Measurement of Non-Use Value of Sand Lake Wetland Under CVM Method

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Abstract
The Sand Lake wetland, located in inland northwestern region of China within Ningxia Province, is a national notable tourist attraction with natural landscape. It is also known as a rare cultural tourist resort in the world. However, rather than just emphasizing on its economic use, non-use value could represent people's consideration of the emotional, cultural, and ecosystem services of the Sand Lake wetland, with significance in water source protection and climate regulation. Therefore, this article utilized the Conditional Value Method (CVM) to evaluate the non-use value of the Sand Lake wetland. A questionnaire survey of year-round residents in the Ningxia province was conducted and found that the non-use value of Sand Lake was 638.145 million RMB. Then, Ordinal Logistic Regression was adopted to analyze the relationship between the social status of respondents and their willingness to pay. It was found that the higher the income and the frequencies of the respondents touring the wetland, the higher their willingness to pay for the non-market value of the Ningxia Sand Lake wetland.
Keywords: CVM, Sand Lake wetland, Non-use value, Ordinal Logistic Regression

Introduction
The wetlands, known as the "kidney of the earth", are a significant natural resource in the world. It, together with forests and oceans, is part of the three major ecosystems of the earth that can help fix excess carbon dioxide, maintain climate humidity, protect biodiversity, reduce harmful substances, purify water, slow down river runoff, and provide flood control and prevent drought. Additionally, it can serve as a recreational tourist destination. However, since the beginning of the 20th century, about half of the world's wetlands no longer exist (TEEB, 2008), and 60% of the remaining wetlands are in a stage of degradation due to population growth and economic development (MEA, 2005). In China, the government has made significant efforts in wetland conservation, such as establishing natural wetland reserves or wetland parks, to some extent, safeguarding natural wetlands, the current state of wetland conservation remains far from optimistic, with an enduring conflict between

wetland preservation and developmental utilization. Currently, chinese wetland research is predominantly focused on the Yellow River Delta; in fact, the importance of water conservation in the middle and upper reaches of the Yellow River is more prominent, and Sand Lake wetland in particular is a well-known and important wetland in this region. Nevertheless, there is currently a dearth of research pertaining to non-use values in this context.

Sand Lake is a rare desert wetland in northwest China, where the view of the southern water village's beauty and the magnificent desert in the north blends perfectly. It is a natural landscape ecotourism area that consists of five major elements: sand, water, birds, reeds, and mountains. In 2007, it was listed as one of the Chinese best scenic spots classified as 5A, and in 2010, it was included in the top ten leisure and tourism lake areas in China (Xu et al., 2023). The total area of Sand Lake in the Ningxia province is 80 square kilometers, with over 20 square kilometers being a desert area and over 40 square kilometers being water. In recent years, with the rapid development of the internet, Ningxia Sand Lake has become an Internet celebrity destination and has attracted increasingly more tourists, consequently driving up the local economy (Huang, 2018).

For the Sand Lake wetlands, serious water quality problems have occurred since 2016. The main reason is that the Sand Lake itself is a closed water body with large evaporation and limited water supply. Continuous indirect infiltration of pollutants from surrounding non-point sources over the years as well as continuous deterioration of water quality with insufficient hydraulic drive has led to the fragile ecosystem of the Sand Lake wetland. The growing area of reeds and water grasses is shrinking, and the water ecosystem and biodiversity are degraded and destroyed (Ynet, 2022). Ningxia Sand Lake eco-tourism resources are fragile and non-renewable. The surrounding residents and tourists constitute significant beneficiary groups of the ecological services provided by Sand Lake wetland. Their willingness to pay for and the level of payment directly reflect their enthusiasm and willingness to participate in Sand Lake wetland ecological conservation efforts. Investigating their willingness to pay for ecological conservation and the influencing factors therein not only informs the establishment of ecological compensation standards for Sand Lake wetland protection but also provides a scientific basis for comprehensive ecological management of it. It holds certain theoretical and practical implications.

