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Valuing the cultural services of a forest protected area in Southwestern China: The roles of online deliberation and sample selection

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ABSTRACT

Deliberation – the process of group discussion and consideration – has been increasingly integrated to valuation of ecosystem services. In an online stated preference survey on the Fanjing Mountain National Nature Reserve in the Southwestern China, we assessed participants' willingness to pay (WTP) for cultural services (non-material benefits gained through interacting with nature, including its ecological and geological elements and characteristics) before and after deliberation. However, among the initial participants, only a subset completed deliberation and the full survey. This dropout of participants may occur in any deliberation-based valuation survey, introducing sample selection bias for estimating the impacts of deliberation. To control sample selection bias, we applied the Heckman correction approach which uses the probability of a given observation being included in the sample based on its other observed characteristics. Overall, deliberation led to a more concentrated distribution of WTP and reduced the effects of sociodemographic drivers of WTP. Deliberation also had varied impacts on different participants' WTP, including increases, decreases, and no change. The median WTP remained unchanged, although the mean WTP became significantly lower after deliberation (even when controlling for sample selection bias that significantly influenced the effects of deliberation). The use value of the Reserve's cultural services for visitors was estimated at approximately 520 million CNY per year based on the pre-deliberation mean WTP, and 314 million CNY based on the post-deliberation mean WTP. This value reflects the Reserve's natural, cultural, and economic significance and the need for continued support for both nature conservation and sustainable tourism management.

1. Introduction

Protected areas conserve and provide various ecosystem services, which are the benefits people obtain from ecosystems. Among these benefits, the non-material benefits obtained through interacting with nature physically or mentally are termed 'cultural services' (Millennium Ecosystem Assessment, 2005). However, many ecosystem services, including cultural services, are not easily incorporated into commonly used development indicators, such as Gross Domestic Product, or traded in markets. Without assessment of their values, they may be overlooked or underestimated in socioeconomic decisions, causing environmental issues as a by-product of socioeconomic development (Costanza et al., 2017; United Nations SEEA-EA, 2021; Chen et al., 2022).

Valuation of cultural services can be accomplished using stated preference approaches. Stated preference approaches assess values by asking participants to state their preferences in hypothetical scenarios (Johnston et al., 2017; Whittington et al., 2017; Hanley and Czajkowski, 2019), and typically include contingent valuation (Boyle, 2017), choice experiments (Holmes et al., 2017), and simulation games (Costanza et al., 2014). Such preferences are often measured as participants' willingness to pay (WTP) for obtaining certain benefits. The value-eliciting scenario of this study uses people's WTP for entering a nature

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reserve and interacting with nature as a proxy for the use value of overall cultural services, rather than for the non-use value associated with bequest or altruistic motives (IPBES, 2022; Pascual et al., 2023). While cultural services may be further classified into more specific types such as aesthetic appreciation, recreation, spiritual experiences, scientific research, and inspiration (United Nations SEEA-EA, 2021), this paper does not estimate the value of any specific type of cultural service separately. The rationale is that clear boundaries between specific types of cultural services do not always exist (e.g., a visitor may have a positive recreation experience partly due to aesthetic appreciation and spiritual experience), and hence aggregating the values of separately measured cultural services could result in double counting.

There is a growing concern that the values inferred from separate individuals' preferences may not truly reflect the values of collective or public goods or services (Lo and Spash, 2013; Kenter, 2016; Schaafsma et al., 2018; Stoeckl et al., 2018; Costanza, 2020), such as many protected areas' cultural services, mainly because each separate individual may not sufficiently consider these services' contributions to private, collective, and public wellbeing, or the collective trade-offs in providing these services. To address this issue, there has been growing interest in complementing assessments of cultural services with deliberation, the process of discussing and considering within a group (Kenter, 2016; Orchard-Webb et al., 2016; Mavrommati et al., 2017; Cheng et al., 2019).

Through deliberation, participants can share information and communicate with each other, engage in collective reasoning (e.g., explaining why a certain preference is expressed) and mutual learning, and integrate more diverse views related to a service, ultimately shaping their understanding of and preferences for that service (Wilson and Howarth, 2002; Vargas et al., 2016; Kenter et al., 2016a; Costanza, 2020; Saarikoski and Mustajoki, 2021). However, it may be challenging to assess the impacts of deliberation on preference expression in a robust way, because (1) when the number of deliberation participants is limited due to funding and time constraints, researchers are concerned about heterogeneity, insufficient representativeness, or lack of statistical significance of the preferences expressed via deliberation (Turner et al., 2010; Saarikoski and Mustajoki, 2021; Wanek et al., 2023); (2) assessing deliberation impacts may need comparison between the preferences expressed before and after deliberation, but researchers (Kenter et al., 2016b; Chen et al., 2024) found that sometimes only a small subset of participants who completed a questionnaire before deliberation were willing to join deliberation and completed the questionnaire again afterward, making the pre-deliberation sample different from the post-deliberation sample. In such cases, the estimate of deliberation impacts on WTP can be biased by sample selection if not corrected. Namely, any difference between pre-deliberation and post-deliberation WTP may not be solely caused by deliberation; it could also be influenced by the selection of certain participants with certain characteristics and interests in deliberation that do not reflect the broader characteristics of the initial participants.

While sample selection bias has raised concerns in economics and other research disciplines (Hindsley et al. (2011), previous studies have not yet proposed a method to correct for sample selection bias arising from participant dropout when estimating the impact of deliberation on WTP. We addressed this gap through an online deliberation-based survey on the Fanjing Mountain National Nature Reserve (see an overview of the Reserve in Section 2.1). Specifically, we investigated individuals' WTP for cultural services provided by the Reserve, assessed the impacts of deliberation, and corrected for sample selection bias using the statistical procedure established by Heckman (1979). The research questions include: (1) Which individuals are more likely to participate in deliberation? (2) What is people's WTP for cultural services? (3) Does deliberation alter this WTP, and if so, how? (4) Does sample selection bias from participant dropout affect the impact of deliberation on WTP? (5) Do demographic variables influence WTP?

While deliberation has been increasingly applied in ecosystem service valuation (e.g., those mentioned previously), recent deliberation studies (Andrade et al., 2023; Chen et al., 2024; Chen et al., 2025) have emphasized the underexplored role of online deliberation in valuation (especially monetary valuation) of ecosystem services, not limited to cultural services. We did not find any assessment of the impacts of *online* deliberation on WTP for ecosystem services. This study addresses this gap and further enhances the understanding of the characteristics of text-based online deliberation, thereby informing future valuation research in selecting and analyzing deliberation media. Although Heckman (1979) approach for correcting sample selection bias is not novel, this study applies it to deliberation-based ecosystem service valuation for the first time. Therefore, this study provides methodological contributions to the estimation of WTP in a statistically robust way when sample dropout occurs in deliberation surveys. Additionally, this study may raise awareness of the cultural and ecological significance of our study area, promoting its conservation.

2. Materials and methods

This section describes the study area, the survey process (including online deliberation) to collect data, the data source, the estimation of WTP for cultural services, and the analytical methods used to assess the impacts of online deliberation on WTP, including how these impacts may be influenced by sample selection bias.

2.1. Study area

The Reserve, also called "Fanjingshan", lies at the convergence of Songtao County, Yinjiang County, and Jiangkou County in the Tongren Region of Guizhou Province. Fig. 1 shows its location. Covering approximately 775 km^2 of land, about 97.6 % of the Reserve is forested, including shrublands, deciduous, coniferous, and subtropical primitive evergreen broadleaf forests (Fanjing Mountain, 2024). With rich biodiversity (more than 3700 recoded plant species and 2300 recorded animal species) and geodiversity (e.g., caves, rock peaks, rifts), varying altitudes between approximately 500 m and 2570 m, as well as diverse ecological and geological landscapes, the Reserve has been included in both the International Man and Biosphere Network and the World Natural Heritage Sites (UNESCO, 2018). It is also considered among important geological heritages and China's top-level scenic areas (Ye et al., 2020; Fanjing Mountain, 2024), attracting visitors nationwide and even internationally to experience cultural services.

2.2. Process of investigating WTP and conducting deliberation

To assess WTP for cultural services obtained from interacting with nature, existing literature (Scarpa et al., 2000; Martínez-Espiñeira and Amoako-Tuffour, 2009; Pascual et al., 2010) has observed how people would trade off the expense and opportunity of visiting a natural area based on the assumption that the sole objective of accessing and interacting with a natural site was to acquire cultural services. While this assumption simplifies the fact that people may visit a natural area for other reasons (e.g., solely for accompanying a friend), it is widely accepted for valuing cultural services, due to the infeasibility of considering every potential factor affecting human-nature interaction. Adopting this assumption and considering the fact that visiting a protected area, whether in China or in many other countries, often requires a ticket or entrance fee (Laband, 2013; Kaffashi et al., 2015; Zhong et al., 2015), we designed the hypothetical scenario presented in Fig. 2 to infer WTP for cultural services.

To conduct deliberation and collect pre-deliberation and post-deliberation data of WTP, we undertook an online survey via Wechat, the most popular social media platfom in China, in May and June of 2020. During this period, a pandemic lock down was implemetned in China, making online survey more feasible than in-person survey. The survey contains multiple phases, as described below.

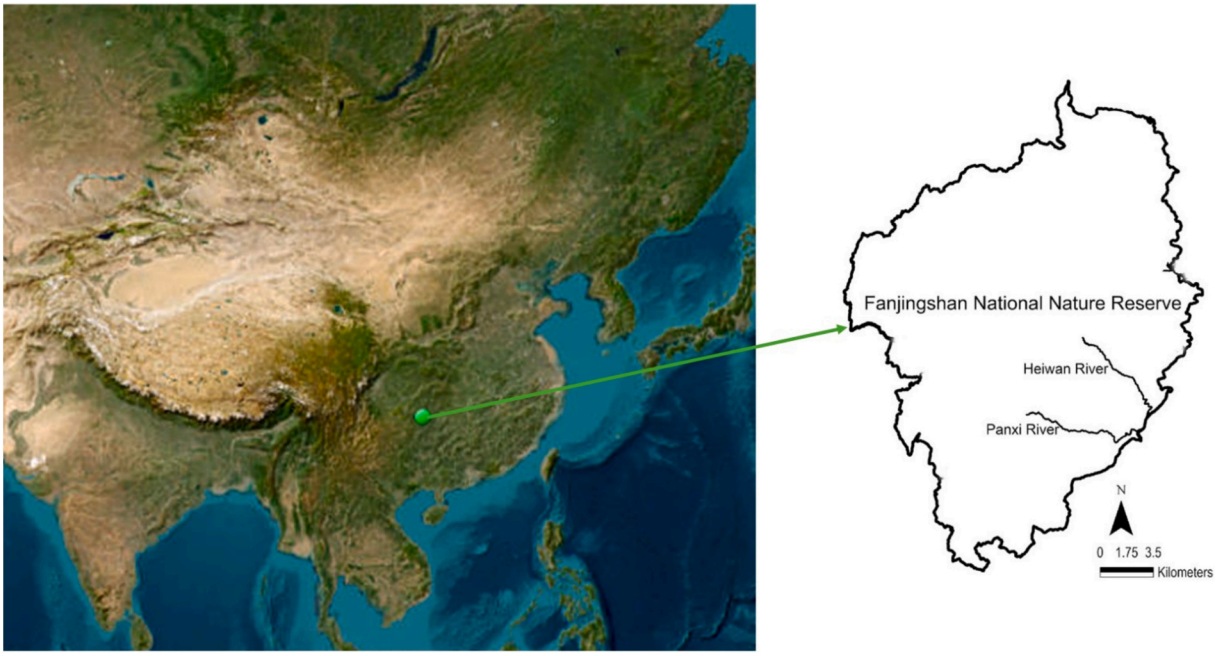

Fig. 1. Location of the Reserve adapted from Tapley et al. (2015) and UNESCO (2018).

