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Estimating the Value of Improvement in Lake Urmia's Environmental Situation Using Choice Experiment

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Abstract

The Lake Urmia and its satellite wetlands have been selected as a demonstration site for the United Nations Development Program/Global Environment Facility/Department of Environment Conservation of Iranian Wetlands Project. This project aims to demonstrate reduction of the major threats of this wetland protected area coordinated through an integrated management plan. A choice experiment was developed to examine public preferences and elicit their willingness to pay on improvements in lake's indicators toward good environmental status. A pilot choice experiment study was administered in Urmia municipality and the data were analyzed using a random parameter logit model. The results revealed that residents of this municipality might strongly prefer improvement in water quantity and were willing to pay significant amounts to promote current water level to the highest level. Furthermore, water quality, numbers of flamingos and Artemia stock were identified as the next important issues which warranted additional management attention.

Keywords:
Choice Experiment, Lake Urmia, Random parameters logit model, Willingness to pay

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INTRODUCTION

Lake Urmia, as the second hyper-saline lake in the world, is located in northwest Iran. Its basin occupies 52000 km^2 which is 3.15 percent of the entire country (Eimanifar and Mohebbi, 2007) and there are more than five million inhabitants in it. The large surface area of the Lake contributes to regulating microclimate of the area (temperature and humidity), making it very suitable for agriculture. In normal years, the total annual water usage in the basin exceeds 4700 million m^3, of which close to 94 percent is utilized for agriculture. As a Ramsar site and a UNESCO Biosphere Reserve, Lake Urmia has important economic, cultural, aesthetics, recreational, scientific, conservative and ecological values. Its rich biodiversity is one of the most obvious values of the Lake (West Azerbaijan Department of Environment, 2010). Within the ecological zone of Lake Urmia, 27 species of mammals, 212 species of birds, 41 species of reptiles, seven species of amphibians and 26 species of fish species have been recorded. Being home of a unique brine shrimp species (Artemia Urmiana) and seasonal settlement for thousands of migrating birds are considered its specific features (Alipour, 2008; West Azerbaijan Department of Environment, 2008).

During two past decades, unsustainable activities have implemented increasing pressures on the natural resources of Lake Urmia Basin. Intensive agricultural efforts, development of water resources, Shahid Kalantari causeway construction and prolonged drought have aggravated this situation. The water level in the lake has declined significantly, exposing large areas of extremely salty lands vulnerable to wind erosion. Increasing of salinity has caused severe decline in Artemia density in the lake and as a result its capacity to host water birds has significantly declined. It is anticipated that by 2021, more than 6 billion m3 of water will be annually used in the basin of which about 90 percent will be allocated to agricultural consumption. This would result in 25 percent reduction of water inflow into the lake compared with the present condition (West Azerbaijan Department of Environment, 2010). These matters have led to degradation of ecosystem and are threading Lake's environmental, economic and social functions. With respect to current critical ecological situation of the lake, the Integrated Management Plan (IMP) for Lake Urmia basin was created in 2010. The plan aimed to help provincial and national agencies to establish a common framework for programs and attempts considering environmental management principals. This plan consists of three management objectives: integrated management of water resources and agriculture, biodiversity, public awareness raising and participation. For each objective, the key issues and necessary actions which must be undertaken were identified.

Since the resources available for managing Lake Urmia, like any other ecosystem, are limited and the plan is so extended, there are many competing demands. It necessitates us to explore the social context for decision making among the many potentially conflicting management priorities. Wetland management in Iran has received more attention in recent years. In many instances, such efforts are being held back by a lack of relevant information on the nature of issues facing management, the cause of the problem and the effectiveness of management procedures and actions in resolving the problem. Worldwide experiences indicate that sustainability of wetlands depends primarily on the extent to which local communities are active in their management. Local communities should therefore be fully engaged in the conservation and management of the Lake and its satellite wetlands. Provincial office of the Department of Environment in West Azerbaijan possesses the full responsibility for management of the lake. Case of study was the Urmia municipality, located in West Azerbaijan along the 18 km of the lake. Figure 1 shows a map of the area.

