EVALUATING ECONOMIC VALUE OF URBAN FOREST: HOUSEHOLDS' WILLINGNESS TO PAY IN SOUTH KOREA

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ABSTRACT

Sustainable development policy emphasizes the role of green areas in urban space. Urban residents in South Korea account for 92% of the total population in 2022. Because urban space is expanding, creating urban forests is essential for sustainable development. The Korean government has expanded urban greenery in most cities since 2005 and focuses on expanding the urban forest to 7,000ha by 2027.

This study aims to derive variables that affect the estimation of the value of urban forests using the contingent valuation method (CVM) and quantitatively analyze the households' willingness to pay (WTP) for urban forest expansion. Data were collected through a process where experienced investigators visited households. Excluding unreliable results, a total of 500 valid samples were analyzed. The authors asked how much people would pay to create urban forests through the one-and-one-bounded dichotomous choice (OOHBDC) model. Zero WTP was applied through the spike model. The estimation results of the model were statistically significant at the 5% significance level.

The average monthly WTP for urban forest development projects was KRW 794 per household (USD 0.60). These results are significant because people in South Korea rarely pay fees for accessing open spaces such as national parks. In addition, respondents' education level, residence, income, and pre-recognition level were found to affect WTP significantly. However, gender and age did not affect WTP. Urban residents agreed that creating such green spaces would help respond to climate change. These results help evaluate the economic benefits of responding to climate change by securing green spaces in cities.

1 INTRODUCTION

The United Nations' Sustainable Development Goal (SDG11) on sustainable cities and communities emphasizes the significance of urban green spaces (UGS) (Cobbinah and Nyame, 2021). Over recent decades, more people globally have lived in urbanized settings than not. Urban people consume more energy than their rural counterparts, and urbanization contributes to increased carbon dioxide emissions(Little *et al.,* 2016). In a context where urbanization accelerates climate change, the climate adaptation and mitigation benefits provided by UGS and vegetation have garnered significant attention from policymakers.

The urbanization rate in South Korea has surged from 27% in 1960 to approximately 81% by 2021(United Nations, 2022). This rapid urbanization process has led to an increase in energy consumption. Energy consumption in the building and transportation sectors in 2021 increased by 132% and 146%, respectively, compared to 2000 (Korea Energy Economics Institute, 2023). In response to the rising demand for energy, the Korean government has focused on enhancing the climate change mitigation functions of UGS. Among other things, Urban forests (UF) contribute indirectly to carbon reduction by reducing the urban heat island effect and increasing the energy efficiency of buildings

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(Nowak *et al.,* 2017; Steenberg *et al.,* 2023). Since 2005, the government has implemented UF creation projects and plans to expand the area of UF to 7,000 ha by 2027 (Korea Forest Service, 2019).

The government enacted the "Creation and Management of Urban Forest Act" (referred to as the "Urban Forest Act") in June 2021 to systematically expand UF. Subsequently, in December 2022, UF were officially recognized as carbon sinks. However, creating green spaces in areas other than state-owned land is challenging due to the scarcity of available land and the high cost of land acquisition in urbanized areas. In other words, creating UGS requires significant financial investment. Indeed, the Korea Forest Service allocated a budget of 240 billion KRW for the UF creation project in 2019 and 330 billion KRW in 2020, yet the effectiveness of these investments has yet to be determined.

Market mechanisms alone cannot fully evaluate the positive effects of UF creation. Some studies have sufficiently demonstrated that public perception can provide opportunities for public participation in decision-making on climate change mitigation policies (Kim and Kang, 2016; Choi and Kim, 2022). Therefore, the central government and local municipalities must adequately consider public evaluation and acceptance of UF creation.

This study examines the public's willingness to pay (WTP) for UF creation projects to measure public acceptance. The aim is to elucidate the public's preferences regarding the benefits of UF and their readiness to support these benefits financially. Furthermore, the Contingent Valuation Method (CVM) is utilized to gather information on the external advantages of UF creation projects. The paper's organization is as follows: The second chapter delineates the research methodology, the third chapter articulates the findings and engages in discussion, and the concluding chapter presents the summative conclusions.

2 MATERIALS AND METHODS

2.1 Method: CV

Transaction prices can evaluate the economic value of goods or services traded in the market. However, for goods not traded in the market, such as the UF creation projects evaluated in this study, the stated preference method, which determines the economic value of a product or service based on survey responses, is used.