*Visitors **CANNOT** access the Reserve freely unless they have an entrance card. The entrance card is valid for one year and grants its owner (not others) exclusive access to the natural sightseeing and recreational area of the Reserve during this period.*

As a potential visitor to the Reserve considering purchasing such a card for yourself, what is the maximum price (in CNY, namely Chinese currency) that you are willing to pay?

□ 0 □ 100 □ 200 □ 500 □ 1,000 □ 2,000 □ 5,000 □ 10,000 □ 20,000 □ Higher than above

Fig. 2. WTP-eliciting scenario.

2.2.1. Phase 1: designing and pretesting value-eliciting questionnaires

We drafted and designed two questionnaires, Questionnaire 1 for pre-deliberation use and Questionnaire 2 for post-deliberation use, by referring to previous stated preference studies, such as Kenter et al. (2011), Kenter et al. (2016b), Wang et al. (2017), and Tu et al. (2020), and consulting six experts in ecological/environmental economics and nature conservation. Then, the preliminary questionnaires underwent pretesting that asked 20 focus group participants to fill them out in early May 2020 in a pilot test before formally distributing. Questionnaire 1 and Questionnaire 2 are attached in the Supplementary Materials.

Questionnaire 1 was designed to be filled out before deliberation. It contains a link to the Reserve's official website to obtain an overview of the Reserve, an invitation link through which people could access the online deliberation groups, a set of multiple-choice questions associated with demographic information, and most importantly, the WTP-eliciting hypothetical scenario introduced previously.

Questionnaire 2 was designed to be filled out after deliberation, containing all the questions presented in Questionnaire 1 and a few additional questions asking if the deliberation improved participants' understanding of our research goals, the cultural services the Reserve, and the ecological and socioeconomic contexts of the Reserve.

2.2.2. Phase 2: distributing and completing questionnaire 1

Questionnaire 1 was first converted into an electronic version using two popular online questionnaire service platforms in China: Wenjuanxing and Tencent Wenjuan. These platforms allow researchers to design survey questions directly on their interfaces. Once finalized and submitted, the platforms automatically generate a survey link. To ensure a broad and diverse sample, we applied only one inclusion criterion related to demographic characteristics: respondents had to be adults. This meant that after clicking the link, individuals were required to confirm that they were over 18 years old before they could access the questionnaire further. The survey link could be shared, copied, and posted across social media, and completed responses from any medium or distribution channel were automatically compiled into a database connected to the lead author's account on the questionnaire service platforms. The link was distributed in June 2020 through the three channels described below, resulting in a total of 1264 participants.

- Paid distribution via the platforms: In addition to using the platforms to create electronic questionnaires, we also paid for their data collection services. Upon receiving payment, the platforms automatically posted the survey link on their public pages, along with a brief description of the research topic and remuneration (2 CNY per completed response) as set by us. These platforms have over 10 million registered users across China. Users who saw the post and were interested could click the link and complete the questionnaire. The platforms also applied automated algorithms to verify the

validity of responses (e.g., detecting and filtering out fake participants, such as robots). Each valid respondent received 2 CNY, distributed by the platforms. How many people viewed the link on the platforms could not be tracked, but the platforms recorded that 538 participants completed the questionnaires and received remuneration.

- Distribution by locals: Five local individuals from the Reserve—a public servant, two university students, a local company employee, and a manual laborer working in the Reserve—were employed to help share the survey link with other local residents. They could directly send the link to strangers in the local area or to their own contacts. They also distributed the link via their WeChat groups and Moments (a feature where users share text and links). Those who viewed the link could click the link to participate if they were interested. Participants recruited through this channel did not receive direct compensation from us. This channel could not monitor how many people viewed the link. Additionally, because the survey was anonymous, the database—where completed responses from all channels were stored—could not identify who submitted each questionnaire or accurately distinguish between participants recruited through this channel and those from the third channel described below. However, of the participants who completed Questionnaire 1, 604 (49.5 %) were local residents who indicated that they had lived in the counties where the Reserve is located. While some local participants might be recruited through the first or third channels, the majority were likely recruited through this channel.
- Snowball sampling by authors on WeChat: The authors from China distributed the link through personal contacts and groups on WeChat and posted it on WeChat Moments. Those who viewed the post and were interested could click the link to participate or share the link with their own networks. Participants recruited through this method were volunteers and did not receive any compensation. As explained earlier, the number of people who viewed the link and submitted responses through this channel could not be estimated precisely. However, if the second channel recruited 604 participants, then 122 participants would have been recruited through this channel.

2.2.3. Phase 3: conducting deliberation and completing questionnaire 2

The deliberation process in our survey aligned with the typical approach in previous deliberation-based valuation studies, which involves convening participants, presenting WTP-eliciting questions, asking them to share, explain, and discuss their WTP with one another, and then restating their WTP (Chen et al., 2024).

Specifically, after filling out Questionnaire 1, participants were welcomed to voluntarily join online groups for deliberation by accessing the invitation link provided to them in Questionnaire 1. To engage and facilitate participants to express their views and interact with each other, participants were not convened into a single large group, where the opportunities for each participant to speak would be rare. Instead, they were divided into 14 groups. Within each group, we took the following actions to facilitate deliberation. We first introduced our research, the Reserve, and cultural services briefly. Then, we asked participants to describe the cultural services they could obtain from the Reserve, share their preferred price options in the WTP-inferring scenario, explain their reasoning, and consider and discuss which price option might bring the greatest benefits to themselves and other stakeholders (e.g., government, Reserve managers, other visitors). To help each group understand the perspectives of others as much as possible, we collected information from groups that responded earlier and shared it with groups that responded later. We also emphasized that there were no right or wrong answers and they did not have to agree with each other, but we encouraged them to discuss in a respectful way. We presented opposing views to participants and asked for their thoughts sometimes. For example, when certain participants said they preferred free entrance to the Reserve, we asked them if free entrance could benefit conservation financially. When participants raised any questions, we responded to them at our earliest convenience.

Participants communicated via typing in WeChat groups, which could be either synchronous or asynchronous. Specifically, once we posted our questions in the chat groups, participants could respond at their convenience. Since the questions and earlier responses remained visible as written records, participants did not need to communicate in real time. Instead, those who viewed the chat later could reply to or comment on both our questions and previous responses. The strengths and limitations of typing as a deliberation medium will be further discussed in Section 4.3. When a group stopped contributing new thoughts for an entire day, we prompted them by asking if they had any additional thoughts before we finished deliberation. If no additional input was provided, we ended the deliberation for that group, sent them the link to Questionnaire 2 (which was created using the same online questionnaire platform as Questionnaire 1), and asked them to complete it promptly. The total duration of deliberation varied by group, ranging from one to four days. Each participant who returned the questionnaire received 5 CNY from us via WeChat.

2.3. Survey data

In total, 1264 participants completed and returned Questionnaire 1, of whom 196 attended deliberation and filled out Questionnaire 2. The original data from Questionnaires 1 and 2 is presented in the Supplementary Materials. To estimate the impacts of deliberation on WTP, we used a multi-stage process for matching the returned Questionnaire 2 with their respective responses in Questionnaire 1 filled by the same participants. Both Questionnaires 1 and 2 required participants to fill in an alias, which enabled us to match the questionnaires filled by 116 participants. Among those who changed aliases after deliberation, we matched the questionnaires filled by additional 11 participants using the IP addresses (assuming that the two questionnaires with the same IP address were filled out by the same person). To further match the questionnaires, we developed an identifying variable that combined all demographic information, including age, income, education level, marital status, occupation, weekly frequency interacting with nature, whether they mainly worked indoors or outdoors, whether they had been to the reserve, whether they had a kid under 18 years old, and whether they had lived in proximity of the Reserve. We then assumed the returned Questionnaires 1 and 2 with the identical identifying variables to be filled out by the same person. This approach allowed us to match response for another 8 participants. Ultimately, we matched Questionnaires 1 and 2 for a total of 135 participants.

The sample we used for this paper included the initial 1264 participants who filled Questionnaire 1 and the 135 valid deliberation participants. The selection process and data usage of our samples are presented in Fig. 3 and will be further explained in Sections 2.4–2.7. Our sample was balanced between males and females, locals and outsiders, and those who had and had not been to the Reserve. However, unmarried young adults (between 18 and 44 years of age) with a higher education degree at bachelor's or postgraduate level constituted a relatively large proportion. We did not involve people under 18 years old in our survey to avoid ethic issues associated with children and teenagers. Appendix 1 presents more details of participants' demographic information.

2.4. Estimation of WTP for cultural services

In the value-eliciting scenario introduced in Section 2.2, participants expressed WTP for cultural services of the Reserve by selecting the maximum price they were willing to pay for a hypothetical entrance pass to access the Reserve's natural areas and experience its cultural services. WTP was denoted in CNY as of 2020, since the survey was conducted in 2020 in China. While each price option they chose implies an interval of WTP, we used the lower limit of the interval to avoid overestimation of