Choice Experiment (CE) was originally developed in economics and marketing to determine consumer's preferences for multi-attribute goods (Romano *et al*., 2008). Recently the application of CE has expanded to other fields including environmental management and is becoming a popular mean of environmental valuation (Bennett and Blamey, 2001; Hanley *et al*., 2001).

In this study, revealed preferences methods could not be used due to the lack of data and missing market for public goods. Under such circumstances, quantification in monetary terms is hard, implying a risk of their negligence during decision making. Most often, a Contingent Valuation Method (CVM) has been chosen to estimate consumer's willingness to pay for non-market goods including environmental risk management (Baral *et al.*, 2008). However it is difficult to distinguish the value of each attribute of multi-attribute goods using CVM. For instance, the damages to Lake Urmia caused by some earlier mentioned factors, includes a variety of effects on water level, wildlife and so on. CVM can estimate the total value of protection but it is not able to identify the value of avoiding each effect. Choice experiment, as an alternative stated preferences technique is capable of distinguishing the value of each attribute of multi-attribute goods.

For environmental studies, CE has recently been applied in forest (e.g., Brey *et al.,* 2007; Czajkowski *et al.*, 2009; Horne *et al.*, 2005; Lehtonen *et al.*, 2003; Meyerhoff *et al.*, 2009; Nielsen *et al*., 2007), wetland (e.g., Birol *et al.,* 2006a; Carlsson *et al.*, 2003; Othman *et al.,* 2004, Westerberg *et al*., 2010), energy (e.g., Bergmann *et al.,* 2006; Paulrud and Laitila, 2010), water supply (e.g., Birol and Das, 2010; Hanley *et al.,* 2006), marine (e.g., Eggert and Olsson, 2009; Liu and Wirtz, 2010; Smyth *et al.,* 2009; Taylor and Longo, 2010; Wallmo and Lew, 2011) and air quality (e.g., Collins, 2007; Firouzzareh and Ghorbani, 2011). This paper, as the first of its kind in Iran, provides a suitable background for next researches and brings a novel contribution to the exiting literature. We conducted a choice experiment for investigating public preferences and eliciting their willingness to pay on improvements of lake's indicators and thus on the nonmarket economic benefits of moves toward good environmental status. Certainly, gained results can evolve sustainable and efficient management strategies that are acceptable and protectable from the view point of local communities.

MATERIALS AND METHODS

Choice experiment is a subcategory of the following methods respectively: stated preference, Multi-Attribute Valuation (MAV) and Choice Modeling (CM). The multi-attribute approach is based on the notion that attributes of an environmental good can be used to understand the general tradeoffs which an individual is willing to make. Choice experiment approach also called a multi-attribute version of the milestone of contingent valuation, assumes that goods and services can be described in terms of characteristics (or attributes) and the levels that these characteristics take. It consists of several choice sets, each containing two or more options also said bundles of (environmental) goods. Participants are shown the choice sets in turn and are asked which option they prefer. Each option is described by a set of attributes and each attribute can take one of several levels. One of these attributes is usually the price and a baseline alter-

Figure1. Left map shows the location of Lake Urmia in Iran. The other presents the Lake Urmia general shape. The bold line in the middle of the lake is the Shahid Kalantari causeway and the vertical line over the lake is the border between two provinces of East and West Azerbaijan

native, corresponding to the status quo, is included in each choice set (Romano *et al*., 2008). Similar to CVM, CE is able to estimate the total economic value of an environmental good or service. Some advantages of CE over CVM are that CE is more flexible than standard CV in estimating individual values and provides more information with small sample size as compared to CV. Moreover, it eliminates several biases of CVM (strategic bias, yea-saying bias, embedding effect) (Birol *et al*., 2006b).

