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Valuing Recreational Benefits in an Aquatic Ecosystem Area with Contingent Valuation Method: Case of ShirinSou Wetland, Iran

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Abstract

In this study, the recreational value of ShirinSou Wetland of the Kabodarahang County in Hamadan Province, Iran was estimated and the visitors' *willingness to Pay* (WTP) was measured by using *Contingent Valuation Method* (CVM) and *One and One Half Bound model* (OOHB) *dichotomous choice* (DC) questionnaire. The results show that 81 percent of investigating individuals will pay for recreational usage of the studied wetland. Estimated WTP is 44671 IRR (US$ 1.68) for each visitor. The total annual recreational value of this wetland is estimated at about 809 (million IRR) (or US$ 30348). Furthermore, the variables of proposed bids and visitors' monthly income are statistically significant at 1%; so, these two variables are considered as the most important factors affecting visitors' WTP. Also, these tow variables have negative and positive effect on WTP, respectively. Age and level of education were the next effective factors with significant impact at the 10% level. Policy makers can take these values into consideration in the decision-making process of the development of the wetlands.

Keywords:
environment; non-use values; willingness to pay; One and One Half Bound model (OOHB)

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INTRODUCTION

The economic definition of value is in terms of economic behavior in the context of supply and demand. Put simply, it is the maximum amount of goods or service – or money income that an individual is willing to forego (*Willingness to Pay* or WTP) in order to obtain some outcome that increases his welfare. The aim of economic valuation is to secure efficient water resource allocation by providing the same level of value information that would normally be afforded by prices for a market good.

Evaluation and implementation of policies affecting wetlands management may require measurement of the economic value of the policies to individuals and groups. Economic value measures could also assist in developing appropriate "bid prices" for wetlands acres to be included in the wetlands reserve programs. Wetlands are important features in the landscape that provide numerous beneficial services for people and for fish and wildlife. Some of these services, or functions, include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters and maintaining surface water flow during dry periods. These valuable functions are the result of the unique natural characteristics of wetlands. Also wetlands provide endless opportunities for popular recreational activities, such as hiking, boating, hunting, fishing, photography of wetland, trapping and bird watching. Almost everyone likes being on or near the water and the presence of so many fascinating life forms makes wetlands especially enjoyable treasures (Okuyama, 2015). A cause of loss in the biodiversity of wetlands is that developers and policy makers do not recognize the values of wetlands. Thus, benefiting measurement methods have been developed to explain the values of wetland. Here, however, there are problems in valuing wetland. One of the problem is that most wetlands have little related to economic markets, leading to difficulty in collecting individual behavior data for measurements (Shrestha et al., 2002).

Direct use values related to water are also well represented in the studies. These are mainly related to recreational activities such as recreational swimming, boating, fishing, bird watching and walking (Brouwer et al., 2009). Non-market valuation techniques, such as the Travel Cost Method (TCM) and the Contingent Valuation Method (CVM) can be used to measure the economic value of recreation in the aquatic ecosystem Area. CVM applications in the literature range from examining WTP for public projects in urban areas (Weldesilassie et al., 2009) to the protection of vast and isolated areas of tropical forest (Horton et al., 2003). Recently, the use of CVM for improving management or developing sustainable ecotourism in the aquatic ecosystem area has received considerable attention (Brouwer et al., 2009). When it comes to the question of restoration of ecological goods or services, the majority of previous studies involve valuing the restoration of river flows and riparian ecosystems (Ojeda et al., 2008; Loomis et al., 2000). Recreational beach valuation was first considered by Bell and Leeworthy (1990), who found that tourists' value of a beach day in Florida was $34. Oh et al., (2008) surveyed out-of-state respondents in South Carolina's major beach recreation cities to assess the value of added beach access points and other beach attributes. Tourist WTP was $6.60 for additional beach access points and facilities, which multiplied by the number of visitors and trips to South Carolina, yielded an economic benefit of $92.7 million per year. Oh et al. (2010) valued attributes greatly influenced by beach managers and coastal communities including the number of beach access points, congestion control, the degree of development, and other relevant regulations among tourists and residents.