The stated preference method is further divided into the CVM and Choice Experimentation (CE). CVM estimates the economic value of the subject under study by directly asking respondents about their WTP. In contrast, CE indirectly estimates the value of the subject by evaluating the relative worth of its various attributes (Pearce and Özdemiroğlu, 2002). This research aims to quantitatively estimate the public WTP, thereby understanding the public's preferences for UF creation projects. Therefore, this study employs CVM. Additionally, CVM involves presenting respondents with hypothetical scenarios and asking them to indicate their choices, a research approach whose procedures are somewhat standardized (Haab *et al.,* 2020).

The CVM application procedure can be divided into four stages. First, the object of valuation is selected, and necessary information is provided to enable respondents to make an informed valuation. The second stage involves deciding on the survey area, sample size, the unit of inquiry, and the method of investigation as well as conducting sample selection and questionnaire development. The third part consists of carrying out the survey and analyzing the results. The last stage involves deriving meaningful insights from the results. The details of each stage will be described in subsections.

2.2 Identification of the Subject for Valuation

Transaction prices can evaluate the economic value of goods or services traded in the market. However, for goods not traded in the market, such as the UF creation projects evaluated in this study, the stated preference method, which determines the economic value of a product or service based on survey responses, is used.

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In CV research, the subject of evaluation is the transition from the current state to the target state. As delineated above, this study defines the current state as the total area of UF within the country, which amounted to 6,100 ha as of 2022. The target is to expand the UF to 7,000 ha by 2027. Cities with ample green spaces offer several benefits compared to those lacking. Firstly, they can lower urban midday temperatures during summer by 3 to 7°C. Secondly, they can reduce noise pollution from transportation by up to 75%. Thirdly, supplying oxygen to urban areas provides a conducive environment for people to rest comfortably.

This study evaluates the value the public assigns to UF planned for future development. In the survey, each respondent was presented with a concise explanation of the negative aspects of urbanization, the benefits of developing UF, and a brief overview of the government's UF creation projects.

2.3 Survey Design

Careful survey design is crucial for obtaining reliable results. The authors endeavored to draft a questionnaire that reflected the existing literature and policy directions and was easily understandable by respondents. The survey agency's supervisor reviewed the authors' draft to ensure its comprehensibility and to verify that the provided information was sufficient for understanding the subject of evaluation.

The first section of the questionnaire provides preliminary information about the subject of evaluation. Respondents receive information about UF creation projects and are prepared for responding to hypothetical scenarios. The second section features questions to assess the WTP. The current UF area as of 2022 and the target for 2027 are presented to enhance understanding, highlighting potential trade-offs in household budgeting that may arise from allocating funds to UF creation projects. The third part consists of questions regarding the unique characteristics of the respondent or their household, aimed at identifying the social and economic profiles of respondents, such as their place of residence, gender, age, educational attainment, and income level.

The second part of the questionnaire is deemed the most critical. WTP queries are generally categorized into open-ended and closed-ended types. The former presents a challenge for respondents, as they struggle with questions that do not offer predefined options, complicating the interpretation of protest bids - a common occurrence (Mitchell and Carson, 1989). Due to these challenges, open-ended questions are infrequently utilized. Conversely, closed-ended questions do not require respondents to make a direct decision but rather provide a range of bid amounts, asking for a simple "yes" or "no" response. This format is akin to purchasing goods in a market, thereby typically yielding higher response rates and reducing strategic behaviors among respondents compared to open-ended questions. Consequently, this study employs closed-ended questions.

2.4 Implementation of the CV survey

Initially, the research methodology selected was face-to-face household surveys. This method incurs higher costs and requires more time than other survey methods. However, considering the limitations of telephone surveys, which struggle with complex questions due to time constraints, and the representativeness issues of online surveys, the authors chose face-to-face surveys to enhance the reliability of the responses despite the higher costs(Boyle, 2017).

Next, it is imperative to present the payment vehicle that best captures the respondents' willingness to pay (Korea Development Institute, 2012). Specifically, the payment vehicle acts as a guide, accurately helping respondents judge the subject in a hypothetical market. Considering the government's plan to fund UF creation through taxes, this study selected income tax as the payment method familiar to respondents. This income tax would be paid over five years, with the frequency of payment set at once a year.