The choice experiment method is theoretically grounded in Lancaster's characteristics theory of value (Lancaster, 1966) and Random Utility Models (RUMs) (Luce, 1959; McFadden, 1974). Lancaster stated those consumers' utilities for goods can be decomposed into utilities for composing characteristics. RUMs are discrete choice econometric models, which assume that the respondent has a perfect discrimination capability, whereas the analyst has incomplete information and must therefore take account of uncertainty (Manski, 1977). According to this framework, the indirect utility function for each respondent i is comprised of two parts: a deterministic element (V), which is typically specified as a linear index of the attributes (X) of the j different alternatives in the choice set, and a stochastic element (e), which represents unobservable influences on individual choice. This is shown in equation (1).

$$U_{ij}=V(X_{ij})+e_{ij} \tag{1}$$

Research is focused on a probability function, defined over the alternatives which an individual faces, assuming that the individual will try to maximize his utility. In order to derive an explicit expression for this probability, it is necessary to know the distribution of the error terms. A typical assumption is that they are independently and identically distributed with an extreme value (weibull) distribution. So the probability of any particular alternative j being chosen can be expressed in terms of a logistic distribution. This specification is known as the Conditional Logit Model (CLM) (Greene, 2003; Maddala, 1999; McFadden, 1974):

$$P_{ij}=\frac{exp(V(X_{ij}))}{\sum_{h=1}^{C} exp(V(X_{ih}))} \tag{2}$$

The systematic part of utility of the jet alternative is assumed to be a linear function of attributes:

$$V_{ij}=ASC+\beta_1X_1+\beta_2X_2+\ldots+\beta_nX_n \tag{3}$$

Where X_n represents the attributes and the ASC captures the influence of unobserved attributes on choice relative to specific alternatives.

An important implication of this specification is that selections from the choice set must obey the Independence of Irrelevant Alternatives (IIA) property, which states that the relative probabilities of two options being selected are unaffected by the introduction or removal of other alternatives. If the IIA property is violated, then CLM results will be biased and hence a discrete choice model that does not require the IIA property should be used. A Random Parameter Logit (RPL) model is a generalization of a standard conditional logit. The advantages of a random parameter logit model are that (i) the alternatives are not independent, i.e. the model does not exhibit the independence of irrelevant alternatives property and (ii) there is an explicit account for unobserved heterogeneity (Greene, 2003). The RPL model allows modeling of taste variation among the population by letting one or more of the coefficients have a probability distribution rather than being fixed. The model could be comprehended by thinking of the person i having his own vector of parameters β_i, which deviates from the population mean: $\beta_i=\beta+\eta_i$ such that the utility of each alternative is:

$$U_{ij}=V(X_j(\beta+\eta_i))+e_j \tag{4}$$

The coefficient vector β_i thus varies among the population with a specified density $f(\beta_i)$ and is assumed to be independent of the density of e's. If the individual β_i could be observed, the choice probability conditional on β_i would be the standard logit. However, β_i is not known and cannot be conditioned on. Therefore, to get the unconditional probability, the integral of the standard logit probability over all possible values of β_i is taken. Consequently, the random parameter logit probability is (Hensher and Greene, 2003; Train, 1998):

$$P_{ij}=\int\left[\frac{exp(V(X_{ij}))}{\sum_{h=1}^{C} exp(V(X_{ih}))}\right]f(\beta)d\beta \tag{5}$$

Where the term within brackets is the familiar conditional logit probability formula. Treating preference parameters as random variables requires estimation by simulated maximum likelihood. Procedurally, the maximum likelihood algorithm searches for a solution by simulating k draws from distributions with given means and standard deviations. Probabilities are calculated by integrating the joint simulated distribution (Train, 2003).