Therefore, this study was designed to measure the non-use value of the Sand Lake wetland by studying the Willingness to Pay (WTP) of the respondents through the Contingent Valuation Method (CVM) via the Payment Card (PC) questionnaire. The effective evaluation and quantification of the non-use value of the Sand Lake wetland and analysis of the relevant factors affecting the WTP can help stakeholders better understand the potential non-use value of Sand Lake more effectively and intuitively to develop further understanding of the environmental value provided by the natural geographical environment system that can be used to evaluate the maintenance of biodiversity, ecological balance, and sightseeing. The framework and structure are shown in Figure 1.
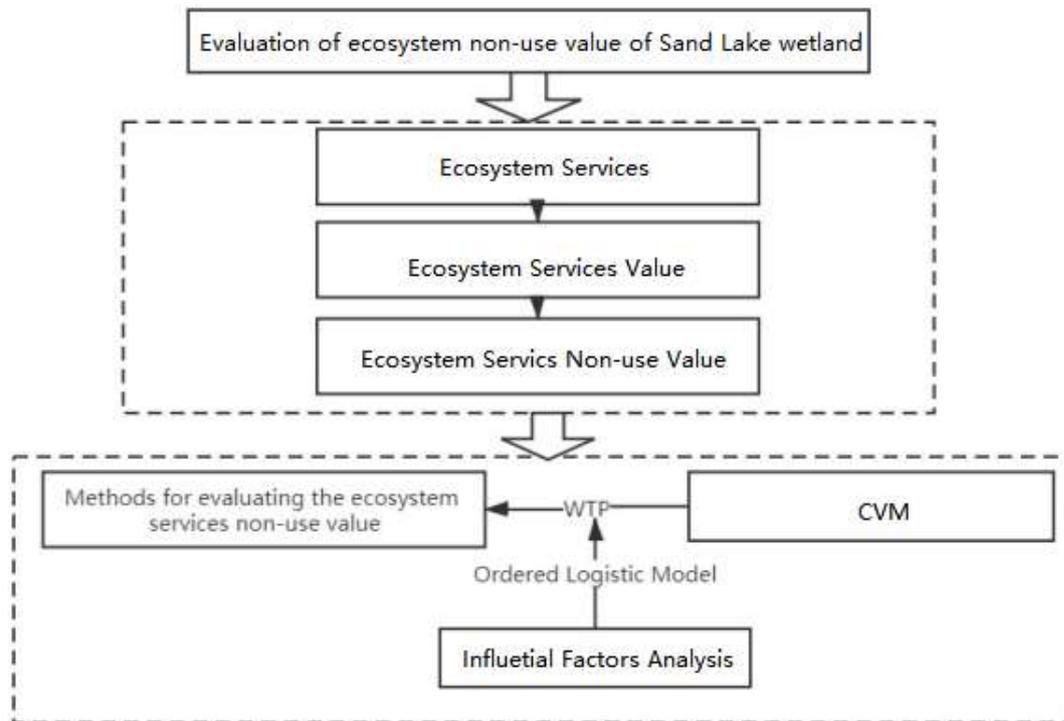
Figure 1 ： The theoretical framework schematic diagram

The total economic value of the natural environment can be divided into use value and non-use value. Use value refers to the value of natural resources that can be utilized by contemporary people, i.e., the expenditure people pay to obtain or enjoy certain environmental resources. Non-use value, on the other hand, refers to an inherent attribute of environmental resources like the cost people are willing to pay to protect the natural environment for future use or just the intrinsic value of environmental resources that are solely based on their existence, regardless of any subsequent human use. It can also recognized as cost that contemporary people are willing to pay to preserve certain resources for future generations (Woodward & Wui, 2001).

Empirical Methodology and Justification
Questionnaire Method
This study utilized the payment card format of the questionnaire, which refers to the specific amount of WTP given by the questionnaire designer and values listed from low-to-high (Blamey et al., 1999). In the questionnaire design process, the interviewee's time and comprehension were fully considered, the questions were set as objective questions where possible. Before filling out the questionnaire, a approximately 30 seconds video was played to briefly introduce Sank Lake Wetland and showed its natural scenery to enable the interviewees to have a relatively comprehensive understanding of the wetland. The questionnaire content is divided into three parts. The first relates to the basic information of the respondents, such as age, education background, occupation, personal monthly income, and the distance of their residence from the Sand Lake. The next section relates to respondents' cognition of the Sand Lake wetland. This includes items on their degree of understanding of the Sand Lake wetland, their level of concern, their satisfaction level of the Sand Lake wetland's current situation, and the frequency with which the respondents have

visited the Sand Lake wetland. The third section relates to whether the respondents were willing to pay for the protection of the Sand Lake wetland and the reasons. After conducting a pilot survey with 20 respondents, 226 questionnaires were collected during the period of May to June, 2023.