Kosz (1996) estimated the benefits of conserving a wetland area and endangered species, etc. by the CVM with the hypothetical development project scenario, resulting that conserving wetlands in a natural state might be more economically efficient than developing the areas. Amigues et al. (2002) estimated the benefits of improving water quality and habitats of waterfront wild fowls in wetlands by designing hypothetical scenario of improving wetland qualities (e.g. water quality and number of waterfront wild fowls increase by 10%). They found that respondents' answers on the benefits differed when using different questionnaire formats in a survey. Birol and Cox (2007) estimated the benefits of designing alternative management scenarios on biodiversity status, open water surface area status and so on, resulting that wetland qualities have significant effects on human society. Hanley et al. (2006) estimated water quality improvement benefits by comparing the status quo and the hypothetical improvement status of ecology, aesthetics/ appearance, and river banks. Similarly, Carlsson et al. (2003) estimated the benefits of the biodiversity of animals and plants in a wetland. Milon and Scrogin (2006) estimated the benefits of a wetland area and species, and Wang et al., (2007) estimated the benefits of numbers of plant species. The previous studies indicate that not only wetlands but also its attributes have significant roles in both ecology and human society through the benefit estimations. In Iran, Pazhouyan and Falihi (2008) determined the recreation value of Anzali Wetland for which the travel cost approach based on household production function was used. The result of this study indicated that distance and travel expenses had significant effects on the provision of recreation services. Under competitive condition, the marginal cost of recreation was estimated to amount to IRR, 1100000 per day. Fatahi and Fathzade (2012) determined the protecting value of Gomishan Wetland in Golestan Province using conditional valuation with double-bounded dichotomous choice questionnaire. The results indicate that the average people willingness to pay for wetland conservation was $6.58 and $35.41 per year for each person and household respectively. Nourikamri et al. (2010) determined recreational evaluation of Choghakhoor Wetland. The result of this study indicated that recreational value of international wetland of Choghakhor using zonal travel cost and contingent valuation methods was equal to 440 and 220 billion Iranian IRR, respectively.

In the following section, the study location and data collection process are described. The third section introduces, the contingent valuation method, with a special emphasis on the theory and empirical application of these methods. Section 4 presents the estimation results and interprets the important parameter estimates. In the fifth section, the results are discussed and implications for management areas are emphasized.

MATERIALS AND METHODS

ShirinSou Wetland is a fresh water lake located in 35° 30' to 35° 45' N and 28° 25' to 40° 48' E in the Northwest of Hamedan Province, Iran. Area of ShirinSou Wetland is about 300 ha. ShirinSou Wetland survival is mostly dependent upon the water quantity entrance through the natural springs and seasonal river near the mentioned wetland. The ShirinSou Wetland ecosystem has a great biodiversity and aesthetic value. Every year in winter, many aquatic and wading birds migrate to this wetland such as *Gelochelidon nilotica, Anas platyrhnchos, Ciconia ciconia*, and *Phalacrocorax carbo*. Also, *Cyprinus carpio* is the most common fish species found in this wetland.

This area forms a suitable habitat for waterfowls and a variety of water species. Unfortunately, no organized use of recreational services has been made in this wetland regarding recreational fishing and swimming that only takes place by visitors. Data used for the analysis were obtained from personal interviews conducted at ShirinSou Wetland during summer 2014. The questionnaire for interviews was carefully designed to provide respondents with adequate and accurate information, making them fully aware of the hypothetical market situation. Regardless of their response, respondents were then asked to identify their maximum willingness to pay as an open-ended question. Secondary visitation data were obtained from the "Department of Environmental Protection" in Hamedan Province and the "Regional Water Company of the Ministry of Energy" that manages different uses of the wetland. The secondary data is a census of information of all wetland visitors for the year 2014. The data set contained 22,350 observations. Thus, the annual population of potential users of ShirinSou Wetland is 22,350 visitors. Also, due to a missing survey, the final response rate to the survey was almost 81%, a total of 175 out of 215 questionnaires were accepted for analysis.

