a higher mean WTP than males. The mean WTP of female and male was respectively 375.52 Yuan and 350.12 Yuan. The results suggested that age has not effect on WTP. The results demonstrate that up to 60 years old respondents have the highest mean WTP, 2032.50 yuan, the age groups of 51-60 years old have the lowest WTP, 264.05 Yuan, from 31-50 years old, as age increased, the mean WTP increased. We found that, at least in the sample, education had no significant effect on WTP. We find that lower education (primary school) and higher education (PhD) respondents tend to state higher mean WTP than other education level. Respondents with monthly household income 9000-10001 Yuan have the highest mean WTP, 907.86 Yuan. The survey included a series of attitude questions, designed to guide respondents to explore their personal views on general environmental issues, including key questions about attitudes towards reclamation. Attitude may be an important determinant of WTP, so it can be used to explain the valuation response. In our survey, we
did not find the strong relationship between the WTP and the attitude of reclamation. The different attitudes of reclamation are not insult in very different mean WTP. The 65% respondents have an opposes the agreement toward the reclamation, but who have a little higher WTP than those have an agreement.

Table 1. Mean WTP and socioeconomic characters of responders.

| Character          | Mean WTP | N  |
|--------------------|---------|----|
| gender             |         |    |
| 0: female          | 375.52  | 258|
| 1: male            | 350.12  | 285|
| age                |         |    |
| 1: < 18            | 830.42  | 24 |
| 2: 18-30           | 323.14  | 293|
| 3: 31-40           | 333.37  | 135|
| 4: 41-50           | 354.24  | 66 |
| 5: 51-60           | 264.05  | 21 |
| 6: > 60            | 2032.50 | 4  |
| education          |         |    |
| 6: Primary School  | 920.63  | 16 |
| 9: Middle School   | 276.92  | 39 |
| 12: High School    | 301.96  | 102|
| 15: College        | 287.44  | 133|
| 16: University     | 377.32  | 224|
| 19: Master         | 420.50  | 20 |
| 22: Doctor         | 1020.00 | 9  |
| income             |         |    |
| 1: < 1000          | 146.30  | 46 |
| 2: 1001-2000       | 315.97  | 72 |
| 3: 2001-3000       | 303.60  | 100|
| 4: 3001-4000       | 400.47  | 95 |
| 5: 4001-5000       | 443.06  | 62 |
| 6: 5001-6000       | 200.00  | 34 |
| 7: 6001-7000       | 378.65  | 26 |
| 8: 7001-8000       | 230.38  | 26 |
| 9: 8001-9000       | 690.00  | 10 |
| 10: 9001-10000     | 907.86  | 14 |
| 11: > 10000        | 501.21  | 58 |
| attitude           |         |    |
| 1: anti            | 367.95  | 353|
| 2: Agree?          | 361.73  | 142|
| 3: not care        | 321.25  | 48 |

3.3. **Total WTP**

The total WTP for losses of the coastal ecosystem services resulting from land reclamation is calculated using the data of mean WTP collected by the CVM. This total WTP value could be added to those associated with other workings for ecosystem services of reclamation projects in order to guide the governmental officials to allocation of funds to protect the coastal ecosystem. The sample mean willingness-to-pay in this study was RMB 362.19 Yuan. Multiply the average WTP by the total number of affected people in the study area (according to the 2000 census, there are 360,700 households and 2.73 persons/household) to calculate the total WTP. Then, the aggregate monetary value of coastal ecosystem losses from reclamation in Zhoushan city could be calculated. It was computed to be RMB 1.31E+08 Yuan and per ha be 7871.45 Yuan. Since this measurement includes
only the affected population living in the study area, it may underestimate the monetary value of the coastal ecosystem loss caused by reclamation.

4. Conclusions
The purpose of this study is to estimate the WTP of coastal ecosystem services that lead to land reclamation in Zhoushan City. The survey used the open payment card CVM to measure the WTP of the reclamation losses caused by ecosystem services by respondents living and working in Zhoushan, and revealed interesting information about the residents' WTP. Of the 677 questionnaires and brochures filled out, 90.3% were valid, indicating that the residents of the city are very concerned about this issue. In this study, the results show that the average willingness to pay is 362.19 yuan; resulting in total the aggregate monetary value of coastal ecosystem losses from reclamation was RMB 1.31E+08 Yuan and per hectare was 7871.45 Yuan. The research shows that there is no close correlation between socioeconomic status and WTP. In addition, women and young people are more willing to pay. Considering the importance of our coastal ecosystem services to meet the needs of economic development and environmental protection, the significance of this research is of great significance for guiding coastal management or decision makers in monetary policy. The results of this study can also be incorporated into economic analysis to determine the feasibility of protecting marine ecosystems in the long run. In addition, for the purpose of environmental loss analysis, the estimated value of coastal ecosystem service loss in this study can be transferred to the concrete reclamation project. We hope that the practical valuation framework and model proposed in this article can provide useful references for future land reclamation research. It can be concluded that the negative impact of reclamation on ecosystem services must be carefully considered in the approval process before construction and management; moreover, without considering the cost of ecosystem services for reclamation development, the current sea area usage fee the cost in the system is obviously insufficient. The sustainable development of coastal areas requires a new compensation method, such as paying for the ecosystem service plan. The result of the study is the payment terms.

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