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Valuation of the Woopo Wetland in Korea: a contingent valuation study

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ABSTRACT. A contingent valuation (CV) method was performed to estimate the conservation value of the Woopo Wetland, Ramsar site, in Korea. The CV survey was rigorously designed to comply with the guidelines for best-practiced CV studies. Respondents overall accepted the hypothetical market and were willing to pay a significant amount (2,731 to 3,960 Korean won = USD 2.10 to 3.05), on average, per household annually to conserve the wetland. These findings have important implications for efforts to consider environmental quality in policy decisions.

1. Introduction

The ecosystem and natural capital stocks contribute substantially to human welfare, both directly and indirectly, and therefore have significant economic value (Costanza *et al*., 1997). Balmford *et al*. (2002) have shown that the costs of conservation are often outweighed by the benefits, and by a significant margin. Thus, numerous studies have been done on ecosystem valuation such as Turner *et al*. (2003) who have summarized the state of the art in ecosystem valuation and offered some future research directions. In the case of wetlands, Söderqvist *et al*. (2000) condensed various studies aimed at estimating the values of wetlands. The global concerns about

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wetlands have led to the establishment of the Convention on Wetlands of International Importance in 1971 and organization of the Global Wetland Economics Network in 1995 as an informal network for social and natural scientists interested in interdisciplinary research.

In Korea, the total economic value of the wetlands was severely underestimated in policy decisions until a few years ago because nonuse benefits from the services of ecosystems have not been considered. As a result, most of the wetlands have been indiscreetly destroyed for the purpose of regional development and commercial exploitation. Thus, policy makers are currently considering the likely effectiveness of regulations and other measures to conserve the wetlands. Policy implications of whether to conduct wetlands conservation actions or not, could, in principle, be deduced from an examination of costs and benefits associated with such actions. An important first step in fostering a productive national debate on wetlands conservation is a better understanding of its conservation value.

This paper, therefore, uses the contingent valuation (CV) as a method to measure the conservation value of the Woopo Wetland, and reports some empirical estimates of the welfare associated with a given ecological park program (EPP). The results show how the public appraise environmental benefits, and whether services of ecosystems are being appreciated enough to justify potentially expensive management policies to ensure environmental sustainability of the inland wetland.

2. Some survey design issues

Several issues relating to the survey can be summarized as follows. First, the survey was undertaken for heads of household or housewives whose ages range from 20 to 65 in the month of June of 2001. The survey was conducted on a face-to-face basis by well-trained interviewers. To draw a representative sample of the population, a professional survey firm extracted a stratified sample of 59 districts in six metropolitan areas, and then randomly selected respondent households within each district. Each district was separated considering the ratio of populations and ages. The basic survey unit was not an individual but the household. Moreover, a pre-test was done with a focus group comprising 30 persons to determine the range of bid amounts for the dichotomous choice (DC) willingness to pay (WTP) questions. Respondents were assigned randomly into ten sub-groups, with each sub-sample being asked a different bid. We finally determined the range from 1,000 to 10,000 Korean won (KRW) with KRW 1,000 intervals. At the time of the survey, USD 1 was approximately KRW 1,300. The survey yielded 540 useable interviews, ten of which were rated by enumerators as being poor quality since they did not provide some of the necessary information for analyzing their WTP. The findings from the survey are therefore based on the analysis of 530 interviews.

Second, we presented the EPP, which covers a nature studying hall, an eco-experience course, and a nature view route, as a policy regarding the conservation of the Woopo Wetland. To provide adequate information concerning the EPP, the survey was communicated to respondents in simple terms and in detail with visual aids such as photographs and blueprints.

Then respondents were asked whether they would be in favor of increased household taxation to conserve the Woopo Wetland.

Third, prior to the WTP survey, we asked respondents about reasons for their having WTP to execute the proposed conservation program. Reasons for respondents' payments indicated that a substantial portion of their value of Woopo Wetland relates to nonuse values. Almost 15 per cent of respondents showed great interest in the need to conserve the Woopo Wetland for reasons relating to their use, whilst nearly 85 per cent revealed nonuse motivations for the conservation. These findings suggest that it is reasonable to assume that part of individual's value of conservation quality stems from nonuse, especially bequest and existence motivations. Therefore, the value estimates calculated in this study correspond to estimates of respondent's total value of the conservation quality of the Woopo Wetland.

Lastly, the income tax was chosen in this study as a payment vehicle for financing the Woopo Wetland conservation. The frequency of the payment is once a year for the next five years and the payment mechanism is an increase of income taxes. The use of taxes as a payment vehicle has well known disadvantages, particularly with regard to incentives (Chilton and Hutchinson, 1999). It is however possible to defend this vehicle if it is a realistic option in the context of the study in question, and because there is some evidence that respondents prefer taxes as a payment vehicle for some public goods because of the 'certainty' they confer in terms of provision compared to voluntary contributions, which might be less 'secure' in terms of good provision. Bateman *et al*. (2003) tested three payment vehicles including taxes and a donation to a charitable trust fund and found the former superior.