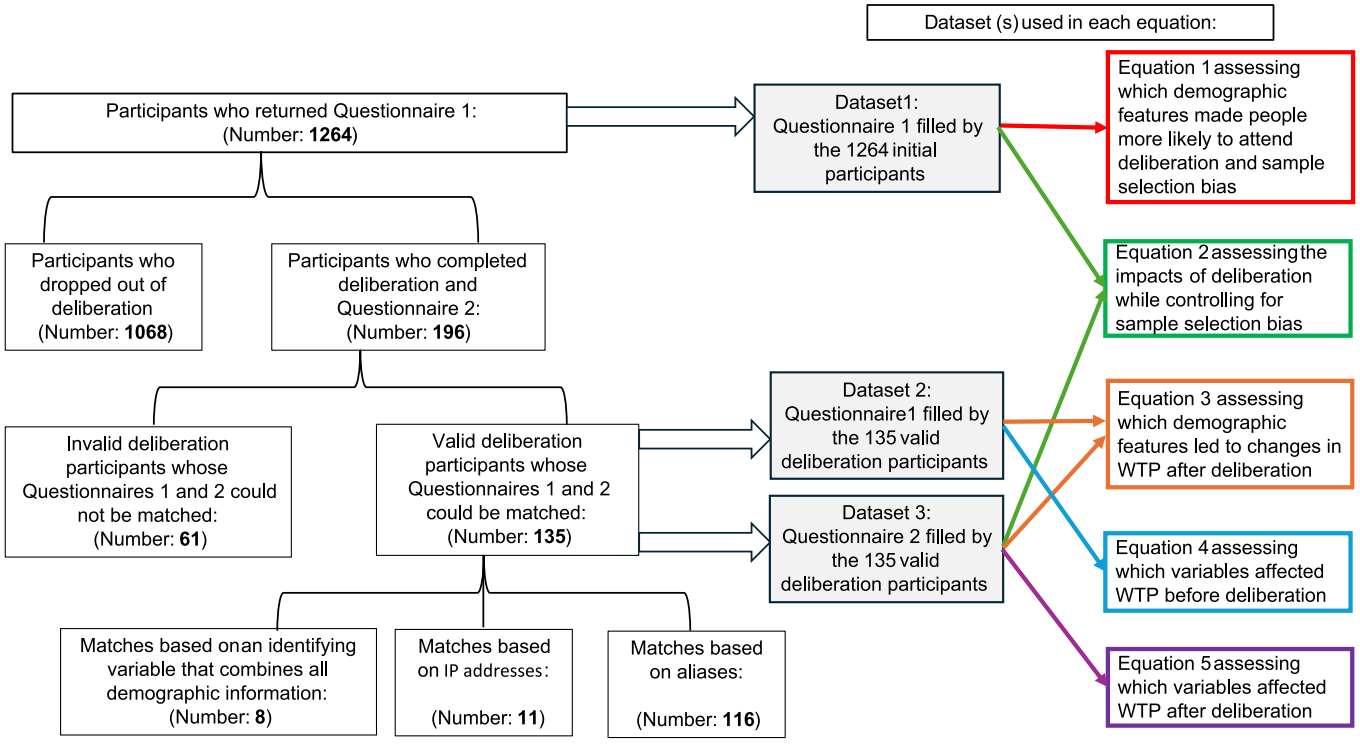

Fig. 3. Sample selection process and data usage in each equation. The equations will be further explained in Sections 2.4–2.7.

the WTP, as WTP in hypothetical scenarios lacks real financial commitment and can be overstated (Vlaev, 2012; Haghani et al., 2021). For example, choosing 100 CNY means that their WTP could reach 100 CNY but remain below 200 CNY; in this case, we considered their WTP to be 100 CNY. If they selected 20,000 CNY or "higher than above," their WTP was recorded as 20,000 CNY for both options. Based on the price options chosen by the 135 valid deliberation participants, we estimated the mean, median, as well as the standard deviations, of their pre-deliberation and post-deliberation WTP.

2.5. Assessment of which demographic features made people more likely to attend deliberation and sample selection bias

In order to correct for sample selection bias, we followed the procedure outlined in Heckman (1979) to utilize a two-stage approach. At the first stage, we identified who in Questionnaire 1 participated in Questionnaire 2, and then calculated the likelihood of participating deliberation was modeled directly using a probit model (Eq. (1)) based on the data from Questionnaire 1 filled by the initial 1264 participants. This probit model also calculates an inverse mills ratio (IMR), and its variables are defined in Table 1. IMR is the ratio of the predicted cumulative probability distribution (denominator) and probability density distribution (numerator) and is given below by $IMR = \frac{f(x)}{F(x)}$, where $f(x)$is the probability density distribution and $F(x)$is the cumulative probability distribution. The IMR in regression can control for the probability of a given observation being included in the sample based on its other observed characteristics. By including the IMR in the second stage of regression that estimates the impacts of deliberation on WTP (see Section 2.6), the model could differentiate between the impacts of deliberation on WTP and the effects of sample selection on WTP.

To reduce the risk of bias, the Heckman approach needs an exclusion restriction (Wolfolds and Siegel, 2019). The exclusion restriction requires that Eq. (1) includes a variable that does not appear in the second stage of the approach and only influences WTP through its effect on deliberation participation. We proposed that time availability influences the likelihood of participating in the deliberation but does not directly

Table 1
Definitions of variables in Eq. (1).

Variables	Definitions
J	A dummy variable which equal to 1 if the participant joined deliberation and 0 otherwise
β_0	The intercept
$\beta_1, \beta_2, \beta_3 \ldots$	The estimated coefficients, which give the marginal change in probability of being included in the second round of sampling given a unit change in the predictor
γ	A vector of coefficients that correspond to variables in the exclusion restriction.
X	The vector of a set of demographic dummy variables, which equal 1 if the participant had a certain characteristic and 0 otherwise. These variables include whether the participants had visited the Reserve, whether they had lived in proximity of the Reserve, whether they had a kid under 18 years old, whether they were a male, whether they had a tertiary education degree (a tertiary degree can be a bachelor degree, master degree, or doctoral degree), whether they mainly worked in outdoor natural areas, whether they were between 25 and 44 years old, whether they were between 45 and 64 years old, whether they were 65 years old or above, whether they had a monthly income between 2000 and 5000 CNY, whether they had a monthly income between 5000 and 10,000 CNY, and whether they had a monthly income over 10,000 CNY. Notably, whether they were between 18 and 24 years old and whether they had a monthly income less than 2000 CNY were excluded from Eq. (1) and hence could be the references for the integrated dummy variables associated with age and income, respectively.
F	The frequency of being out in nature per week, which ranges from 0 to 7 (0 means never, 7 means everyday);
P	A dummy variable of participants' perception of cultural services, which equal to 1 if the participant agreed that interacting with the Reserve could generate cultural services and 0 otherwise.
E	The exclusion restriction that consists of 6 variables: whether a participant was married, widowed, or never married (being divorced was excluded from the equation and thus served as the reference category for the other marital status types), and 3 interaction terms between these marital status variables and whether the participant had a child under 18 years of age.
ε	The error term. Notably, since each error term differs across equations, we assigned a unique subscript to each one to avoid confusion. Therefore, the error terms in Eqs. (1)–(5) are denoted as $\varepsilon_1 - \varepsilon_5$.

affect WTP. Thus, our exclusion restriction combined a collection of six variables that cover marital status (never married, divorced, married, widowed) interacted with whether a participant had a child under 18 years old (Yes or No). Our assumption was that the marital status and presence of a child together might impact the amount of time available for participation.

$$prob(J=1)=\beta_0+\beta_1 X+\beta_2 F+\beta_3 P+\gamma E+\varepsilon_1 \quad (1)$$

2.6. Assessment of impacts of deliberation and sample selection bias on individual preferences

We estimated whether deliberation influenced WTP for cultural services from two perspectives. First, we directly compared the pre-deliberation and post-deliberation WTP of the 135 valid deliberation participants, including the means, medians, and distributions, since these values were expressed by the same individuals; Second, we estimated an OLS regression using Eq. (2) to examine whether the pre-deliberation WTP of the initial 1264 participants differed significantly from the post-deliberation WTP of the 135 valid deliberation participants, and whether this difference could be attributed to deliberation, while accounting for sample selection bias. Eq. (2) is based on the combined data from Questionnaire 1 completed by the 1264 initial participants and Questionnaire 2 completed by the 135 valid deliberation participants. Eq. (2) represents the second stage of the two-stage Heckman (1979) approach and controls for sample selection bias through integrating the IMR from Eq. (1).

$$W=\beta_0+\beta_1 X+\beta_2 F+\beta_3 P+\beta_4 D+\beta_5 IMR+\varepsilon_2 \quad (2)$$

where W refers to either the pre-deliberation WTP of the initial 1264 participants or the post-deliberation WTP of the 135 valid deliberation participants; D is a dummy variable, which equals 1 if the WTP was expressed after deliberation; IMR is the inverse mills ratio; the other variables are defined in Table 1. We incorporated WTP into the model as a continuous variable instead of a discrete choice.

Though the regression coefficient on the IMR reflects the marginal effect of the IMR on WTP, it does not reflect whether including or excluding the IMR would affect our estimation of other coefficients. Therefore, we bootstrapped Eq. (2) by 10,000 times, including both versions with and without the IMR. For each replication, we stored the coefficients on the dummy variable D for both the versions with and without the IMR. We then performed a *t*-test to test the hypothesis that the two coefficients were the same, with the alternative hypothesis being that they were not the same. A bootstrap method is often used for small datasets to create new samples by randomly sampling with replacement from the original dataset (Horowitz, 2019), which have the same size as the original dataset. In each sampling, the probability of each observation being selected is equal.

2.7. Assessment of impacts of demographic variables on individual preferences

Next, to assess whether participants with certain demographic characteristics significantly increased or decreased their WTP after deliberation, we ran the regression in Eq. (3) based on the data from both Questionnaire 1 and Questionnaire 2 filled by the 135 valid deliberation participants.

$$W_2-W_1=\beta_0+\beta_1 X+\beta_2 F+\varepsilon_3 \quad (3)$$

where W_2 is the post-deliberation WTP, W_1 is the pre-deliberation WTP, and hence W_2-W_1 reflects the change in WTP; the other variables are defined in Table 1. We did not include perception of cultural services (P) as a variable in Eq. (3) because it is not a demographic characteristic and may change before and after deliberation, whereas demographic variables remain constant for each participant.

We also assessed which variables affected pre-deliberation and post-deliberation WTP, respectively, using Eqs. (4) and (5). Eq. (4) is based on the data from Questionnaire 1 filled by the 135 valid deliberation participants, while Eq. (5) is based on the data from Questionnaire 2 filled by the 135 valid deliberation participants. Variables in these two equations have been defined previously

$$W_1=\beta_0+\beta_1 X+\beta_2 F+\beta_3 P+\varepsilon_4 \quad (4)$$

$$W_2=\beta_0+\beta_1 \mathrm{X}+\beta_2 F+\beta_3 P+\varepsilon_5 \quad (5)$$

Additionally, one potential concern regarding statistical inference from estimating Eqs. (1)–(5) was heteroskedasticity, particularly with respect to income. We adjusted our estimates following White (1980) so that they were robust to heteroskedasticity.

3. Results

3.1. Likelihood to join deliberation

The results of Eq. (1) show how demographic variables influenced the likelihood of joining deliberation among the 1264 participants who completed Questionnaire 1. The full results are presented in Appendix 2, while Table 2 below shows the demographic variables with statistically significant impacts. Although the coefficient for having a child is positive, and the coefficients for three marital status categories (being

Table 2
Demographic variables affecting likelihood of joining deliberation. This table reports the coefficient values of the probit model rather than the marginal effects. The marginal effects of each variable on the likelihood of participating must be below 1; however, this need not be true for the coefficients. Standard errors are reported in parentheses. + $p<0.1$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

Variables	Estimates of the variables' effects
(Intercept)	−5.651***
	(0.377)
Whether they had a tertiary education degree (YES = 1)	−0.364***
	(0.109)
Whether they had lived in Yinjiang County, Jiangkou County or Songtao County, Guizhou Province (YES = 1)	0.546***
	(0.155)
Whether they had a kid under 18 (YES = 1)	4.852***
	(0.417)
Whether they were over 65 years old (YES = 1)	0.939+
	(0.484)
Married (YES = 1) [a]	4.085***
	(0.322)
Never Married (YES = 1) [a]	3.880***
	(0.322)
Widowed (YES = 1) [a]	4.638***
	(0.654)
Being married with a kid under 18 (YES = 1)	−4.730***
	(0.436)
Being never married with a kid under 18 (YES = 1)	−5.120***
	(0.558)
Being widowed with a kid under 18 (YES = 1)	−9.835***
	(0.796)
Num.Obs.	1264
AIC	772.2
BIC	880.2
Log.Lik.	−365.11
F	5.662
RMSE [b]	0.29

[a] Being "Married", "Never married", and "Widowed" are compared to being "Divorced".