This study employs the dichotomous choice (DC) method, a type of closed-ended question, with a particular focus on the Single-Bounded Dichotomous Choice (SBDC) model and the more recently

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studied One-and-a-Half-Bounded Dichotomous Choice (OOHBDC) model. The OOHBDC model, as described by Cooper *et al.* (2002), offers the advantage of being easier for respondents to answer and is statistically more efficient than the SBDC model. However, Bateman *et al.* (2009) pointed out that results obtained using this model might violate procedural invariance due to the potential for differing responses to the first and second questions. Additionally, Johnston *et al*. (2017) recommended using the SBDC model to ensure incentive compatibility. Consequently, this research aims to enhance the reliability of the analysis results by comparing the estimates from both the SBDC and OOHBDC models.

2.5 Data Modeling

Unlike the SBDC model, the OOHBDC model can utilize responses to follow-up questions to interpret results. In this model, two predetermined bids, denoted as ${A_i}^L$ and ${A_i}^H$(where ${A_i}^L < {A_i}^H$), are used. Respondents are divided into two groups, each being initially presented with either bid ${A_i}^H$ or ${A_i}^L$. The survey concludes at that point for those first presented with ${A_i}^H$ and responding affirmatively. If the response is negative, a subsequent question about their WTP for ${A_i}^L$ is posed. Conversely, respondents initially presented with ${A_i}^L$ and responding affirmatively are then asked about their WTP for ${A_i}^H$. A negative response to 'a' concludes the survey, considering the response indicative of a zero WTP.

In a survey of 500 individuals, 55% of respondents indicated an unwillingness to pay anything for an UF creation project, underscoring the need for a model that effectively captures a zero WTP. The spike model, grounded in the utility difference model, has been widely adopted by scholars to incorporate instances of zero WTP (Kriström, 1997; Yoo and Kwak, 2002). Within the OOHBDC framework, which elicits binary responses of "yes" or "no", the probability of a "yes" response to a given bid amount, denoted as R, concerning the WTP, denoted as F, can be articulated in Equation (1) and (2).

$$P(\text{"yes"}) = P(F \geq R) = 1 - G_F(R; s_0, s_1) \qquad (1)$$

$$P(\text{"no"}) = P(F < R) = G_F(R; s_0, s_1) \qquad (2)$$

$G_F(\bullet)$ represents the cumulative distribution function of F, with s_0 and s_1 serving as the parameters. Typically, a logistic distribution is employed when addressing the distribution of WTP. The specific form of $G_F(\bullet)$ is as follows:

$$G_F(R; s_0, s_1) = \begin{cases} [1 + \exp(s_0 - s_1 R)]^{-1}, \ if\ R > 0 \\ [1 + \exp(s_0)]^{-1}, \ if\ R = 0 \\ 0, \ if\ R < 0 \end{cases} \qquad (3)$$

The spike is expressed as $[1 + \exp(s_0)]^{-1}$, and the average WTP in the spike model can be calculated as $\frac{1}{s_1}\ln(1 + \exp(s_0))$(Hanemann, 1984).

In this study, the model was extended by substituting s_0 with $s_0 + x'_i\beta$ to analyze the impact of covariates on WTP. Here, a vector of covariates, x'_i, reflecting the socio-economic characteristics of the respondents, and a vector of parameters to be estimated, β, are introduced.

3 RESULTS

3.1 Data

From July 31 to August 18, 2023, a face-to-face survey was conducted in 16 regions across South Korea, excluding Jeju Island. The target was selected randomly based on the population census data from the Korean Statistical Information Service (KOSIS) in 2022. At the time of the survey, the exchange rate was 1 USD to 1,318.47 KRW. Researchers provided respondents with randomly selected bid amounts, structured into five sets: (2,000 / 4,000), (3,000 / 6,000), (5,000 / 8,000), (7,000 / 10,000), and (9,000 / 12,000) KRW. Each respondent was then asked to express their willingness to pay, starting from either the lower or higher amount within the selected set.

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Table 1 summarizes the distribution of responses to the bid amounts among 500 respondents. Of those, 144 respondents in the group initially presented with the lower bid amount indicated a zero WTP. Similarly, in the group initially presented with the higher bid amount, 131 respondents demonstrated no willingness to pay. Overall, 55% of the respondents expressed no willingness to pay. The significant proportion of respondents exhibiting a zero WTP in both bid amount groups emphasizes the necessity for applying a spike model that can accommodate zero WTP.