The estimated coefficients of the attributes can be used to estimate the tradeoffs between the attributes which respondents would be willing to make. The price attribute can be used in conjunction with the other attributes to determine the willingness to pay of respondents for gains or losses of attribute levels. This monetary value is called the implicit price or part worth of the attribute (Hensher *et al.*, 2005):

$$WTP = -\beta_{\text{nonmarket attribute}} / \beta_{\text{monetary attribute}} \quad (6)$$

The first step in CE design is to define the good to be valued in terms of its attributes and their levels. The good to be valued in this CE study is the Lake management scenario. Significant management attributes pertaining to the Lake Urmia were identified through extensive review of the existing literature, focus groups, expert's consultations and considering Integrated Management Plan for Lake Urmia Basin. As a result of group discussions, backed up by discussion with officers from the Environmental Protection Agency, four environmental attributes were chosen for the CE. These are also in agreement with second and third objectives of IMP. Water level, amount of water salinity, flamingo and Artemia species are concerned as four key attributes. The quantity and quality of water supply to the lake and satellite wetlands are important factors affecting the sustainability of their ecological functioning. Decreasing of water supplies to the lake has caused higher salt amounts per surface unit and accordingly salt crystallization, ecosystem depletion and an inappropriate habitat. Maybe it is the reason of why water level and water salinity attracted a lot of interests. Water birds, obviously flamingo, and Artemia species as the indicators of lake management play a main role in ecosystem and make it internationally important. For each attribute, three levels were assigned. First one represents the existing condition, or the status quo, and the other two ones represents the potential future conditions that could result from varying management intensities. Water level characteristic was divided to long term level (1276m), ecologic level (1274.1m) and minimum level (1271m). Long term level reveals an optimum level. While lake's water level is fluctuating above 1274.1, the lake would continue its normal ecological functions and at minimum level, it would experience a critical situation. Water salinity at optimum, moderate and critical conditions takes some levels such as less than 220 gr/lit, 220-300 gr/lit and more than 300 gr/lit, respectively. Population of flamingo and Artemia were classified considering long term (25 years) and short term (5 years) targets of IMP. It is expected that during the coming 25 years, the population of flamingo and Artemia will increase to 4000 pairs and 40 cysts per liter. Also, during the coming 5 years, 1000 pairs of flamingos and 25 cysts per liter will be breeding. The fifth attribute included in the CE is a monetary one, which is required to estimate welfare change. The price vector used in the design was chosen based on previous contingent valuation survey on Lake Urmia (Maliki, 2011). The payment vehicle was a mandatory annual contribution that all Urmia citizens would make to a fund exclusively devoted to the Lake Urmia management, which would be managed by a trustworthy and an independent body. This payment mechanism does not seem to have evolved into much protest from the general public and it was adopted in the study. Also, it can solve the incentive to free ride (Whitehead, 2006). In the focus group sessions no concern was raised from the participants and they generally accepted the idea that improvements had to be paid for. This may be due to the degradation perceptible effects on the area. The payment levels used are 75000, 150000 and 300000 IRR. The attributes, levels and descriptions are provided in table1.

Considering that with five attributes and their levels, a collective factorial design (Louviere *et al.,* 2000) would have resulted in a

Table 1: Description of attributes and levels used in the CE

Attribute	Levels	Description
Water level	low	1271 m
	moderate	1274.1 m
	high	More than 1276 m
Water quality	low	Salinity over 300 gr/lit
	moderate	220-300 gr/lit
	high	Less than 220 gr/lit
Flamingo	low	Less than 1000 pairs
	moderate	1000 pairs
	high	4000 pairs
Cysts of Artemia	low	Less than 11 cysts per liter
	moderate	11 cysts per liter
	high	40 cysts per liter
Monetary attribute	75000, 150000 and 300000 IRR	Annual contribution to the Lake Urmia management fund

* 1 $ =29291 IRR (2012)

total of 59049 alternative management combinations. As this would constitute an unreasonably large design in practice, a D-optimal fractional factorial design with 36 alternatives was developed and paired into 18 choice sets using an array of procedures and macros in SAS 9.2 (Kuhfeld, 2010). The attributes were assumed to be generic across alternatives with standardized orthogonal contrast coded levels. Moreover, the choice sets were blocked to 6 different versions, each with three choice sets. Each set contained two environmental improvements scenarios and an "opt out" option which is considered as a status quo or baseline alternative whose inclusion in the choice set is instrumental to achieving welfare measures that are consistent with demand theory (Louviere *et al.,* 2000).