[b] RMSE (Root Mean Square Error) represents the square root of the average of the squared differences between the predicted values and the actual values. Since the dependent variable (whether a participant attended deliberation) is binary (0 or 1), the maximum possible deviation of the RMSE should be 1. An RMSE of 0.29 means that the model's predicted probabilities deviate from the actual outcomes by 0.29.

married, never married, and widowed) are also positive, their interaction terms are all negative. This may be because the positive effect of having a child on deliberation participation is strongest among divorced individuals, while non-divorced individuals (including those who are married, never married, or widowed) with children might face greater time constraints or family responsibilities, making participation in deliberation more difficult. These findings regarding the interaction between marital status and having a child support the assumption of the exclusion restriction required for the Heckman estimator mentioned previously. Moreover, people who had lived near the Reserve might have greater interest in the Reserve and were more likely to join deliberation than those who had not. People over 65 years old might have retired and had more available time, being more likely to join deliberation than those aged 18 to 24. However, people with a higher education degree were less willing to join deliberation, probably because these people were busier than the others.

3.2. Impact of deliberation and sample selection: changes in the magnitude of WTP

The regression results of Eq. (2) in Table 3 show that the post-deliberation WTP is significantly lower than the pre-deliberation WTP. However, this only suggests a decrease in the average magnitude of WTP after deliberation, rather than that most participants reduced WTP. In fact, among the 135 valid deliberation participants, 35 participants (25.9 %) expressed the same WTP before and after deliberation. A total of 66 participants (48.9 %) expressed higher WTP after deliberation, including 45 participants (33 %) who increased their WTP from 0 CNY or 100 CNY to 200 CNY or 500 CNY. Conversely, 34 participants (25.2 %) reported a lower WTP after deliberation, including 15 (11 %) who reduced their WTP from 1000 CNY or higher to 500 CNY or lower. Although more participants increased their WTP than those who decreased it, the average individual WTP/person/yr declined from 657 CNY before deliberation to 397 CNY after deliberation. This decline was due to the greater magnitude of WTP reductions, particularly in cases where participants lowered their WTP from 5000 to 20,000 CNY to just a few hundred CNY, compared to the magnitude of WTP increases observed.

We did not remove or classify WTP of 5000 CNY or higher as invalid outliers in our calculation, as we could not disprove that these WTP reflected genuine preferences. For example, the participants with such high WTP had monthly incomes of 5000 CNY or even more than 10,000 CNY, making these amounts theoretically affordable. Retaining these high WTP values in our calculation was also useful for assessing changes in WTP before and after deliberation and comparing the mean and median WTP. We found a disparity between the mean and median WTP, due to the asymmetric distribution of WTP. The median WTP of the 135 valid deliberation participants remained at 200 CNY/person/yr both before and after deliberation, reflecting that the mean WTP was inflated by high individual values in both stages. Moreover, the standard deviation of their WTP decreased from 2123 before deliberation to 526 after deliberation. Compared to the pre-deliberation WTP, the lower standard deviation and smaller gap between the mean and median values in the post-deliberation WTP imply that deliberation led to a more concentrated distribution of WTP without changing the median WTP (see more results in Section 3.3).

Moreover, although the IMR does not have a significant direct impact on WTP (Table 3), the results of the bootstrapping exercise, shown in Table 4, suggest that it impacts the effects of deliberation: excluding the IMR from Eq. (2) would overestimate the magnitude of deliberation impact on WTP by 1.4 %, and this difference is statistically significant. The estimates of other variables in Eq. (2) are not described here but presented in Appendix 3, because the focus of this section is the impacts of deliberation.

Table 3
Impact of deliberation on WTP based on Eq. (2). Standard errors are reported in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Variables	Impacts on WTP
(Intercept)	−1480.004 (1552.420)
Deliberation: whether they joined deliberation (YES = 1)	−744.887*** (165.077)
IMR	1067.161 (688.096)
Num.Obs.	1399
R2	0.052
R2 Adj.	0.041
AIC	26,428.39
BIC	26,522.78
Log.Lik.	−13,196.2
F	4.801
RMSE [a]	3040.01

[a] In this model, the dependent variable—WTP—is continuous, ranging from 0 to 20,000. The range of the dependent variable sets the maximum potential RMSE. Consequently, both this table and the later Table 5 exhibit a much larger RMSE compared to Table 2. The RMSE in Table 3 also indicates that the model's predictions deviate from the actual values by an average of 3040.

3.3. Impact of deliberation: changes in the distribution of WTP

Changes in the distribution of preferences expressed by the 135 valid deliberation participants are also shown in Fig. 4. The pre-deliberation WTP was most frequently expressed at 100 CNY/person/yr. However, the post-deliberation WTP converged toward 500 CNY/person/yr and especially 200 CNY/person/yr. Moreover, the distribution of WTP became more convergent after deliberation (Fig. 4), and this change was statistically significant: a Kolmogorov–Smirnov test for the pre-deliberation and post-deliberation WTP yielded a p-value of less than 0.0001. An additional test in Appendix 4 also provides statistically significant evidence that deliberation reduced the spread of WTP: deliberation significantly reduced the distance between participants' WTP and the mean WTP, and the distance between participants' WTP and the median WTPs.

The change in the distributions of participants' WTP could be attributed to the following reasons. (1) Participants acknowledged that the Reserve required funding for management, and local governments saw potential revenue as an incentive for nature conservation. Free entry also raised concerns about uncontrolled visitor numbers and overcrowding. Consequently, fewer participants supported free entry after deliberation. (2) 1000 CNY for an entrance card would be too expensive for many locals, who might prefer spending that amount visiting multiple scenic sites rather than just the Reserve. After deliberation, fewer participants still chose 1000 CNY/person/yr or higher. (3) 100 CNY for an entrance pass offering unlimited annual access was underpriced, since a single-entry ticket to some nature reserves in China can cost 100 CNY. This reduced the number of participants who chose 100 CNY after deliberation.

Table 4
How the IMR influences the impacts of deliberation on WTP.

	Mean effects of excluding IMR on deliberation impacts on preferences [a]	t-statistics	P-value	Expected bias in estimates of deliberation impacts due to exclusion of IMR [b]
WTP	−10.66	31.078	<2.2e-16	1.4 %

[a] The coefficient of deliberation in the regression removing IMR from Eq. (2) minus the coefficient of deliberation in Eq. (2) with IMR.

[b] The ratio = (the mean effect of IMR)/(the coefficients of deliberation in Eq. (2) with IMR).

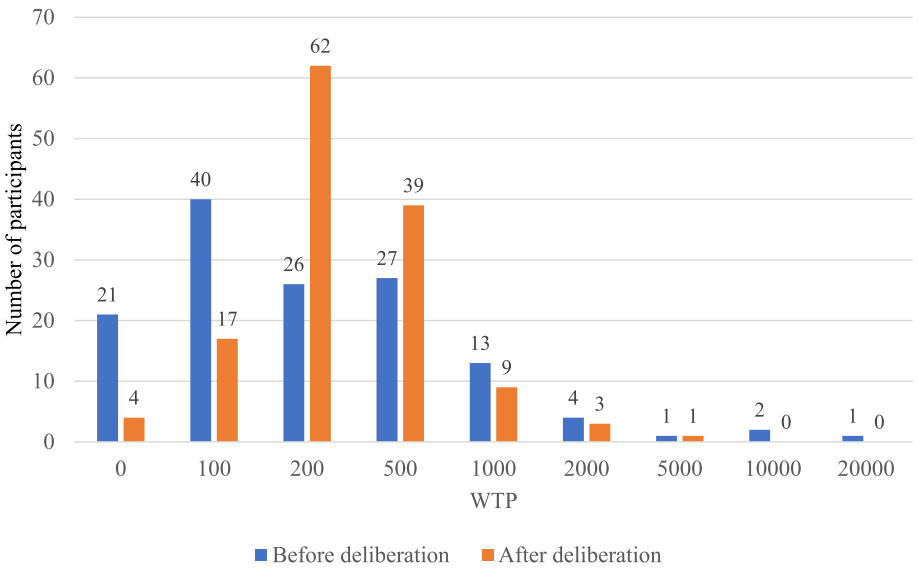

Fig. 4. Number of participants with different levels of WTP before and after deliberation.

3.4. Impacts of demographic variables on WTP

The regression results of Eqs. (3)–(5) show different variables' impacts on preferences for cultural services before and after deliberation. The full results are presented in Appendix 5. Table 5 extracts the variables with significant impacts on WTP from Appendix 5. In Table 5, Column 2 shows that those who had a kid improved their WTP after deliberation. This aligns with Columns 3 and 4: their WTP was significantly lower than others' before deliberation but no longer significantly different afterward. Column 2 also shows that those whose monthly income was higher than 10,000 CNY reduced their WTP after deliberation. Consistently, Columns 3 and 4 demonstrate that these participants expressed significantly higher WTP than others before deliberation, but this difference was no longer significant after deliberation.

Although people's preferences for an ecosystem service may be contingent upon their knowledge of and interests in the service (Costanza, 2020) – for example, individuals who have visited or lived in proximity of a protected area may have different interests and knowledge compared to those who have not (Watson et al., 2014) – we did not find any significant difference in WTP between those who have visited the Reserve and those who have not, nor between locals and outsiders.

Table 5
Impacts of variables on WTP. Column 1 shows variable names. Columns 2, 3, and 4 show the impacts of demographic variables on the change in WTP (which equals post-deliberation WTP minus pre-deliberation WTP), pre-deliberation WTP, and post-deliberation WTP, respectively, with standard errors reported in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Variables	Change in WTP	Pre-deliberation WTP	Post-deliberation WTP
(Intercept)	186.258	1021.968**	290.803***
	(569.1783)	(538.9352)	(101.9744)
Whether they had a kid under 18 (YES = 1)	698.366*	−782.454*	−19.084
	(348.181)	(347.342)	(87.567)
Whether they had a monthly income more than 10,000 CNY (YES = 1)	−2078.082+	1975.460+	28.121
	(1229.743)	(1154.296)	(188.969)
Num.Obs.	135	135	135
R2	0.104	0.139	0.057
R2 Adj.	0.008	0.038	−0.052
AIC	2550.4	2542.0	2097.9
BIC	2594.0	2588.5	2144.4
Log.Lik.	−1260.195	−1255.017	−1032.954
F	1.082	1.379	0.523
RMSE	2740.35	2637.23	509.06

4. Discussion

4.1. Changing preferences through online deliberation

Many studies (Kenter, 2016; Kenter et al., 2016b; Wang et al., 2017; Lliso et al., 2020; Saarikoski and Mustajoki, 2021) have found that the enhancement of understanding of a service and a broad range of issues related to it may affect people's preferences for the service. Over 90 % of the deliberation participants reported that deliberation enhanced their understanding of our survey, the cultural services the Reserve could provide to other people and society (not only themselves), as well as the socioeconomic and environmental contexts of the Reserve (Appendix 1). This could, in turn, influence their WTP.