CVM Methods

As measure non use value, CVM, known as willingness survey method, is currently the most widely used non-market evaluation method to evaluate the intangible benefits of public goods such as wetlands. Since the wetland ecosystem services have characteristics of public goods and external economy, the CVM method can be used to transform the value of the ecosystem service's functions into the respondents' maximum willing to pay(WTP) for environmental goods or services or the minimum willing to accept (WTA) compensation for environmental degradation through a series of hypotheses. (Venkatachalam, 2004; Fang et al., 2015; Johnson & Whitehead, 2000). The difference between WTA and WTP is affected by many factors, such as income, consumer psychology, property rights, evaluation objects, etc. When evaluating non-use values, WTP values are often used as this study did (Petrolia & Kim, 2011). In contrast, WTA is mostly used to evaluate the value of ecosystems that have been severely damaged (Patton et al., 2015).

The whole evaluation process of CVM is based on a hypothetical economic market background. It involves analyzing the factors that influence the respondents' willingness to calculate the average willingness to pay per person per year, thereby assessing the non-use value via the following formula:

$$E(WTP) = \sum_{i=1}^{n}(A_i P_i)$$

(1)

$$Q = E(WTP) \cdot P \cdot a$$

(2)

E(WTP): Expected average per capita WTP in the sample.
A_i: Amount of payment by the i-th respondent.
P_i: Probability corresponding to the payment of the i-th respondent.
Q: Estimated non-use value of Sand Lake wetland.
P: Average WTP rate.
a: Total population of Ningxia province.

Logistic Regression

Logistic regression is mainly used in research to analyze the probability of two or more factors in leading to the occurrence of a certain event. Odds ratios are obtained using logistic regression when there are multiple explanatory variables. With the exception of the response variable being a binomial, the process is relatively similar to multiple linear regression (Sperandei, 2014).

This study utilized the ordinal logistic model. The dependent variable WTP is ordinal and multi-classified. In this study, the WTP option is divided into four categories (1-100CNY, 101-200CNY, 201-400CNY, 401-600CNY), and the order of options indicates the amount level in which the respondents were willing to pay.

The ordinal logistic model is as follows:

$$P(y \le j) = \frac{e^{\alpha_j - \sum\limits_{k=1}^{K} \beta_i x_{ij} + \varepsilon_i}}{1 + e^{\alpha_j - \sum\limits_{k=1}^{K} \beta_i x_{ij} + \varepsilon_i}}$$

(3)

Where, j is the level of willingness to pay, i is the subscript of the independent variable, $P(y \le j)$ represents the occurrence probability of respondent'' willingness to pay, x_{ij} is the independent variable, β_i is the coefficient, α_j is the intercept, and ε_i is the error.

The dependent variable in this study is the chances ratio of the WTP. This study assumes that the respondent'' age, education, occupation, monthly personal income, distance of residence from the wetland, and frequency to the wetland can influence the WTP.

$$WTP_i = f(age_i, education_i, occupation_i, income_i, distance_i, frequency_i, c_i)$$

Among which, C_i is the constant term, and i is the ith respondent.

Table
Variable Definition and Description

Variable	Type	Value
age	order	1=under 20; 2=21-40; 3=41-60; 4=beyond 60
education	order	1=under junor high school; 2=technical secondary school/high school; 3=junior college/undergraduate; 4=beyond postgraduate
occupation	classification	1= civil servants and career editors; 2= enterprise workers; 3= self-employed households; 4= students; 5= farmers; 6= unemployed or retired; 7= other
income	order	1= less than CNY2000 ; 2=CNY2001-4000 ; 3=CNY4001-6000 ; 4=CNY6001-8000 ; 5= CNYmore than 8000
distance	order	1= Shizuishan City; 2= other regions of Ningxia (except Shizuishan); 3= regions outside Ningxia Province
frequency	order	1=0 time; 2=1-5 times; 3=5-10 times; 4= more than 10 times

Results Discussion
Reliability and Validity of the Data
In order to ensure the accuracy of the questionnaire and the reliability of the research results, it is necessary to analyze the reliability and validity of the questionnaire statistical results.