Table 1: Number of responses for each set of bids in this survey

Bids[a]		**Number of answers**				
First	Second	"yes-yes"	"yes-no"	"no-yes"	"no-no"	Totals
2,000	4,000	-	15	14	21	50
3,000	6,000	-	9	22	19	50
5,000	8,000	-	2	18	30	50
7,000	10,000	-	2	14	34	50
9,000	12,000	-	-	10	40	50
	Totals	-	28	78	144	250
First	Second	"yes"	"no-yes"	"no-no-yes"	"no-no-no"	Totals
12,000	9,000	-	-	17	33	50
10,000	7,000	-	-	17	33	50
8,000	5,000	-	-	17	33	50
6,000	3,000	-	4	26	20	50
4,000	2,000	-	8	30	12	50
	Totals	-	12	107	131	250

Note: [a] The unit is Korean won (USD 1.0 = KRW 1,318.47 at the time of the survey

3.2 Estimation Results of the Model

As previously mentioned, the OOHBDC model allows for using responses to follow-up questions to analyze results. However, it is imperative to ensure the validity of the analysis by assessing the presence or absence of hypothetical bias in the respondents' answers, as noted by Mitchell and Carson (1989). Therefore, comparisons are made with the SBDC model, which utilizes only the responses to the initial question. If there is no significant difference between the outcomes of the two models, it can be inferred that bias is absent. Conversely, should differences arise, adhering to the results estimated by the SBDC model is advisable. Table 2 presents the estimated outcomes of both the SBDC and OOHBDC models.

Table 2: Results derived from the models

Variables	**One-and-one-half bounded model**[d]	**Single bounded model**[d]
Constant	−0.1908 (−2.13)	−0.1968 (−2.19)
Bid amount[a]	−0.7585 (−13.29)[#]	−0.6486 (−11.22)[#]
Spike	0.5476 (24.62)[#]	0.5490 (24.68)[#]
Average of yearly household willingness to pay	KRW 793.97 (USD 0.60)	KRW 924.45 (USD 0.70)
t-values	11.01[#]	14.11[#]
95% CI[b]	KRW 674.45 to 959.41 (USD 0.51 to 0.72)	KRW 763.35 to 1141.89 (USD 0.58 to 0.87)
Log-likelihood	−445.27	−405.25
Wald statistics (*p*-values)[c]	121.25 (0.000)	95.55 (0.000)
Sample size	500	500

[a] The unit is KRW 1,000 (USD 0.76).

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[b] The confidence interval is estimated using Krinsky and Robb (1986) method.
[c] The null hypothesis is that the estimated parameters are jointly zero.
[d] The figures presented within parentheses adjacent to the coefficient estimates represent their corresponding*t*-values.
[#] implies that the estimate carries statistical meaningfulness at the 5% level.

The estimated coefficients for the constant, bid amounts, spikes, and the average WTP per household are all statistically significant at the 5% significance level. Notably, the negative coefficient associated with bid amounts suggests that an increase in the bid amounts results in a decreased probability of receiving positive responses from respondents.

Furthermore, the spike values in each model indicate the likelihood of a zero WTP. It is expected that these values would closely mirror the proportion of respondents who report no willingness to pay. The analysis confirms that the spike values fulfill these expectations. This demonstrates that applying the OOHBDC model yields results similar to those obtained using the SBDC model.

The annual average household WTP estimated by the two models was KRW 794 (USD 0.60) and KRW 924 (USD 0.70), respectively. The latter estimate is KRW 130 (USD 0.10) higher than the former. To determine the statistical significance of this difference, we must examine the confidence intervals for the WTP estimates from both models. Non-overlapping intervals would indicate significant differences between the estimates. The parametric bootstrap technique proposed by Krinsky and Robb (1986), was employed to calculate confidence intervals. According to Table 2, the confidence intervals partially overlap. Thus, significant response bias does not occur in the OOHBDC model. Moreover, adopting it implies a conservative approach since the former value is lower than the latter. Consequently, this study applies the OOHBDC model in subsequent discussions.

3.3 Reflection of Covariates

Covariates are variables that can influence a respondent's probability of giving a positive answer to a bid price. These covariates encompass the personal characteristics of the respondent, such as Education, Gender, and Age, which reflect individual attributes. Variables such as Head, Income, and Area represent the characteristics of the respondent's household. Knowledge variables indicate the respondent's subjective judgment. Both the SBDC and OOHBDC models are statistically significant, with the estimated spike values from these models closely aligning with the proportion of responses indicating zero WTP. These findings are detailed in Tables 3 and 4.