Among the 135 valid deliberation participants, 48.9 % increased their WTP after deliberation, while 25.2 % reduced WTP. Increases in WTP following deliberation have been reported in previous literature (Kenter et al., 2011; Wang et al., 2017), where deliberation enhanced participants' awareness of a service and their appreciation of its significance. Decreases in WTP after deliberation have also been observed previously (Kenter, 2016; Kenter et al., 2016b), where deliberation prompted more critical consideration (e.g., considering alternative uses of money) and led to more realistic WTP. In our survey, the deliberation not only enhanced participants' understanding of the cultural services themselves but also their substitutes, leading to varied impacts on WTP across different participants. Moreover, earlier studies (Lliso et al., 2020; Saarikoski and Mustajoki, 2021) have suggested that deliberation can help participants deepen their understanding of the survey, reconsider their preferences, and articulate their reasoning, leading to a more thoughtful and rational expression of WTP. However, even if this is the case, more rational WTP does not necessarily imply more conservative or limited values, as reflected in our observations of increased, decreased, and unchanged WTP following deliberation.

Furthermore, WTP demonstrated a more convergent distribution in a statistically significant way after deliberation. This convergence might be due to negotiation, mutual understanding, and consideration of a broader array of issues (e.g., the service's contributions to others and the service's substitutes) during the deliberation process, all contributing to consensus building (Kenter et al., 2011; Lo and Spash, 2013; Vargas

et al., 2016; Costanza et al., 2017). Additionally, Eqs. (4) and (5) found that the impacts of sociodemographic variables on WTP in Table 5 (Columns 3 and 4) were significant prior to deliberation but became insignificant after deliberation. We confirmed that the differences between the pre-deliberation and post-deliberation coefficients of these variables were statistically significant by performing a bootstrapping procedure and running *t*-tests on the differences. The corresponding results are provided in Appendix 6. This shows that deliberation reduced the effects of sociodemographic drivers of WTP.

4.2. Implications of the WTP for cultural services

In practice, the Reserve does not offer annual entrance passes but charges a standard entrance fee of approximately 100 CNY, valid for three consecutive days. Free or discounted entry is also available for students, children, veterans, seniors, and individuals with disabilities (Fanjing Mountain, 2024). Therefore, the actual average entrance cost per visit is likely lower than 100 CNY. We did not find data on how frequently individuals visit the Reserve each year. However, the average pre-deliberation WTP/person/yr (657 CNY) and post-deliberation WTP/person/yr (397 CNY) we estimated indicate that visitors would be willing to pay more than the actual entrance costs if they visit fewer than 6.5 and 4 times per year, respectively. These findings imply the presence of consumer surplus on average.

Our estimates of WTP also complement real-world tourism revenue data to better understand the value of the Reserve's cultural services. Between 2019 and 2023, the Reserve received an average of 1,130,000 visits annually, generating approximately 293 million CNY in tourism revenue per year (Guizhou Provincial Government, 2023). However, tourism revenue underestimates the full value of cultural services: while it captures on-site consumption, it may exclude other travel-related expenses (e.g., commuting costs) and the opportunity costs of time spent traveling (Mayer and Woltering, 2018; Chen, 2021). Since one individual may contribute multiple visits per year, the total number of visits may exceed the number of unique visitors. Therefore, it is inappropriate to estimate the total value of cultural services by simply multiplying WTP/person/yr by the number of visits. However, as over 70 % of visits are made by people from outside provinces (Zhang, 2023), who are unlikely to visit the Reserve multiple times per year, we can assume that the number of unique visitors equals 70 % of total visits. Based on the average of 1,130,000 annual visits, this translates to an estimated 791,000 visitors per year. This estimate may still be conservative for three reasons: (1) the proportion of visits from outside provinces may exceed 80 % of total visits in some periods (Guizhou Provincial Government, 2024); (2) local residents may also visit only once a year; and (3) the 2019–2023 average annual visits were negatively impacted by pandemic-related travel restrictions and hence likely underrepresented typical annual visits in normal years. For instance, annual visits rose to 1,950,000 in 2024 (Tongren Goverment, 2025). Using the estimated 791,000 annual visitors, the value of the Reserve's cultural services would be approximately 520 million CNY per year based on the pre-deliberation WTP, and 314 million CNY based on the post-deliberation WTP. This suggests that the annual tourism revenue of 293 million CNY captures about 56 % and 93 % of the cultural service value, respectively.

Although our estimates of WTP may involve uncertainties and inaccuracy, which will be discussed in Section 4.4, the findings above reflect strong public interest in experiencing the natural landscapes, biodiversity, geodiversity, and cultural services offered by the Reserve. The findings also demonstrate the Reserve's substantial economic value—even though the value of cultural services captures only a fraction of the total value of its ecosystem services, many of which have not been assessed in this study. Ongoing and increased government support, conservation efforts, and financial investment are needed to ensure the sustainable management of both tourism and ecosystem of the Reserve. While tourism serves as an important driver of local economic growth, over-tourism should be avoided to prevent environmental degradation and biodiversity loss, thereby ensuring the Reserve's long-term contributions to human well-being.

4.3. Pros and cons of an online survey

Both online and in-person (or face-to-face) surveys have their own sets of advantages and disadvantages for obtaining valid samples. For example, online questionnaires can be widely distributed via the internet (Xie, 2020), while in-person surveys can reach diverse geographic areas by conducting workshops or distributing questionnaires in different locations (Kenter et al., 2014). Both methods can use professional recruitment companies to improve the efficiency of participant recruitment and to control the representativeness, balance, or size of sample (Völker and Lienhoop, 2016; Wang et al., 2024a). They can both offer compensation or rewards to further motivate participation. However, in-person surveys may provide greater continuity for deliberation: the entire process, including deliberation and questionnaire completion at both pre- and post-deliberation stages, can be conducted in a single workshop, with remuneration or compensation contingent on full participation (Aanesen et al., 2021). This format helps secure full participation and reduce participant dropout, which is more likely in online surveys, especially discontinuous ones like this study, where participants completed Questionnaire 1 before attending our online chat groups.

In comparison, online surveys eliminate the need for travel and can be conducted without physical meetings. This is especially useful when participants or researchers are unwilling or unable to travel. Online surveys may also offer lower financial costs and reduce time requirements. For example, unlike in-person surveys that require researchers to physically approach and invite participants, participants could join our survey simply by seeing and accessing the survey link posted on websites or social media, regardless of whether they had been directly invited. Online surveys also enhance participants' anonymity and confidentiality, promoting higher participation rates when respondents have privacy concerns (Friess and Eilders, 2015; Chen et al., 2024). Online survey platforms can automatically compile data and even generate summary statistics, facilitating data analysis. Finally, by eliminating paper use, online surveys can save more resource.

However, unlike in-person surveys that enable researchers to physically track how many questionnaires are sent and returned, our online could not track where the participants accessed the link (e.g., via our own WeChat posts, those of friends, or strangers) or how many people viewed the link on each questionnaire distribution channel. Even when we sent the link directly to someone, we could not always determine whether that individual completed the questionnaire, because there was no physical return. Consequently, we were unable to estimate the response rate for the questionnaire, which is typically measurable in traditional in-person surveys (González-Cabán et al., 2007; Völker and Lienhoop, 2016). We were also unable to identify who submitted each questionnaire or determine how many respondents were personal contacts, as all responses were saved anonymously in our online database. In comparison, in-person surveys not only allow researchers to identify personal contacts, but also enable accurate matching of pre-deliberation and post-deliberation questionnaires (Kenter, 2016; Aanesen et al., 2021; Jiang et al., 2023), such as through asking an individual to physically returned both questionnaires at the same time. Although 196 people participated in our deliberation, we were able to match the pre- and post-deliberation questionnaires for only 135 participants. This matching process also involved certain assumptions and uncertainties, as explained in Section 2.3. More discussion about the differences between online surveys and other survey modes (e.g., mail, in-person) in stated preference research can be found in Olsen (2009), Lindhjem and Navrud (2011), and Chen et al. (2024). Additionally, each of the channels used to distribute Questionnaire 1 has its own pros and cons, as summarized in Table 6.

Table 6
Pros and cons of questionnaire-distributing channels.

Channels	Pros	Cons
Paid distribution via questionnaire service platforms	These platforms provide researchers with efficiency and convenience in collecting data from a large and diverse pool of respondents. Additionally, these platforms incorporate built-in quality control features, employing automated algorithms to detect and filter invalid responses (e.g., those completed suspiciously quickly).	Offering monetary compensation increases research expenses and might encourage insincere responses, driven primarily by participants' interest in earning rewards rather than contributing to research. Researchers have limited control over participants' characteristics beyond basic inclusion criteria.
Snowball sampling by researchers via WeChat	This method distributes questionnaires easily through personal networks, capitalizing on existing relationships and facilitating cost-effective distribution (Parker et al., 2019). Moreover, participants recruited by personal contacts may be more engaged or motivated to complete a survey (Valerio et al., 2016). This method can also extend participants to those who cannot be directly accessed by researchers, expanding sample size (Sharma, 2017).	Participants recruited through personal connections are not based on random sampling but might share similar socio-demographic characteristics, leading to homogeneity among participants and limiting the generalizability of the findings (Sharma, 2017). Researchers using this method cannot track how widely or precisely the questionnaire has been distributed, making it difficult to manage the sample's representativeness or meet specific sampling requirements (Parker et al., 2019). Furthermore, responses gathered through personal connections might tailor their answers to align with perceived expectations, leading to biased responses (Bergen and Labonté, 2020).
Distribution by locals	Local distributors can enhance the relevance of the survey within the community, promoting local engagement in research. The varied backgrounds of our local distributors helped capture differing perspectives from the local community. This channel also reduced the data collection workload for us. If snowball sampling was conducted by our local distributors, this channel also shared the same pros as the snowball sampling method described above.	Employing local distributors increased our research expenses. We had limited control over how they distributed Questionnaire 1 and whom they recruited, although we could monitor whether the participants they recruited were from the local area by checking the IP addresses of the responses. Additionally, since local distributors shared Questionnaire 1 through their personal networks, this channel shared the same limitations as the snowball sampling method described above.