3. Model and empirical results

This section focuses on the theoretical aspects of DC–CV surveys based on the utility difference model used by Hanemann (1984, 1989). The DC–CV question asks the respondent to accept or reject a suggested bid for a given environmental change. When each respondent is presented with a bid (A), there are two outcomes such as 'yes' or 'no'. Given the assumption of a utility-maximizing respondent, for respondent $i = 1, 2, \ldots, N$, the log-likelihood function of the DC model takes the explicit form

$$\ln L = \sum_{i=1}^{N} \left\{ I_i^Y \ln \left[1 - G(A_i)\right] + \left(1 - I_i^Y\right) \ln G(A_i) \right\} \tag{1}$$

where $G(A_i)$ is the probability of a 'no' response to A_i, and $I_i^Y = \mathbf{1}$ (ith respondent's response is 'yes') where $\mathbf{1}(\cdot)$ is an indicator function, which is one if the argument is true and zero otherwise. Following the practice of former studies, we formulate $G(A) = [1 + \exp(a - bA)]^{-1}$.

The purpose of conducting a CV study is frequently to obtain a welfare measure, such as mean WTP. One can use these estimation results to generate estimates of mean and truncated mean welfare measures. Hanemann (1984) provided a formula to calculate the mean WTP if

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Table 1. *Estimation results for the WTP model*

Variables	*Estimation results*[a]
Constant	0.814(4.02)*
Bid	−0.298(−7.98)*
Mean WTP (unit: Korean won)[a]	2,731
95% confidence interval[b]	[1,957–3,345]
99% confidence interval[b]	[1,771–3,475]
bootstrapped *t*-value	6.67*
Truncated mean WTP (unit: Korean won)[a]	3,960
95% confidence interval[b]	[3,567–4,405]
99% confidence interval[b]	[3,498–4,502]
bootstrapped *t*-value	15.96*
Number of observations	530
Log-likelihood	−298.97
Wald statistic[c]	107.65*
(*p*-value)	(0.000)
McFadden's pseudo-R^2	0.14
Fraction of correct predictions	0.72

Notes: The numbers in parentheses are *t*-values, computed from the analytic second derivatives of the log-likelihood. [a]At the time of the survey, USD 1 was approximately equal to KRW 1,300. [b]The confidence intervals were calculated by the use of the non-parametric bootstrap method with 5,000 replications. *indicates statistical significance at the 1% level. [c]The hypothesis is that all the parameters are jointly zero and the corresponding *p*-value is reported in the parentheses below the statistic.

WTP must be greater than or equal to zero. It is called truncated mean WTP and derived as $(1/b)\ln[1+\exp(a)]$. In addition, if some respondents view wetland development as beneficial, then their WTP to conserve the wetland could be negative, i.e. they would need to be compensated for not converting the wetland into a farmland or industry complex. To allow for this, we can use the alternative mean WTP formula provided by Hanemann (1989), a/b.

We estimated the DC–CV model by the maximum likelihood estimation method. Table 1 shows the results of this estimation. All the parameters in the model are statistically significant at the 1 per cent level. Using the Wald statistic, the estimated equation is statistically significantly different from zero at the 1 per cent level. The coefficient for the bid is negative, as expected. That is, a higher bid makes a 'yes' response less likely. This result corresponds with the intuitive rationale and economic theory. In addition, estimates of the two types of mean WTP are shown in Table 1. The mean and truncated mean WTP estimates are calculated as KRW 2,731 and KRW 3,960 per household per year, respectively, and statistically meaningful based on their *t*-values.

In addition, we present confidence intervals for the point estimate of mean WTP in order to allow for uncertainty, rather than report the point estimate only. The 95 and 99 per cent confidence intervals computed by

the use of the non-parametric bootstrap method are presented in Table 1. We also estimated the WTP model with covariates (the detailed results are omitted here for brevity). Some covariates such as income and age significantly affect the likelihood of stating 'yes' to a given bid.

Finally, we attempt to expand the sample values to the population estimates in order to obtain at least a preliminary evaluation of the proposed conservation program for governmental policy options. When expanding the sample to the population, one critical concern is the external generalization of the sample values to the population. This is dependent on the representativeness of the sample frame and the survey response rate. As described earlier, the sample frame was a random sample of the households extracted by a professional polling firm and the sample response rate by the face-to-face interview was almost 100 per cent. Thus, our data can be seen to provide accurate figures for social value of conserving the wetland. Using the number of regional households, we can deduce the annual total conservation value. As a result, the annual total conservation value based on the mean WTP is KRW 19.46 billion. Similarly, annual benefit based on the truncated mean WTP value is KRW 28.22 billion.

4. Concluding remarks

The main objective of this study was to measure the conservation value of the Woopo Wetland. This objective was carried out using a DC–CV survey, which complied with most of the guidelines set out by the NOAA panel (Arrow *et al*., 1993). In the survey, respondents utilized the hypothetical market to state their WTP for the proposed conservation program at a particular tax price and then expressed whether they would be willing to pay to improve the environmental conditions of the Woopo Wetland. The results imply that the Woopo Wetland is an important natural resource with considerable conservation value. To be useful for policy purposes, the benefits estimated were aggregated to a relevant population.

These results will provide valuable information to decision makers for developing policies related to environmental development or conservation. For example, let us suppose that the government has a reclamation project for constructing farmlands and industry complexes. If these conservation benefits were incorporated into the economic analysis, the benefit–cost ratio would be much lower and also the final result would be economically undesirable. Moreover, the conservation value of the Woopo Wetland can be utilized as a preliminary standard for various purposes, such as for developing a financing plan to execute the EPP and pricing an entrance fee for an ecological park.

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