Optimal sampling strategy for the selection of offers (bid design approach)

In this study we used Boyle et al. (1988) proposed method to determine optimal sampling strategy for the selection of offers. This sampling procedure is known as the "method of complementary random numbers". This procedure obtains a preliminary estimate of the distribution of values. This can be done in a well-designed pretest survey in which respondents are asked to state a specific value rather than simply answering yes / no to the proposed dollar amounts. Pretest valuation responses are used to construct an empirical c.d.f. that is used to specify the closed-ended offers for the final survey. Closed-ended offers are developed in a four-step process. First, given a sample size of N, N/2 random numbers (probabilities, pi's) are generated from a uniform distribution on the interval (0, 1). Second, an additional N/2 probability (qi's) is derived as:

$$qi = 1 - pi \quad (1)$$

This computation gives the researcher N probability data points, N/2 randomly selected pi's and N/2 calculated qi's. Third, the probabilities (pi's and qi's) are converted to RLs offers using the empirical c.d.f. of values derived from the pretest survey data, and the RLs offers are rounded to even RLs amounts. Finally, the RLs offers are randomly assigned to surveys (Boyle et al., 1988). These prices were derived on the basis of a pretest of 40 open-ended surveys, using the bid design approach in Boyle et al. (1988) shown in Table 1.

Choosing the sample size

Mitchell and Carson (1989) give the following formula for the necessary sample size N:

$$N = \left(\frac{Z\hat{V}}{\delta}\right)^2 \quad (2)$$

where, N is the sample size needed, δ is the percentage difference between the true willingness to pay and the mean of the estimated WTP bids, and Z represents the critical value for t-statistics. Reasonable values for δ lie between 0.05 and 0.3. In this situation we need to have a prior estimate of the coefficient of variation, V, (relative error) where:

$$V = \frac{\sigma}{\overline{\overline{TWTP}}} \quad (3)$$

where, σ is the standard deviation of WTP responses (estimated from pretest) and $\overline{TWTP}$ is the true (or population mean) WTP (estimated from pretest). According to equations 2 and 3:

$$V = 28^{1} / 41.5^{2} = 0.675 \quad (4)$$

$$N = (1.96 \times 0.675/0.1)^2 = 175 \quad (5)$$

In this study to determine the sample size, the Mitchell and Carson formula are applied and 175 visitors were chosen for interviewing on the shore of ShirinSou Wetland to find the recreation value. Equation 2 is based on the assumption that a simple random sampling is used (Bateman et al., 2002).

An innovative part of this study was that a relatively new survey-based method was implemented to ask questions about WTP values. Typically, single bound and double bound approaches are used in dichotomous survey formats. For example, in using single bound elicitation format, a WTP question is asked whether the respondent would like to pay a given amount for a given option, say $10, where the answer would be “yes” or “no”. In double bound elicitation format, depending on the response to the first question, a second question along similar lines with a different value is asked. However, a criticism of the double bound approach is that respondents are not told in advance that there will be a second value. As a result, interviews tend to focus on the first price, with the second price coming as something of a surprise when introduced at a later stage. This surprise may cause discrepancies in the responses to the two prices. To remedy this, Cooper et al (2002) proposed an alternative survey design, one and one half bound (OOHB).

[1] *in thousands of IRR*
[2] *in thousands of IRR*

OOHB Equation

In the OOHB format, the respondent is given two prices in advance $[B_i^D, B_i^u]$ and is told that while the exact cost of the item is not known for sure, it is known to lie within the range bounded by these two prices. One of the two prices is then selected at random, and the respondent is asked whether they would be willing to pay this amount. They are then asked about the other price only if doing so would be consistent with the stated price range (Madani et al., 2012). If the lower price, $[B_i^D]$, is randomly drawn as the starting bid, the three possible response outcomes are (no), (yes, no), and (yes, yes); We denote the corresponding response probabilities by π_i^N, π_i^{YN}, π_i^{YY}. If the higher price $[B_i^u]$ is randomly drawn as the starting bid, the possible response outcomes are (yes), (no, yes) and (no, no). We denote the corresponding response probabilities by π_i^Y, π_i^{NY}, π_i^{NN}. We observe that:

$$\pi_i^N=\pi_i^{NN}\equiv pr\{C_i\leq B_i^D\}=G(B_i^D,\alpha) \quad (6)$$

$$\pi_i^{YN}=\pi_i^{NY}\equiv pr\{B_i^D\leq C_i\leq B_i^U\}=G(B_i^U,\alpha)-G(B_i^D,\alpha) \quad (7)$$

$$\pi_i^{YY}=\pi_i^{Y}\equiv pr\{B_i^U\leq C_i\}=1-G(B_i^U,\alpha) \quad (8)$$

where C represents the maximum willingness to pay, G is distribution function and α represents the parameters of the distribution.