We also acknowledge that typing online as a deliberation medium has several limitations. First, it may exclude individuals who are less comfortable with using WeChat or typing, potentially biasing the representativeness of our data. Second, the lack of verbal interaction and nonverbal cues (e.g., facial expressions and tone of voice), which are important for engagement and mutual understanding, may hinder the depth and nuance of discussions (Davies and Chandler, 2012; Chen et al., 2024); Online anonymity may also reduce participants' accountability for their statements (Friess and Eilders, 2015). Additionally, typing enables asynchronous text-based discussions, which may make it more challenging for participants to develop a sense of group connection and engagement compared to real-time discussions (Watts, 2016).

However, online typing was the best available deliberation medium for our survey, because: (1) it overcame travel restrictions; (2) some participants did not want to disclose any personal information, such as voice and physical appearance, and explicitly expressed discomfort with deliberating via voice calls or video meetings; and (3) typing (which can be either synchronous or asynchronous) was more feasible than fully synchronous communication, such as voice calls, video meetings, and face-to-face meeting, because participants had different time schedules.

Different survey venues, including the choice of deliberation media, have varying characteristics, such as the inclusion of nonverbal cues, IT proficiency requirements, levels of confidentiality, and synchronicity. These characteristics can influence the inclusiveness and engagement of surveys (Sherman et al., 2013; Chen et al., 2024), sample composition, the genuineness of responses (Nicosia et al., 2014), and overall data quality (Marta-Pedroso et al., 2007), ultimately affecting survey results. Further research is needed to examine whether and how online and in-person survey venues lead to different valuation outcomes, and to compare whether the impacts of online deliberation on WTP differ between text-based chats and other media, such as video or voice meetings.

4.4. Validity of sample and R^2

Our samples in both Questionnaire 1 and Questionnaire 2 have younger ages, lower marriage rates, higher levels of education, higher incomes, and lower unemployment rates compared to the general population of Tongren, where the Reserve is located. This bias is partly attributable to the online procedure used to distribute our questionnaires and conduct deliberation. As discussed earlier, the online procedure was not entirely based on random sampling and did not fully include individuals with low digital literacy or limited interest in the internet. Previous studies in both China and other countries have found that that younger and better-educated individuals are generally more proficient in using social media and more comfortable with online communication (Van Deursen et al., 2011; Chen et al., 2016; Correa, 2016; Xie et al., 2017). These individuals, as well as those with higher incomes, also tend to express greater concern for and interest in environmental benefits and nature conservation (Dimante et al., 2016; Chinese Ministry of Ecology and Environment, 2020; Jin and Li, 2020; Ren et al., 2020). Although we provided financial incentives to participants who completed the full survey, including the deliberation stage, these incentives were very modest. Therefore, our participants can be considered largely voluntary. Previous research in economic, environmental, and various other fields has found that university students are more likely than the general population to voluntarily participate in surveys due to greater time availability, curiosity, accessibility, and the perception of surveys as learning opportunities (Murphy et al., 2005; Holdsworth, 2010; Smith et al., 2010). Consequently, it is unsurprising that university students accounted for more than 30 % of the participants in both Questionnaire 1 and Questionnaire 2.

The bias in our sample was anticipated and does not compromise the main goal of this study: assessing whether WTP can be influenced by online deliberation and by sample selection bias resulting from participant drop-off during the survey process—and, if so, to what extent. This is because achieving this goal does not rely on sample representativeness, but rather on the differences in WTP and sample compositions between pre-deliberation and post-deliberation observations. The findings relevant to this goal would remain valid even if all participants came from a single population group (e.g., all male students from the same school with the same income level). Nevertheless, when estimating the impacts of deliberation on WTP, we still included demographic variables in our regression analysis to at least partly control for the influence of these variables on WTP.

However, we acknowledge that the limited representativeness and variability within the sample constrain the study's ability to achieve other goals, including assessing WTP for cultural services and examining the effects of demographic variables on WTP. Specifically, the biased

sample limits the representativeness of our WTP estimates and reduces their generalizability to the broader population. It may also lower the explained variance in the models and lead to under- or overestimation of the relationships between predictors and outcomes. This likely contributes to the low R^2 values observed in our models based on both the 1264 initial participants and the 135 valid deliberation participants. These limitations highlight the need for more representative and sufficiently large samples, as well as the development of strategies to obtain such samples, in future deliberation-based valuation studies.

Another contributor to the low R^2 values could be the exclusion of potentially important variables that may influence WTP for cultural services. These variables, according to prior research in China and other countries, may include individuals' commitment to nature conservation, recognition of the importance of protected areas, attitudes toward nature-based recreation, distance to a tourism destination, and the perceived quality of cultural services (e.g., vegetation cover, water clarity, and crowding levels) (Rosenberger et al., 2012; Barrena et al., 2014; He et al., 2019; Gao et al., 2024). Additionally, the small sample size of only 135 valid deliberation participants, which is also common in previous deliberation-based valuation studies (Kenter, 2016; Völker and Lienhoop, 2016; Aanesen et al., 2021), can further contribute to the low R^2 values.

Although these low R^2 values indicate limited explanatory or predictive power of our models, we still found statistically significant relationships between some variables (e.g., whether an individual attended deliberation) and WTP. Meanwhile, due to the complexity of ecological and socio-economic systems, as well as their interactions with humans (Costanza et al., 2017), it is normal for WTP to be influenced by unmeasured or unobservable variables. To further investigate the relationships between people's sociodemographic characteristics and WTP, future deliberation-based valuation studies will require not only more representative and sufficient participants but also the integration of other variables that may affect WTP.

4.5. Effectiveness of the Heckman approach for controlling for sample selection bias

In our study, the 135 valid deliberation participants represented only 10 % of the 1264 initial participants. For researchers aiming to estimate the impacts of deliberation, or to utilize deliberation anywhere in the valuation process, the dropout of participants between the pre-deliberation and post-deliberation survey stages can introduce sample selection bias. This concern is legitimate (Table 4), as the inclusion of the IMR into our regression analysis made a statistically significant difference in the impact of deliberation on WTP. Adopting the sample correction approaches of Heckman (1979) was an intuitive and effective way to address the sample bias and enabled more robust estimation of the impacts of deliberation.

However, it is important to note the restrictions associated with this method. For example, Tucker (2010) suggested that the application of IMR should be limited to models based on linear regression and binary selection. Puhani (2002) highlighted that collinearity between the IMR and other regressors could make it difficult to separate the effects of the IMR from those of other variables, potentially reducing the robustness of the regression coefficients. Though we conducted our assessment using linear regression, assessments of the impacts of deliberation on ecosystem service valuation using non-linear regressions should explore alternative sample selection and correction approaches, such as the full information maximum likelihood estimation (Tucker, 2010) and a semi-parametric approach controlling for truncated data (Wang et al., 2024b).

5. Conclusion

The cultural services of protected areas are vital to human well-being and economic development, underscoring the need for continued and even increased support for both nature conservation and sustainable tourism management. Deliberation may influence people's understanding of and preferences for cultural services through mutual learning, communication, and the consideration of a wider range of related issues, such as substitutes and societal benefits. Deliberation may also lead to more rational preferences through enabling participants to reconsider, justify, and explain their preferences. Overall, the online deliberation in our survey led to greater convergence in WTP, driven in part by consensus reached among some participants. We also observed varied impacts of the online deliberation on WTP for the Reserve's cultural services, including increases, decreases, and no change in WTP. Although the average WTP declined after deliberation, the median WTP remained unchanged.

When the post-deliberation sample is a subset of the pre-deliberation sample, assessing the impacts of deliberation on ecosystem service valuation can benefit from approaches that control for sample selection bias. The Heckman sample correction method enhanced the robustness of our assessment, but it is not universally applicable to rectifying all types of sample selection issues. Alternative sample selection and correction approaches should be further explored. More robust assessments of deliberation's impacts in the future should improve demographic representativeness and statistical sufficiency of deliberation participants. They should also explore a wider range of factors that may influence WTP for ecosystem services and examine how these factors shape the effects of deliberation on WTP. In addition, further investigation is needed to determine whether and how differences in survey venues (including deliberation media) influence valuation outcomes and the effectiveness of deliberation.

Statement of author contribution

Haojie Chen proposed this study, conducted the survey, collected and analyzed data, contributed to a portion of research funding, undertook the original drafting of this paper, and revised this paper; Matthew R. Sloggy proposed the use of the Heckman approach and the Inverse Mills Ratio, assisted with conducting and revising data analysis (such as sample selection bias control, regressions, and robustness check), edited the paper, and also contributed to a portion of research funding; Robert Costanza and Ida Kubiszewski contributed to survey design and edited and refined this paper; Tong Zhang prepared Appendix 1 and edited the paper; Luhua Wu assisted with data collection. All authors reviewed and approved this paper for submission.

CRediT authorship contribution statement

Haojie Chen: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Matthew R. Sloggy:** Writing – review & editing, Writing – original draft, Supervision, Software, Methodology, Investigation, Funding acquisition, Formal analysis. **Robert Costanza:** Writing – review & editing, Supervision, Project administration, Methodology. **Ida Kubiszewski:** Writing – review & editing, Supervision, Project administration, Methodology. **Tong Zhang:** Writing – review & editing, Formal analysis. **Luhua Wu:** Data curation.

Declaration of competing interest

We declare that we have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.forpol.2025.103526.

Data availability

data is attached in e-components

References

Aanesen, M., Armstrong, C.W., Van Rensburg, T., 2021. Do we choose differently after a discussion? Results from a deliberative valuation study in Ireland. Land Econ. 97 (1), 207–223. https://doi.org/10.3368/le.97.1.100719-0144R.

Andrade, R., van Riper, C.J., Goodson, D.J., Johnson, D.N., Stewart, W., López-Rodríguez, M.D., Cebrián-Piqueras, M.A., Horcea-Milcu, A.I., Lo, V., Raymond, C.M., 2023. Values shift in response to social learning through deliberation about protected areas. Glob. Environ. Chang. 78, 102630. https://doi.org/10.1016/j.gloenvcha.2022.102630.

Barrena, J., Nahuelhual, L., Báez, A., Schiappacasse, I., Cerda, C., 2014. Valuing cultural ecosystem services: agricultural heritage in Chiloé island, southern Chile. Ecosyst. Serv. 7, 66–75. https://doi.org/10.1016/j.ecoser.2013.12.005.

Bergen, N., Labonté, R., 2020. "Everything is perfect, and we have no problems": detecting and limiting social desirability bias in qualitative research. Qual. Health Res. 30 (5), 783–792. https://doi.org/10.1177/1049732319889354.

Boyle, K.J., 2017. Contingent valuation in practice. In: A Primer on Nonmarket Valuation, pp. 83–131. https://doi.org/10.1007/978-94-007-7104-8_4.

Chen, H., 2021. The ecosystem service value of maintaining and expanding terrestrial protected areas in China. Sci. Total Environ. 781, 146768. https://doi.org/10.1016/j.scitotenv.2021.146768.

Chen, A.N., Downey, J.P., McGaughey, R.E., Jin, K., 2016. Seniors and information technology in China. Int. J. Hum. Comput. Interact. 32 (2), 132–142. https://doi.org/10.1080/10447318.2015.1067499.