The questionnaire consisted of three parts. An introductory section explained the purposes of the survey, lake's current situation, related attributes and their possible levels to the respondents. Also, an example question with instructions presented in this part. Respondents were reminded that there were no right or wrong answers and that we were only interested in their opinions. At the next stage, respondents were asked to answer three choice sets and choose the alternative they had preferred. In addition to the CE questions, data on the respondents' social and economic characteristics, and environmental attitudes were collected. The descriptive statistics of the sample are presented in Table 2. The attitudes of the respondents for environmental issues were elicited through a series of questions on their purchase of environmentally friendly products, environmental publications, interest in watching environmental programs and visiting related sites. These were measured on a Likert-type scale ranging from zero (never) to 4 (always). An Environmental Consciousness Index (ECI), ranging from 0 to 16, was calculated using the Likert scores (similar to Birol *et al.,* 2006a).

The CE survey was administered in September and October of 2012 through some face to face interviews with a total of 180 respondents. The population, from which the sample was chosen, was defined as those 18 years or older individuals living in the municipality of the Urmia County. The municipality population consisted of 680228 citizens according to the latest census conducted in 2011. Personal interviews permitted the researcher to ensure that respondents understood the task descriptions perfectly; meanwhile presenting additional information in case it was needed. From a pretest of the questionnaire, we found that the length of questionnaire should be kept as short as possible. Also, visual aids such as photographs could enable better understanding of questions and make respondents interested. Figure 2 depicts an example of a choice set.

RESULTS AND DISCUSSION

In total, 180 surveys were collected. Since each respondent evaluates three choice sets, a

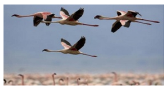
	Alternative A	Alternative B	Current state
water level	High 	Moderate 	I prefer NO lake management
water quality	Moderate 	Low 	
Flamingo	High 	Moderate 	
Artemia	Moderate 	High 	
Payement	15000 IRR	7500 IRR	
I would prefer:	□	□	□

Figure 2: An example of a choice set.

total of 540 choices are observed, which is why CE can provide more information with a small sample size. Descriptive statistics revealed that the average respondent has lived in the Urmia municipality for almost 19 years and 76 percent of the respondents have visited the Lake Urmia more than three times. Average number of household members is 3.9 persons, which is similar to the West Azerbaijan average of 3.7 members per household (National Population and Housing Census, 2011). About half (47 percent) of the respondents are married and there is at least one child younger than 16 years in 40 percent of households. 51 percent of the respondents are female which is similar to the West Azerbaijan average of 49 percent (National Population and Housing Census, 2011), with an average age of 45 years. The disposable monthly household income is on average 7565000 IRR and average number of years that respondent has educated is about 15 years which means 80 percent of respondents have completed at least one semester at the university level in average. Environmental tendency status of respondents was determined using calculated ECI and interval of standard deviation from the mean, which indicates 16, 46, 20.8 and 16.85 percent of respondents have strongly negative, somewhat negative, somewhat positive and strongly positive tendencies, respectively. Also, only 1.7 percent is members in an environmental non-governmental organization.

The CE data were coded using effects coding, rather than dummy variables, as the former will provide estimations that are uncorrelated to the intercept of the model (Louviere *et al.*, 2000). Effects coding means that at least one level of each attribute is not included as an identified variable. The excluded level is coded as negative one and usually is the level that hypothesized to have the most negative effect on environmental amenities. Therefore, in this study the omitted levels were critical levels of four environmental attributes.