Table 2
Reliability test results

Overall standardized item-based Cronbach α	Cronbach α after removing the item
a = 0.764	$a_1 = 0.758$
	$a_2 = 0.617$
	$a_3 = 0.646$

The reliability test results are shown in Table 2, where a1 refers to respondent'' understanding of Sand Lake, a2 refers to respondent'' concern about Sand Lake, and a3 refers to the impact of Sand Lake on their lives. It can be seen from the table that the Cronbach's α coefficient for the reliability test of the questionnaire is 0.764. The questionnaire's internal consistency is good when the Cronbach's α coefficient is between 0.7 and 0.9, indicating that it passes the reliability test.

Besides that, the questionnaire validity was tested via the Kaiser-Meyer-Olkin (KMO) and Bartlett's test as shown in Table 3.

Table 3
Kaiser-Meyer-Olkin(KMO) and Bartlett's test

KMO Measure of Sampling Adequacy		0.672
Bartlett's Sphericity Test	Approximate Chi-Square	180.705
	Degrees Of Freedom	3
	Significance	0.000

The validity was remarkable since the KMO sampling adequacy was 0.672, which was higher than 0.6. Therefore, the data collected passed the reliability and validity tests, which proved that the questionnaire data can be analyzed and studied.
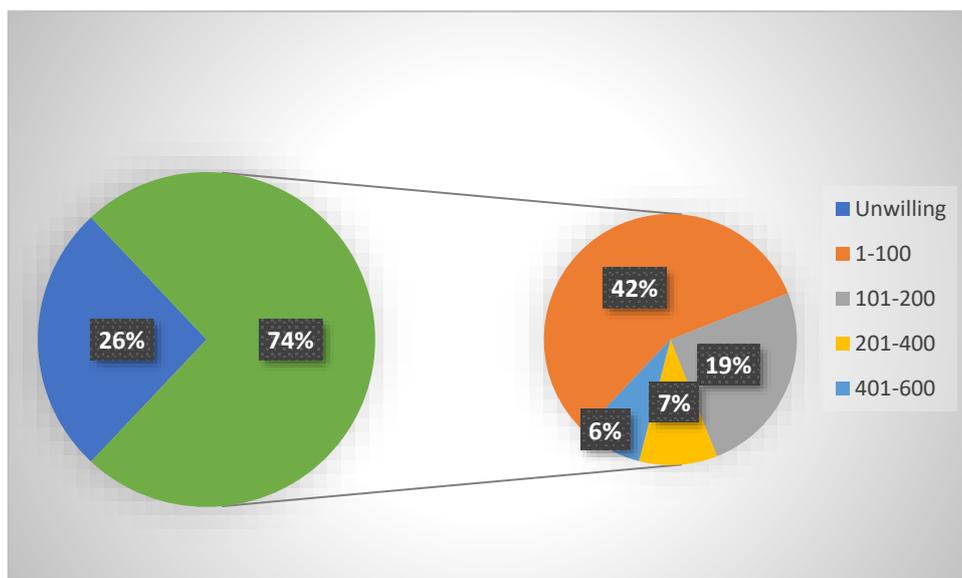

Figure 2：The status of willingness to pay

As seen in Figure 2, from 226 valid questionnaires collected, 167 respondents were willing to pay for the protection and development of the Sand Lake wetland with a rate of 73.89%,

indicating that most people were willing to provide support for the ecological protection and sustainability of the Sand Lake wetland. However, more than half of the respondents chose the amount between 1-100 CNY, and only 6% selected the range of 401-600 CNY. The respondents decreased sharply from the lower amount to the higher amount of payment. This indicated that although there was a high rate of people who were willing to pay, the amount is relatively small.