Let $d_i^Y=1$ if either the starting bid is B_i^D and the response is (yes, yes) or the starting bid is Biu and the response is (yes), and 0 otherwise; let $d_i^{NY}=1$ if either the starting bid is B_i^D and the response is (yes, no), or the starting bid is B_i^u and the response is (no, yes), and 0 otherwise; and let $d_i^{NN}=1$ if either the starting bid is B_i^D and the response is (no), or the starting bid is B_i^u and the response is (no, no), and 0 otherwise.Then the log likelihood function for the response to a CVM survey using the OOHB format is:

$$\ln L^{OOHB}(\alpha)=\sum_{i=1}^{N}\{d_i^Y\ln[1-G(B_i^u,\alpha)] + d_i^{NN}\ln[G(B_i^D,\alpha)]\} + d_i^{NY}\ln[G(B_i^u,\alpha)-G(B_i^D,\alpha)] \quad (9)$$

We denote the resulting MLE by $\hat{\alpha}^{OOHB}$; the associated information matrix $I^{OOHB}=(\hat{\alpha}^{OOHB})$ is equal to minus the expectation of the Hessian of the maximized log likelihood function in equation (9). Cooper et al. (2002) consider that eliminating the element of surprise has the potential to remove discrepancies in the responses to the two valuation questions, but that it comes at the cost of not always being able to ask the second valuation question. That is, the second question will be appropriate half the time, on average. Due to the advantages of this approach, in this analysis the OOHB has been adopted (Cooper et al., 2002).

When the respondent is asked to pay B$ for the recreational usage of ShirinSou Wetland of Kabodarahang city in Hamadan Province, the individual will accept the offer if it is less than his maximum willingness to pay (B≤C) and refuse otherwise. Conditional mean compensating variation, E (CV|α) is given by:

$$E(CV|\alpha)=\int_0^{\max B}G(B;\alpha)dB=\int_0^{\max B}\left(\frac{1}{1+exp\{-\alpha_0+\alpha_1 B)\}}\right)dB \quad (10)$$

where α_1 is the co-efficient estimate on the bid amount and α_0 is either the estimated constant (if no other independent variables are included) or the grand constant calculated as the sum of the estimated constant plus the product of the other independent variables times their respective means. These conditional welfare measures are obtained as function of the probability of acceptance of the bid amount.

RESULTS AND DISCUSSION

In order to analyze the responses to the OOHB surveys, a Cumulative Distribution Function (CDF) was applied to the OOHB data in order to assess WTP. Statistical analysis of variables and estimating parameters of logit model carried out with SPSS (IBM Corp., Armonk, NY, USA) and Shazam software (Shazam Ltd., London, UK), respectively. For the OOHB dichotomous choice format, the value ranges of bids are

Table 1
Bids Design for OOHB Dichotomous Choice Questions

Bid range (in thousands of IRR)	(5,20)	(7.5,25)	(10,30)	(12.5,40)	(15,60)	Total
Number of responses	35	35	35	35	35	175
Percentage	20	20	20	20	20	100

shown in Table 1.

The starting bid value was selected randomly from the set of prices. Similarly, the first price from the two values in the bracket was also randomly selected. Respondents were first told that "the price of admission to ShirinSou Wetland will be somewhere in the range of B_i^D to B_i^U line." One of the prices was selected at random, and the respondent was asked "if the price of this admission were [the selected price], would you buy it?" with a follow-up question using the other price where this was logical. The result of a MLE estimator for contingent valuation method is shown in Table 2.