The parametric models are specified so that the probability of selecting a particular management scenario is a function of the attributes and the Alternative Specific Constant (ASC),

Table 2: Descriptive statistics of the respondents

Variable	M	SD	Min	Max	Description
Gender	0.51	0.46	0	1	1 if female
Marista	0.47	0.46	0	1	1 if married
Age	44.7	10.13	19	56	Respondent age
Edu	15.2	2.23	8	20	Number of years the respondent has educated
Yrsregion	19.24	13.3	0.5	56	Number of years the respondent has lived in the Urmia municipality
Housize	4.9	1.76	2	11	Household size
Child	0.4	0.66	0	1	1 if respondent has a child that is less than 16 years old
Eci	10.93	2.68	4	16	Environmental consciousness index(0-16)
Member	0.03	0.18	0	1	1 if the respondent is the member of an environmental group
Income	7565000	4591000	2000000	40000000	Income(RLs)
Visit	0.76	0.43	0	1	1 if respondent has visited Lake Urmia more than 3 times

which is specified to equal 1 when either management scenario A or B is chosen and 0 when the status quo option is chosen. Using a dataset consisting of the 540 choices obtained from 180 respondents, the CLM was estimated with Stata11.00. The results from the CLM are reported in the first column of Table 3. Coefficients signs show the influence of attributes on choice probabilities: here, all attribute coefficients (except high level of Artemia) have the expected signs. The signs of environmental attributes are positive, as consumer preference theory predicts, since these attributes are coded to show an increase in environmental quality, which should lead to increased utility. Price is negative and therefore also in accord with standard economic theory. All of the attributes are significant determinants of utility and the overall fit of the model, measured by the adjusted McFadden's ρ^2 of 0.35 is good by conventional standards used to describe probabilistic discrete choice models (Hensher *et al*., 2005; Louviere *et al*., 2000). To test whether the CL model is appropriate, the Hausman and McFadden (1984) test for the IIA property is employed. The results of the test indicate that IIA property is rejected at the 1% level for two cases while it is in conclusive in the third case. Therefore, the CLM may not be the appropriate specification for the estimation and one should be cautious in elaborating further on it. Consequently the data are estimated by using the RPLM.

Table 3: CLM, RPL and RPL with interactions estimates for lake management attributes

Attriburtes and interactions	CLM	RPL1		RPL2	
	Coefficient(S.E.)	Coefficient(S.E.)	Coeff.std(S.E.)	Coefficient(S.E.)	Coeff.std(S.E.)
ASC	-0.32(0.35)				
Moderate quantity	0.94***(0.1)	0.71***(0.15)	0.57**(0.25)	0.68***(0.15)	0.38(0.29)
High quantity	0.36***(0.12)	0.76***(0.23)	0.69**(0.28)	0.78***(0.23)	0.78***(0.26)
Moderate quality	0.21**(0.1)	0.05(0.16)	-0.032(0.27)	0.06(0.15)	-0.036(0.27)
High quality	0.37***(0.12)	0.67***(0.23)	0.49**(0.24)	0.69***(0.22)	0.2*(0.36)
Moderate flamingo	0.23***(0.09)	0.052(0.13)	0.19(0.26)	0.023(0.13)	-0.1(0.3)
High flamingo	0.05(0.11)	0.43**(0.19)	-0.66***(0.23)	0.44**(0.19)	-0.62**(0.23)
Moderate artemia	0.54***(0.1)	0.249(0.15)	0.39**(0.19)	0.018(0.14)	0.33*(0.21)
High artemia	-0.28**(0.12)	0.33* (0.22)	0.3*(0.29)	0.34**(0.22)	0.41*(0.25)
Payment	-0.0003***(0.00005)	-0.0003***(0.00001)		-0.0003***(0.00007)	
Age*payment				0.0000032**(0.0000012)	
Gender*payment				0.0000094***(0.000023)	
Edu*payment				0.0000066*(0.0000037)	
Visit*payment				0.000039**(0.000019)	
Log likelihood	-513	-379		-367	
Likelihood ratio test	169***	177.3***		179***	
ρ^2	0.35				
Sample size	540	540		540	