Chen, H., Costanza, R., Kubiszewski, I., 2022. Land use trade-offs in China's protected areas from the perspective of accounting values of ecosystem services. J. Environ. Manag. 315, 115178. https://doi.org/10.1016/j.jenvman.2022.115178.

Chen, H., Costanza, R., Kubiszewski, I., Sloggy, M.R., Wu, L., Zhang, T., 2024. Integrating online deliberation into ecosystem service valuation. J. Environ. Manag. 351, 119796. https://doi.org/10.1016/j.jenvman.2023.119796.

Chen, H., Zhang, T., Costanza, R., Kubiszewski, I., Sloggy, M.R., Wu, L., Luo, H., 2025. Assessing individual and social values of cultural services of a protected area through online deliberation. Ecol. Econ. 235, 108632. https://doi.org/10.1016/j.ecolecon.2025.108632.

Cheng, X., Van Damme, S., Li, L., Uyttenhove, P., 2019. Evaluation of cultural ecosystem services: a review of methods. Ecosyst. Serv. 37, 100925. https://doi.org/10.1016/j.ecoser.2019.100925.

Chinese Ministry of Ecology and Environment, 2020. The Response to Proposal No. 6836 of the Third Session of the Thirteenth National People's Congress. viewed March 12, 2024. https://www.mee.gov.cn/xxgk2018/xxgk/xxgk13/202012/t20201201_810832.html.

Correa, T., 2016. Digital skills and social media use: how internet skills are related to different types of Facebook use among 'digital natives. Inf. Commun. Soc. 19 (8), 1095–1107. https://doi.org/10.1080/1369118X.2015.1084023.

Costanza, R., 2020. Valuing natural capital and ecosystem services toward the goals of efficiency, fairness, and sustainability. Ecosyst. Serv. 43, 101096. https://doi.org/10.1016/j.ecoser.2020.101096.

Costanza, R., Chichakly, K., Dale, V., Farber, S., Finnigan, D., Grigg, K., Heckbert, S., Kubiszewski, I., Lee, H., Liu, S., 2014. Simulation games that integrate research, entertainment, and learning around ecosystem services. Ecosyst. Serv. 10, 195–201. https://doi.org/10.1016/j.ecoser.2014.10.001.

Costanza, R., de Groot, R., Braat, L., Kubiszewski, I., Fioramonti, L., Sutton, P., Farber, S., Grasso, M., 2017. Twenty years of ecosystem services: how far have we come and how far do we still need to go? Ecosyst. Serv. 28, 1–16. https://doi.org/10.1016/j.ecoser.2017.09.008.

Davies, T., Chandler, R., 2012. Online deliberation design. In: Democracy in Motion: Evaluation the Practice and Impact of Deliberative Civic Engagement, pp. 103–131.

Dimante, D., Tambovceva, T., Atstaja, D., 2016. Raising environmental awareness through education. Int. J. Contin. Eng. Educ. Life Long Learn. 26 (3), 259–272. https://doi.org/10.1504/IJCEELL.2016.078446.

Fanjing Mountain, 2024. Introduction of the Scenic Area. viewed April 3 2024. https://fanjingshan.gz.cn/?page_id=743.

Friess, D., Eilders, C., 2015. A systematic review of online deliberation research. Policy Internet 7 (3), 319–339. https://doi.org/10.1002/poi3.95.

Gao, Q., Cui, S., Shi, P., Li, Z., 2024. Exploring tourists' preferences and willingness to pay for national park recreation improvements based on regret and utility comparison. Sci. Rep. 14 (1), 21524. https://doi.org/10.1038/s41598-024-72494-w.

González-Cabán, A., Loomis, J.B., Rodriguez, A., Hesseln, H., 2007. A comparison of CVM survey response rates, protests and willingness-to-pay of native Americans and general population for fuels reduction policies. J. For. Econ. 13 (1), 49–71. https://doi.org/10.1016/j.jfe.2006.10.001.

Guizhou Provincial Government, 2023. Fanjing Mountain Presents an Impressive "Transcript" - 2023 Eco-Civilization Guiyang International Forum. https://www.guizhou.gov.cn/ztzl/2023nstwmgygjlt/gzst/202307/t20230711_80794249.html?isMobile=false.

Guizhou Provincial Government, 2024. Ecotourism Booms on the Western Slope of Fanjing Mountain. viewed April 4 2025. http://www.guizhou.gov.cn/ztzl/lycyh/zxdt/202408/t20240822_85427890.html.

Haghani, M., Bliemer, M.C., Rose, J.M., Oppewal, H., Lancsar, E., 2021. Hypothetical bias in stated choice experiments: part II. Conceptualisation of external validity, sources and explanations of bias and effectiveness of mitigation methods. J. Choice Model. 41, 100322. https://doi.org/10.1016/j.jocm.2021.100309.

Hanley, N., Czajkowski, M., 2019. The role of stated preference valuation methods in understanding choices and informing policy. Rev. Environ. Econ. Policy. https://doi.org/10.1093/reep/rez005.

He, S.-Y., Su, Y., Wang, L., Cheng, H.-G., 2019. Realisation of recreation in national parks: a perspective of ecosystem services demand and willingness to pay of tourists in Wuyishan pilot. J. Nat. Resour. 34 (1), 40–53. https://doi.org/10.31497/zrzyxb.20190104.

Heckman, J., 1979. Sample selection bias as a specification error. Econometrica 47, 153–161. https://doi.org/10.2307/1912352.

Hindsley, P., Landry, C.E., Gentner, B., 2011. Addressing onsite sampling in recreation site choice models. J. Environ. Econ. Manag. 62 (1), 95–110. https://doi.org/10.1016/j.jeem.2010.10.00.

Holdsworth, C., 2010. Why volunteer? Understanding motivations for student volunteering. Br. J. Educ. Stud. 58 (4), 421–437. https://doi.org/10.1080/00071005.2010.527666.

Holmes, T.P., Adamowicz, W.L., Carlsson, F., 2017. Choice experiments. In: A Primer on Nonmarket Valuation, pp. 133–186. https://doi.org/10.1007/978-94-007-7104-8_5.

Horowitz, J.L., 2019. Bootstrap methods in econometrics. Annu. Rev. Econ. 11, 193–224. https://doi.org/10.1146/annurev-economics-080218-025651.

IPBES, 2022. Methodological Assessment Regarding the Diverse Conceptualization of Multiple Values of Nature and its Benefits, Including Biodiversity and Ecosystem Functions and Services. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany.

Jiang, N., Ao, C., Xu, L., Wei, Y., Long, Y., 2023. Will information interventions affect public preferences and willingness to pay for air quality improvement? An empirical study based on deliberative choice experiment. Sci. Total Environ., 161436 https://doi.org/10.1016/j.scitotenv.2023.161436.

Jin, T., Li, M., 2020. Does education increase pro-environmental willingness to pay? Evidence from Chinese household survey. J. Clean. Prod. 275, 122713. https://doi.org/10.1016/j.jclepro.2020.122713.

Johnston, R.J., Boyle, K.J., Adamowicz, W., Bennett, J., Brouwer, R., Cameron, T.A., Hanemann, W.M., Hanley, N., Ryan, M., Scarpa, R., 2017. Contemporary guidance for stated preference studies. J. Assoc. Environ. Resour. Econ. 4 (2), 319–405. https://doi.org/10.1086/691697.

Kaffashi, S., Yacob, M.R., Clark, M.S., Radam, A., Mamat, M.F., 2015. Exploring visitors' willingness to pay to generate revenues for managing the national elephant conservation center in Malaysia. Forest Policy Econ. 56, 9–19. https://doi.org/10.1016/j.forpol.2015.03.004.

Kenter, J.O., 2016. Integrating deliberative monetary valuation, systems modelling and participatory mapping to assess shared values of ecosystem services. Ecosyst. Serv. 21, 291–307. https://doi.org/10.1016/j.ecoser.2016.06.010.

Kenter, J.O., Hyde, T., Christie, M., Fazey, I., 2011. The importance of deliberation in valuing ecosystem services in developing countries—evidence from the Solomon Islands. Glob. Environ. Chang. 21 (2), 505–521. https://doi.org/10.1016/j.gloenvcha.2011.01.001.

Kenter, J.O., Reed, M.S., Irvine, K.N., O'Brien, L., Brady, E., Bryce, R., Christie, M., Church, A., Cooper, N., Davies, A., 2014. UK National Ecosystem Assessment Follow-On. Work Package Report 6: Shared, Plural and Cultural Values of Ecosystems. UK National Ecosystem Assessment.

Kenter, J.O., Bryce, R., Christie, M., Cooper, N., Hockley, N., Irvine, K.N., Fazey, I., O'Brien, L., Orchard-Webb, J., Ravenscroft, N., Raymond, C.M., Reed, M.S., Tett, P., Watson, V., 2016a. Shared values and deliberative valuation: future directions. Ecosyst. Serv. 21, 358–371. https://doi.org/10.1016/j.ecoser.2016.10.006.

Kenter, J.O., Jobstvogt, N., Watson, V., Irvine, K.N., Christie, M., Bryce, R., 2016b. The impact of information, value-deliberation and group-based decision-making on values for ecosystem services: integrating deliberative monetary valuation and storytelling. Ecosyst. Serv. 21, 270–290. https://doi.org/10.1016/j.ecoser.2016.06.006.

Laband, D.N., 2013. The neglected stepchildren of forest-based ecosystem services: cultural, spiritual, and aesthetic values. Forest Policy Econ. 35, 39–44. https://doi.org/10.1016/j.forpol.2013.06.006.