The figure 3 shown among the respondents who are willing to pay, the status of different form have been chosen. In which, 42.51% selected the raising taxes for the government departments to disposal of and 25.75% chose establishing related protection funds, implying that most of the respondents still hoped the payment could be under the control of public trust.
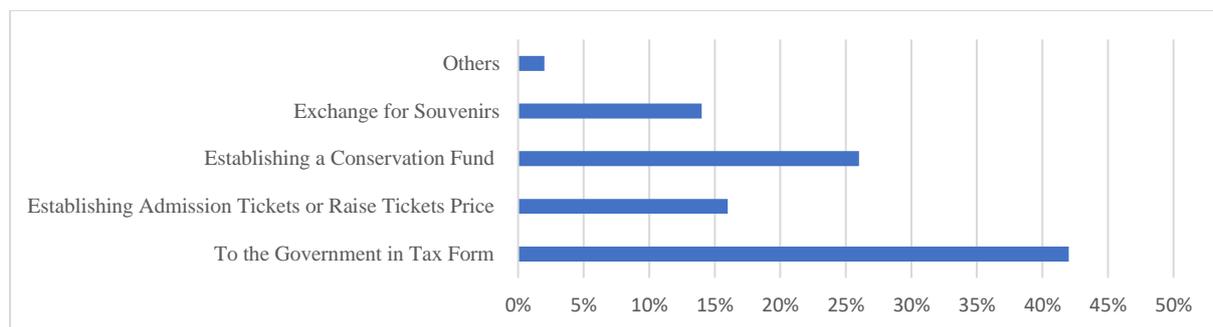

Figure 3 ： The form of willingness to pay

On the other hand, regarding the reasons for refusing to pay, 37 respondents or nearly 6.23% stated that it was due to their limited expenditure budget. Combined considering with their monthly income and willingness to pay, most of whom had a high willingness to pay and strong environmental awareness, but their monthly income was less than 4,000 implying the living standard was lower middle. Therefore, they had no budget to do anything for the environment. From this, the significant problem of environmental protection lies in people's living and economic condition. However, 30.51% stated that they could not enjoy any benefits brought by the protection of the Sand Lake wetland, and 28.81% were not interested in the protection of the Sand Lake wetland. This indicated that people's attention to the environment was still related to their own interests.

CVM results

The non-use value of the Sand Lake wetland was estimated by taking the Ningxia province's location as the research area. By the end of 2021, Ningxia's permanent population was 7.25 million. The median amount of willingness to pay in the sample was selected as the expected willingness to pay by interpolation method. Therefore:

$$E(WTP) = 88.02 \ per \ capita \ RMB/year$$

According to equation (2), the non-use of Sand Lake is 638.145 million yuan.

Ordinal Logistic Regression Analysis

In order to ensure the rationality and accuracy of the model, a parallelism test was conducted to verify whether the linear relationship between the independent variable and dependent variable existed before the logistic regression analysis.

Table 4
Parallel line test

Model	-2 Log-Likelihood	Chi-square	Degrees of Freedom	Significance
Null Hypothesis	230.727			
Conventional	193.910b	36.817c	42	0.697

Based on the parallel line test, multiple ordered logistic regression can be carried out because the significance is 0.697 (more than 0.05), demonstrating that the parallelism test accepted the null hypothesis. The results showed that the linear relationship between the independent variables and dependent variable was reasonable and possibly could be assumed, therefore the logistic regression model continued to create.

Table 5
Ordinal Logistic Regression Analysis

Independent Variable	Coefficient	Standard error	Z statistic	WaldX^2	Value	OR	OR(95%CI)
Age	0.314	0.267	1.174	1.379	0.24	1.368	0.811~2.309
Education	0.169	0.208	0.809	0.655	0.418	1.184	0.787~1.780
Occupation	-0.142	0.122	-1.168	1.364	0.243	0.867	0.683~1.101
Income	0.733**	0.201	3.652	13.338	0	2.08	1.404~3.082
Distance	-0.519	0.311	-1.668	2.781	0.095	0.595	0.323~1.095
Frequency	0.742**	0.193	3.838	14.732	0	2.1	1.438~3.067