Standard errors are in parentheses. *p<0.1, **p<0.05 and *** p<0.01

Table 4: marginal WTPs for lake management attributes

Attributes	Moderate quantity	High quantity	Moderate quality	High quality	Moderate flamingo	High flamingo	Moderate artemia	High artemia
WTP(RLs)	21520***	24670***	1917	21777***	751	14000**	571	10764*

*p<0.1, **p<0.05 and *** p<0.01

In order to circumvent the IIA assumption and investigate whether or not the data exhibit unobserved unconditional heterogeneity, the RPL model was estimated. All choice attributes except the monetary payment were specified to be normally distributed (Revelt and Train, 1998; Train, 1998). The results of the RPL1 are reported in the second column of Table 3. All of the lake management attributes are significant factors in the choice of a future management scenario. It is not possible to establish any consensus preferences for moderate levels of water quality, flamingo and Artemia. Nevertheless, signs are as expected a priori and ceteris paribus higher levels of any single attribute increases the probability that a management scenario is selected. In other words, respondents prefer those management scenarios, which result in higher levels of water quantity, water quality, flamingo and Artemia. The sign of the payment coefficient indicates that the effect on utility of choosing a choice set with a higher payment level is negative. RPL model estimations reveal significant derived standard deviations for the high quantity, high quality, high flamingo and both levels of Artemia indicating that the data supports choice specific unconditional unobserved heterogeneity for these attributes and some respondents might prefer lower levels of these. However, these standard deviations are not large enough to affect the overall sign of the coefficients which suggests that the entire sample prefers higher levels of these.

Even if unobserved heterogeneity can be accounted for in RPL1, it fails to explain the sources of heterogeneity (Boxall and Adamowicz, 2002). Detection of sources of observed preference heterogeneity was done in the RPL2 by including variables constructed as interactions between respondent-specific characteristics and choice-specific attributes. In this study, age, gender, number of visits and years of education were considered to be important determinants of WTP and they were interacted with the monetary attribute. The results of the RPLM with interactions are reported in the third column of Table 3. The log-likelihood ratio test rejects the null hypothesis that the regression parameters for the CL model and the RPL model with interactions are equal at 5 percent significance level. Hence, improvement in the model fit can be achieved with the application of the RPL2 and this model is appropriate for analysis of the data set presented in this paper. The RPLM with interactions results reveal that those respondents who are female (similar to Carlsson *et al.*, 2003; Wielgus *et al.*, 2009), elder respondents (likewise Paulrad and Laitila, 2010; Wielgus *et al.*, 2009), those who have higher education years (similar to Bergmann *et al.*, 2006; Birol and Das, 2010; Birol *et al.*, 2006a; Eggert and Olsson, 2009) and those who have visited the Lake Urmia more than three times (like Birol and Das, 2010; Birol *et al.*, 2006a) are more likely to pay higher payments for the management scenario of Lake Urmia.

When the parameter estimates are obtained by the use of the appropriate model, welfare measures, in the form of marginal willingness to pay (MWTP) can be determined by applying Eq.(6). Table 4 reports the MWTP for the average respondent in the sample using the Wald procedure (Delta method) in Stata 11.00. With a fixed cost coefficient and normally distributed attributes, marginal WTP is also normally distributed.

The estimated WTP values for the average respondent indicate that on average a respondent values the improvement in water quantity the most, as they are willing to pay 24670 IRR and 21520 IRR per person per year to ensure that the water level is improved from the current level, which is the lowest level, to the high and moderate levels, respectively. At the second level of importance is improvement in water quality which means decreasing amount of salinity from the current hyper saturation level to the best level. This level is estimated to worth 21777 IRR. The preferred environmental attributes are followed by the highest number of flamingos, with an estimated MWTP of 14000 IRR. At last, respondents are willing to pay 10764 IRR to increase the Artemia stock of the lake to its best level. Looking closer at estimated WTPs, moderate levels for water quality, flamingo and Artemia were not statistically significant compared with high levels. Respondents, thus only seem WTP to reach high levels of these attributes, but not to reach moderate levels. Moreover, it is worth noting that consistency with preference theory is demonstrated by the estimated willingness to pay increasing with increased improvement of the qualitative attributes.