Table 3: Definition of variables used in the model

Variables	Definitions	Mean	Standard deviation
Education	The respondent's education level (1: High school graduate, 2: College, 3: Undergraduate, 4: Graduate degree)	2.26	0.84
Gender	The respondent's gender (0 = Male, 1 = Female)	0.50	0.50
Age	The respondent's age	43.38	11.85
Head	The respondent is the head of household or not (0 = No, 1 = Yes)	0.61	0.48
Income	The respondent's monthly income level (1: Under 1 million KRW, 11: Over 8 million KRW)	7.59	1.62
Area	The respondent's residence (0 = Non-Seoul Metropolitan area; 1 = Seoul Metropolitan area)	0.52	0.50
Knowledge	The respondent's prior knowledge about urban forests (1: To no extent, 4: To a large extent)	3.28	0.70

Table 4: Results derived from the models with covariates

https://doi.org/10.52202/077185-0163

Variables[a]	One-and-one-half bounded model[e]	Single bounded model[e]
Constant	−1.9571 (−4.08) #	−0.1968 (−2.19) #
Bid amount[b]	−2.4889 (−19.62) #	−0.6486 (−11.22) #
Education	−0.4455 (−3.75) #	-0.4592 (−3.83) #
Gender	0.2665 (1.13)	0.1931 (0.80)
Age	−0.0136 (−1.64)	−0.0105 (−1.25)
Head	0.5687 (2.24) #	0.5255 (2.05) #
Income	0.1686 (2.68) #	0.1737 (2.70) #
Knowledge	−1.0026 (−6.73) #	−0.9909 (−6.58) #
Spike	0.5416 (22.23) #	0.5454 (22.41) #
Average of yearly household willingness to pay	KRW 704.61 (USD 0.53)	KRW 828.44 (USD 0.63)
t-values	11.21#	9.80#
95% CI[c]	KRW 595.70 to 845.40 (USD 0.45 to 0.64)	KRW 686.95 to 1,017.16 (USD 0.52 to 0.77)
Wald statistics (*p*-values) [d]	125.67 (0.000)	97.23 (0.000)
Log-likelihood	−394.42	−502.02
Sample size	500	500

[a] They are described in Table 3.
[b] The unit is KRW 1,000 (USD 0.76).
[c] This refers to the confidence interval calculated through in Krinsky and Robb (1986).
[d] The null hypothesis is that the model is mis-specified.
[e] The figures in parentheses next to the coefficient estimates represent the corresponding t-values..
[#] implies that the estimate carries statistical meaningfulness at the 5% level.

All of the coefficient estimates, except for Gender and Age, have statistical significance. It is more useful to focus on the signs of the coefficients for covariate estimates rather than the coefficients themselves, as shown in Table 4. A positive coefficient value indicates that an increase in the magnitude of the variable leads to a higher probability of a positive response to the proposed bid amount. For example, a positive coefficient for Income suggests that individuals with higher incomes are more likely to accept the offered amount. Conversely, a negative coefficient for the Knowledge variable implies that individuals with prior knowledge of UF are less likely to agree to the proposed bid amount.

3.4 Discussion

To assess public acceptance of UF, it is necessary to maintain the representativeness of the sample and ensure it reflects the broader population. The sample is representative if some variables are similar to those in the population. Currently, the proportion of female respondents in the sample is 50.0%, and the average monthly household income falls within the 7.59 interval. The income range of the seventh interval set in the survey questionnaire is between 4 million KRW and 5 million KRW, while the eighth interval is between 5 million KRW and 6 million KRW. Additionally, at the time of the survey, the corresponding figures for the entire population were 50.0% and 5.03 million KRW, respectively. Therefore, there is no significant difference between the sample's characteristics and the overall population's characteristics.

Previously, we considered the mean WTP derived from estimating the OOHBDC model without covariates. The average WTP per household for UF creation is identified as KRW 794 (USD 0.60), which is statistically significant within a 5% confidence interval. According to the Statistics Korea, there are 21,579,415 households in South Korea at the time of the survey. Multiplying the average WTP by this number yields an aggregate WTP for the entire population. Consequently, the total WTP for UF creation in South Korea amounts to approximately KRW 17.13 billion (USD 13 million), indicating the project's substantial value to Korean households.