Lindhjem, H., Navrud, S., 2011. Are internet surveys an alternative to face-to-face interviews in contingent valuation? Ecol. Econ. 70 (9), 1628–1637.
Lliso, B., Mariel, P., Pascual, U., Engel, S., 2020. Increasing the credibility and salience of valuation through deliberation: lessons from the global south. Glob. Environ. Chang. 62, 102065. https://doi.org/10.1016/j.gloenvcha.2020.102065.
Lo, A.Y., Spash, C.L., 2013. Deliberative monetary valuation: in search of a democratic and value plural approach to environmental policy. J. Econ. Surv. 27 (4), 768–789. https://doi.org/10.1111/j.1467-6419.2011.00718.x.
Marta-Pedroso, C., Freitas, H., Domingos, T., 2007. Testing for the survey mode effect on contingent valuation data quality: a case study of web based versus in-person interviews. Ecol. Econ. 62 (3–4), 388–398. https://doi.org/10.1016/j.ecolecon.2007.02.005.
Martínez-Espiñeira, R., Amoako-Tuffour, J., 2009. Multi-destination and multi-purpose trip effects in the analysis of the demand for trips to a remote recreational site. Environ. Manag. 43 (6), 1146–1161. https://doi.org/10.1007/s00267-008-9253-9.
Mavrommati, G., Borsuk, M.E., Howarth, R.B., 2017. A novel deliberative multicriteria evaluation approach to ecosystem service valuation. Ecol. Soc. 22 (2). https://doi.org/10.5751/ES-09105-220239.
Mayer, M., Woltering, M., 2018. Assessing and valuing the recreational ecosystem services of Germany's national parks using travel cost models. Ecosyst. Serv. 31, 371–386. https://doi.org/10.1016/j.ecoser.2017.12.009.
Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-Being: Current State and Trends. Island Press, Washington, DC (USA).
Murphy, J.J., Allen, P.G., Stevens, T.H., Weatherhead, D., 2005. A meta-analysis of hypothetical bias in stated preference valuation. Environ. Resour. Econ. 30, 313–325. https://doi.org/10.1007/s10640-004-3332-z.
Nicosia, K., Daaram, S., Edelman, B., Gedrich, L., He, E., McNeilly, S., Shenoy, V., Velagapudi, A., Wu, W., Zhang, L., 2014. Determining the willingness to pay for ecosystem service restoration in a degraded coastal watershed: a ninth grade investigation. Ecol. Econ. 104, 145–151. https://doi.org/10.1016/j.ecolecon.2014.02.010.
Olsen, S.B., 2009. Choosing between internet and mail survey modes for choice experiment surveys considering non-market goods. Environ. Resour. Econ. 44, 591–610. https://doi.org/10.1007/s10640-009-9303-7.
Orchard-Webb, J., Kenter, J.O., Bryce, R., Church, A., 2016. Deliberative democratic monetary valuation to implement the ecosystems approach. Ecosyst. Serv. 21, 308–318. https://doi.org/10.1016/j.ecoser.2016.09.005.
Parker, C., Scott, S., Geddes, A., 2019. Snowball Sampling. SAGE research methods foundations doi:10.4135/.
Pascual, U., Muradian, R., Brander, L., Gómez-Baggethun, E., Martín-López, B., Verma, M., Farley, J., 2010. The economics of valuing ecosystem services and biodiversity. In: Kumar, P. (Ed.), The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations. Routledge, Earthscan, pp. 184–317.
Pascual, U., Balvanera, P., Anderson, C.B., Chaplin-Kramer, R., Christie, M., González-Jiménez, D., Martin, A., Raymond, C.M., Termansen, M., Vatn, A., 2023. Diverse values of nature for sustainability. Nature 1–11. https://doi.org/10.1038/s41586-023-06406-9.
Puhani, P., 2002. The Heckman correction for sample selection and its critique. J. Econ. Surv. 14 (1), 53–68. https://doi.org/10.1111/1467-6419.00104.
Ren, Y., Lu, L., Zhang, H., Chen, H., Zhu, D., 2020. Residents' willingness to pay for ecosystem services and its influencing factors: a study of the Xin'an River basin. J. Clean. Prod. 268, 122301. https://doi.org/10.1016/j.jclepro.2020.122301.
Rosenberger, R.S., Needham, M.D., Morzillo, A.T., Moehrke, C., 2012. Attitudes, willingness to pay, and stated values for recreation use fees at an urban proximate forest. J. For. Econ. 18 (4), 271–281. https://doi.org/10.1016/j.jfe.2012.06.003.
Saarikoski, H., Mustajoki, J., 2021. Valuation through deliberation-citizens' panels on peatland ecosystem services in Finland. Ecol. Econ. 183, 106955. https://doi.org/10.1016/j.ecolecon.2021.106955.
Scarpa, R., Hutchinson, W.G., Chilton, S.M., Buongiorno, J., 2000. Importance of forest attributes in the willingness to pay for recreation: a contingent valuation study of Irish forests. Forest Policy Econ. 1 (3–4), 315–329. https://doi.org/10.1016/S1389-9341(00)00026-5.
Schaafsma, M., Bartkowski, B., Lienhoop, N., 2018. Guidance for deliberative monetary valuation studies. Int. Rev. Environ. Resour. Econ. 12, 267–323. https://doi.org/10.1561/101.00000103.
Sharma, G., 2017. Pros and cons of different sampling techniques. Int. J. Appl. Res. 3 (7), 749–752.
Sherman, L.E., Michikyan, M., Greenfield, P.M., 2013. The effects of text, audio, video, and in-person communication on bonding between friends. Cyberpsychol.: J. Psychosoc. Res. Cybersp. 7 (2).
Smith, K., Holmes, K., Haski-Leventhal, D., Cnaan, R.A., Handy, F., Brudney, J.L., 2010. Motivations and benefits of student volunteering: comparing regular, occasional, and non-volunteers in five countries. Can. J. Nonprofit Soc. Econ. Res. 1 (1).
Stoeckl, N., Hicks, C., Farr, M., Grainger, D., Esparon, M., Thomas, J., Larson, S., 2018. The crowding out of complex social goods. Ecol. Econ. 144, 65–72. https://doi.org/10.1016/j.ecolecon.2017.07.021.
Tapley, B., Okada, S., Redbond, J., Turvey, S.T., Chen, S., Lü, J., Cunningham, A., 2015. Failure to detect the Chinese giant salamander (*Andrias davidianus*) in Fanjingshan national nature reserve, Guizhou Province, China. Salamandra 51, 206–208.
Tongren Goverment, 2025. Converting Ecological Assets into Internationally Significant Resources. viewed April 3, 2025. http://szb.tongren.gov.cn/trrb/content/202503/11/content_60833.html.
Tu, M., Zhang, B., Xu, J., Lu, F., 2020. Mass media, information and demand for environmental quality: evidence from the "under the dome". J. Dev. Econ. 143, 102402. https://doi.org/10.1016/j.jdeveco.2019.102402.
Tucker, J.W., 2010. Selection bias and econometric remedies in accounting and finance research. J. Account. Lit. 29, 31–57.
Turner, R.K., Morse-Jones, S., Fisher, B., 2010. Ecosystem valuation: a sequential decision support system and quality assessment issues. Ann. N. Y. Acad. Sci. 1185 (1), 79–101.
UNESCO, 2018. Fanjingshan. viewed 16 July 2020. https://whc.unesco.org/en/list/1559.
United Nations SEEA-EA, 2021. System of Environmental-Economic Accounting—Ecosystem Accounting. White cover publication. https://seea.un.org/ecosystem-accounting.
Valerio, M.A., Rodriguez, N., Winkler, P., Lopez, J., Dennison, M., Liang, Y., Turner, B.J., 2016. Comparing two sampling methods to engage hard-to-reach communities in research priority setting. BMC Med. Res. Methodol. 16, 1–11. https://doi.org/10.1186/s12874-016-0242-z.
Van Deursen, A.J., Van Dijk, J.A., Peters, O., 2011. Rethinking internet skills: the contribution of gender, age, education, internet experience, and hours online to medium-and content-related internet skills. Poetics 39 (2), 125–144. https://doi.org/10.1016/j.poetic.2011.02.001.
Vargas, A., Lo, A.Y., Rohde, N., Howes, M., 2016. Background inequality and differential participation in deliberative valuation: lessons from small-group discussions on forest conservation in Colombia. Ecol. Econ. 129, 104–111. https://doi.org/10.1016/j.ecolecon.2016.06.009.
Vlaev, I., 2012. How different are real and hypothetical decisions? Overestimation, contrast and assimilation in social interaction. J. Econ. Psychol. 33 (5), 963–972. https://doi.org/10.1016/j.joep.2012.05.005.
Völker, M., Lienhoop, N., 2016. Exploring group dynamics in deliberative choice experiments. Ecol. Econ. 123, 57–67. https://doi.org/10.1016/j.ecolecon.2016.01.006.
Wanek, E., Bartkowski, B., Bourgeois-Gironde, S., Schaafsma, M., 2023. Deliberately vague or vaguely deliberative: a review of motivation and design choices in deliberative monetary valuation studies. Ecol. Econ. 208. https://doi.org/10.1016/j.ecolecon.2023.107820.
Wang, P., Han, L., Zhou, R., Mei, R., Ai, F., Zhong, L., 2017. Application of the deliberation contingent valuation method to the non-use value of resources in the Dalai Lake protected area. Resour. Sci. 39 (5). https://doi.org/10.18402/resci.2017.05.10.
Wang, L., Huang, L., Cao, W., Zhai, J., Fan, J., 2024a. Assessing grassland cultural ecosystem services supply and demand for promoting the sustainable realization of grassland cultural values. Sci. Total Environ. 912, 169255. https://doi.org/10.1016/j.scitotenv.2023.169255.
Wang, L., Jiang, Y., He, Z., 2024b. A semiparametric alternative to the Heckman correction: application with left-censored data on parental transfers. Empir. Econ. 66 (4), 1847–1866. https://doi.org/10.1007/s00181-023-02507-6.
Watson, J.E., Dudley, N., Segan, D.B., Hockings, M., 2014. The performance and potential of protected areas. Nature 515, 67–73. https://doi.org/10.1038/nature13947.
Watts, L., 2016. Synchronous and asynchronous communication in distance learning: a review of the literature. Q. Rev. Distance Educ. 17 (1), 23.
White, H., 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica 817–838. https://doi.org/10.2307/1912934.
Whittington, D., Adamowicz, W., Lloyd-Smith, P., 2017. Asking willingness-to-accept questions in stated preference surveys: a review and research agenda. Ann. Rev. Resour. Econ. 9, 317–336.
Wilson, M.A., Howarth, R.B., 2002. Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation. Ecol. Econ. 41, 431–443. https://doi.org/10.1016/S0921-8009(02)00092-7.
Wolfolds, S.E., Siegel, J., 2019. Misaccounting for endogeneity: the peril of relying on the Heckman two-step method without a valid instrument. Strateg. Manag. J. 40 (3), 432–462. https://doi.org/10.1002/smj.2995.
Xie, Y., 2020. Ecological labeling and wildlife conservation: citizens' perceptions of the elephant ivory-labeling system in China. Sci. Total Environ. 702, 134709. https://doi.org/10.1016/j.scitotenv.2019.134709.
Xie, Y., Qiao, R., Shao, G., Chen, H., 2017. Research on Chinese social media users' communication behaviors during public emergency events. Telematics Inform. 34 (3), 740–754. https://doi.org/10.1016/j.tele.2016.05.023.
Ye, F., Li, J., Shu, D., Shi, L., Ge, F., Pan, W., Wu, G., Shi, C., Li, H., Heliang, L., Xie, X., 2020. Study of characteristics, genesis and evolution of important geological relics in the Fanjing Mountain world natural heritage site, Guizhou Province. Acta Geosci. Sin. 1–11. https://doi.org/10.3975/cagsb.2020.063002.
Zhang, H., 2023. Record High for the Same Period! Mount Fanjing Welcomed 386,000 Visitors in the First Quarter. Colorful Guizhou viewed April 4, 2025. https://baijiahao.baidu.com/s?id=1763302625278696537&wfr=spider&for=pc.
Zhong, L., Buckley, R.C., Wardle, C., Wang, L., 2015. Environmental and visitor management in a thousand protected areas in China. Biol. Conserv. 181, 219–225. https://doi.org/10.1016/j.biocon.2014.11.007.