 * $P < 0.05$ ** $P < .001$

As shown in the regression results, the P values of personal monthly income and the frequency of visiting Sand Lake were both smaller than 0.001, showed that that personal monthly income and the frequency of Sand Lake tourism were highly significant to the expected WTP amount. This refers to the social and economic characteristics of the questionnaire responses and their WTP for the non-market value of the Sand Lake wetland. From the data, there was no obvious correlation between the respondents' WTP for the non-market value of the Sand Lake wetland and the gender, age, job category, education level, and residual distance from the wetland. Comparatively, the income and familiarity with Sand Lake wetland are important factors that affect WTP for the non-use value of it. In other words, this study found that the richer the respondents, or the more times they visited the wetland, the more willing they were to protect the non-use value of the wetland, and the more money they were willing to pay. In the terms of monthly income, when it is increased by one unit, the change in expected WTP is 2.08 times. Meanwhile, for the variable frequency of touring the wetland, an increase by one unit means that the amount respondents willing to pay would be incentive by 2.1 times.
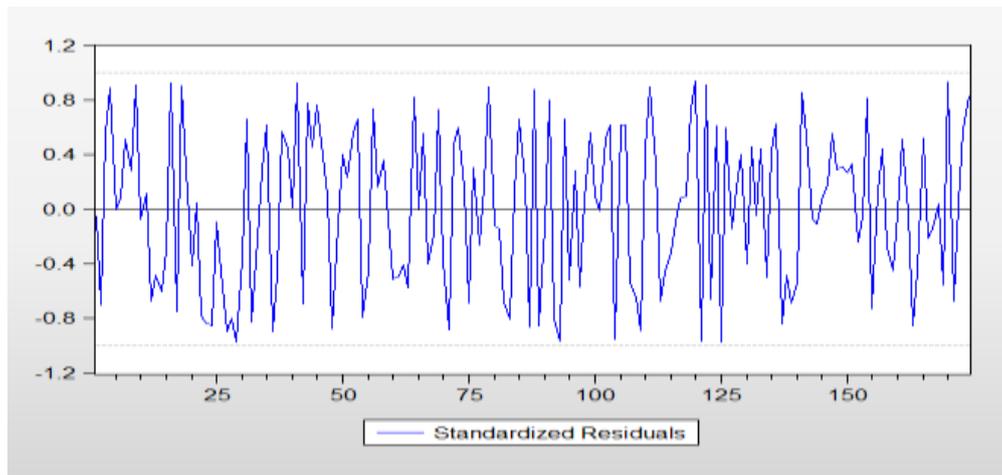
Figure 4：The graph of standardized residuals of the logistic model

As shown in the standardized residual graph(Figure 4), the oscillation of the residual conforms to the characteristics of random stability. Hence, it can be preliminary judged that the fitting of the model meets the requirements of the analysis.

Conclusion and Policy Recommendations
This research evaluated the value of the Sand Lake wetland from the perspective of the non-use value. Based on the analysis of the data obtained, the research draws the following conclusions.

In terms of non-use value, the calculated result of the Sand Lake wetland ecosystem service was approximately 638.145 million CNY. The median WTP of all respondents was 88.02 CNY. And based on Ordinal Logistic Regression Analysis model, frequency of citizens visited the wetland and the income would be significant influential to willingness they were to pay to protect continued existence of the wetland and the satisfaction that can be enjoyed by generations.

In combining the actual situation of the Sand Lake wetland and the analysis of this article, in order to more effectively and rationally use the resources, the following suggestions are put forward. First, it is advised to gradually enhance the Sand Lake wetland ecosystem monitoring system, routinely examine and record different indicators of the Sand Lake wetland ecosystem, and comprehend the pattern of changes in time to provide the direction for the Sand Lake wetland's protection. To help the protection of the wetlands, the database should also be be carefully and conditionally made available to scientific researchers.

Second, in relation to different ecosystem, it is advised to create a trust fund that is primarily funded by the local government as well as donations from environmentally conscious businesses, non-profits and members of the public.

Besides that, it is recommended to implement a multi-party cooperative protection financing mechanism for the wetland protection. The management department should establish unique regions and development strategies that leverage the natural and cultural attributes of the area, while tapping into private sector investments

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