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Table 5: Estimation of total willingness to pay (WTP)

	Estimates	95% confidence intervals
Mean annual WTP per household	KRW 793.97 (USD 0.60)	KRW 674.45 to 959.41 (USD 0.51 to 0.72)
Total annual WTP	KRW 17.13 billion (USD 13 billion)	KRW 14.55 to 20.70 billion (USD 11.04 to 15.70 billion)

Note: The unit is Korean won (USD 1.0 = KRW 1,318 at the time of the survey).

Given these findings, it can be concluded that UF creation initiatives by governments and local authorities indeed represent valuable policies for the populace. However, based on the outcomes of this study, the authors do not believe that the government can continue to expand UGS indefinitely. Several challenges remain to be addressed.

Firstly, a significant portion of the participants, accounting for 55.0%, reported zero WTP. This reluctance to incur costs for visiting government-established green spaces and parks has been prevalent since the abolition of national park entrance fees in 2007. This sentiment intensified after the additional abolition of entrance fees for cultural heritage sites such as temples in May 2023. As this survey was conducted in August 2023, after the implementation of these policies, the WTP estimated in this study could be lower than that in previous research. Despite enjoying the benefits of green spaces, many individuals perceive it as unreasonable to pay to use UF. However, expanding UF necessitates financial contributions from the public.

Secondly, climate change mitigation policies such as green roofs, green walls, and the construction of zero-energy buildings, which do not require additional land acquisition costs, are being increasingly implemented. Furthermore, research in South Korea indicates that in larger cities with higher populations, implementing projects without requiring additional space enhances the efficiency of financial investments (Ji et al., 2022). Given the current state of urbanization, securing additional areas for UF may necessitate restructuring cities or developing non-urban areas. It remains crucial to provide the public with compelling evidence that further expansion of UF is effective.

This study evaluates public preference toward a specific policy implemented by the Korean government. Our primary goal is to evaluate public willingness to pay for urban forest projects, rather than develop new methodological approaches. The paper focuses on the economic benefits of creating UF to reduce greenhouse gas (GHG) emissions. Our findings reveal a general desire among the public for improved environmental conditions, yet there is a reluctance to incur additional costs for developing UF. Contrary to previous studies, our results indicate a significantly lower willingness to pay. Direct comparison with other studies is challenging due to differences in valuation methods, sample sizes, and survey timing, which may account for this discrepancy. Nonetheless, our research provides valuable insights for policymakers to understand current public perceptions, thereby assisting in developing informed policies.

4 CONCLUSIONS

The recent increase in GHG emissions has heightened concerns regarding climate change in South Korea. Mitigation policies, represented by GHG reduction efforts, are being implemented across various sectors, including carbon neutrality and RE100 initiatives. Particularly in urbanized areas, maintaining climate change below a 1.5°C increase, as stipulated in the Paris Agreement, necessitates the role of UGS. The government has actively pursued the development of UF for a long time.

This study employs the CV method to estimate the annual average WTP of households for UF creation. The OOHBDC model was adopted to elicit WTP responses. For comparison, the SBDC model, which uses only the first response from the survey, was also applied. The spike model, recognized for its capability to handle zero WTP responses explicitly, was utilized. Consequently, the estimates from the

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OOHBDC model were used for analysis. The estimated average household WTP was 794 KRW (USD 0.60) per year. This estimate is statistically significant at the 5% level, and the sample also accurately represents the population. The total WTP for the entire population of South Korea was calculated to be KRW 17.133 billion (USD 13 million). This economic valuation can serve as a quantitative basis for policymakers when setting policy budgets.

The findings of this study suggest several implications for policymakers. More than half of all households appeared to be either skeptical towards UF creation projects or reluctant to provide financial support. Given that over 90% of the population resides in urban areas, continuing the development of UF necessitates persuading the public of their benefits through enhanced awareness. Additionally, the results of this study have contributed to the literature demonstrating recent trends in climate change mitigation policies. Conducting CV surveys annually over several years and analyzing data to examine how public values change over time could also be beneficial. Furthermore, investigating how values vary by region and identifying other geographical factors that influence value could serve as valuable research topics.

NOMENCLATURE

F	bid amount	(KRW, USD)
R	willingness to pay	(KRW, USD)
G	cumulative distribution function	(–)
P	probability	(–)

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