Following economic theory, bid amount was statistically significant at the 1% level. Both the parameter estimate and the marginal effect had a negative sign. This implies that as the proposed entrance fee shown to respondents was increased, they were less likely to agree to pay the extra money for recreational uses. Income was positively related to maximum WTP for recreational usage of the studied wetland. It means that the probability of acceptance to pay the bid price increases as income goes up. This supports the hypothesis that higher incomes result in larger demand for goods and services. Individuals with higher incomes had more disposable income that could be spent on recreation.

Younger respondents were found to have higher WTP values for recreation uses than respondents who were at least 50. Environmentalism is a recent phenomenon in the developing world, and pro-environment attitudes may be more common among the youngers. Older individuals may also be more skeptical that the additional fees collected would be used for preservation and development of facilities near the wetland. Also from Table 1, it is seen that the coefficient of education variable is positive. It means that the probability of acceptance to pay the bid price increases as education goes up. This is not a surprising result, as these individuals expressed their non-market environmental preferences through the survey.

Given the model test statistics and the highly significant constant parameter, the model is therefore significant and the estimated parameters are reliable descriptors for the recreational value of ShirinSou Wetland. The Esterlla's R^2 measures the portion of variation explained by the model. Esterlla's R^2 is 0.37, which is on the up side. Data on respondents such as gender, household size and members of environmental organizations were collected and tested as additional parameters. However, these were found to be not significant, indicating that they are not explanatory variables in the calculation of WTP. Therefore, these variables were not included in the final model. In this regression, we test collinearity by Principle Component (PC) and Heteroscedasticity by Breusch–Pagan (BP). According to Table 2, PC and BP show that there is no problem in the estimation of regression in collinearity and heteroscedasticity.

Economic benefit estimates

Using Eq (10), mean WTP was calculated as the mean of the other independent variables. The resulting mean willingness to pay for the recreational value of ShirinSou Wetland per visitor was 4.4671 (in10,000 IRR;) (equals to US$-1.68)[3] for each visit in 2014. The resulting logit curve is well balanced and does not exhibit any 'fat tail' at the high bid amount. This is evidenced by median WTP being 6.1771 (in 10,000 IRR; equals to US$ 2.32) nearly equal to the mean. Also, the annual population of potential users of ShirinSou Wetland is 22,350 visitors, of which 81 % are willing to pay for recreational uses. Therefore the total annual recreational value of this wetland is estimated at about 809 (in million IRR) (or US$ 30,348).

[3] *At the time of the survey 1 US$=26648 (in September of 2014)*

Table 2
Logit Results of the Dichotomous Choice CV Experiment with One and One Half Bound (OOHB) Format

variable	Co-efficient	t-statistic	Standard error	Marginal effect
Constant	-7.643	-6.67***	1.145	-
Bid amount	-0.367	-4.76***	0.077	-0.1045
Monthly income	0.0068	4.25***	0.002	0.0019
education	0.134	2.31*	0.058	0.0415
Age(younger)	0.052	2.36*	0.022	0.0148
Log-Likelihood Function			-109.71	
Percentage of Right Predictions			0.80	
Esterlla R^2			0.37	
Breusch–Pagan			0.54	

***p<0.01,*p<0.1

CONCLUSION

The purpose of this study was to estimate the recreational use value accrued to visitors to ShirinSou Wetland in the Northwest of Hamedan Province, Iran. Using the OOHB bid function, an expected WTP recreational value of 44,671 IRR (equals to US$ 1.48) per visit per household was estimated at 2014. Visitors' economic value of public beach access allows decision-makers the ability to better compare management policies in their efforts to provide sufficient public beach access through a target effective strategy. The results also could be transferred into other wetlands of the country or the region using benefit transfer techniques.

Assuming that the ShirinSou spring fed wetland supplies 6 million m^3 of water per year, the ecosystem service value (only recreational value) of water is about 135 IRR (equals to US$ 0.0051) per m^3. Current I.R.I agricultural water prices in this region is from 70 to 100 IRR per m^3 (or US$ 0.0026 - 0.0038). Existing prices are not based on the value of the lost ecosystem services such as recreation. The ecosystem cost (only recreational value) of 135 IRR (equals to US$ 0.0051per m^3) is a hidden subsidy currently paid through the loss of nature's services to society. Policy makers can take these values into consideration in the decision-making process of the development of the wetlands (or other water bodies).

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