CONCLUSION

The Lake Urmia and its satellite wetlands have been selected as a demonstration site for the UNDP/GEF/DOE conservation of Iranian Wetlands Project. This project aims to demonstrate reduction of the major threats of this wetland protected area coordinated through an integrated management plan. This paper contributes, as one of the first studies of its kind in Iran, to the existing literature on the valuation of wetlands by providing estimates of the welfare economic benefits to society associated with various management scenarios in the Lake Urmia. A choice experiment provides a structured context in which public preferences for ecosystem management can be evaluated quantitatively. Because CE forced respondents to make tradeoffs among attributes, respondents had to decide which ecosystem characteristics were more important to them. The results of choice experiment provide managers with information about how these tradeoffs can be made in a way that maximize public support for ecosystem management. The results indicate that there are positive and significant economic benefits associated with environmental attributes of the Lake Urmia. The relative implicit prices of the attributes used here provide insights that might be useful in designing policy in a range of settings. It was found that respondents may strongly prefer improvement in water quantity and are willing to pay 24670 RLs to promote lowest level to the highest level. What is more, improvement in the water quality, numbers of flamingos and Artemia stock are identified as next important issues for the public and therefore should receive more management attention and priority. Development of a prompt action plan for allocating a percentage of water from the dams of the basin to the Lake, increasing water efficiency especially for agricultural activities (known as the main water use sector) and undertaking volumetric water delivery in this section could be some measures to stop the present negative trend and increase water level gradually. Also, monitoring water quality of Lake and the main rivers, investigating ecologically feasible methods of salt harvesting, providing strict protection to the breeding colony of flamingos, restoring Artemia resources and increasing the production capacity could be mentioned as next influential efforts. Further, there is considerable preference heterogeneity within the public, which characteristics such as age, gender, education and numbers of visits are the sources of this heterogeneity. Thus, the inclusion of environmental training in the educational programs and providing visit programs could be useful. An internal validation question was included in the questionnaire to test the consistency of the results. Respondents were asked to indicate which single attribute was most important to them. The ordering of the attributes by votes from respondents was: water level, water quality, flamingo and Artemia. This shows consistency with the preference results shown in Table 3.

It should however be noted that this study is a small pilot conducted to understand the significance and direction of the public's valuation of different attributes of the Lake Urmia's ecosystem. In order to provide the policy makers with more accurate figures on the costs and benefits of improving Lake Urmia environmentally, a more comprehensive CBA study should be conducted. Estimating various benefits which may be generated by the improvement of the lake and comparing with estimated costs for achieving such improvements can provide policy guidance in a cost-benefit framework.

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REFERENCES

1- Alipour, S. (2008). *Atlas of the Urmia Lake national park.* West Azerbaijan Provincial Directory of Environmental Protection. West Azerbaijan.

2- Baral, N., Stern, M., J., & Bhattarai, R. (2008). Contingent valuation of ecotourism in Annapurna conservation area, Nepal: Implications for sustainable park finance and local development. *Ecological Economics,* 66, 218-227.

3- Bennett, J., & Blamey, R. (2001). *The Choice Modeling Approach to Nonmarket Valuation*. Cheltenham UK and Northampton, MA, USA: Edward Elgar.

4- Bergmann, A., Hanley, N., & Wright, R. (2006). Valuing the attributes of renewable energy investments. *Energy Policy*, 34, 1004-1014.

5- Birol, E., & Das, S. (2010). Estimating the value of improved wastewater treatment: The case of River Ganga, India. *Journal of Environmental Management*, 91, 2163- 2171.

6- Birol, E., Karousakis, K., & Koundouri, P. (2006a). Using a choice experiment to account for preference heterogeneity in wetland attributes: The case of Cheimaditida wetland in Greece. *Ecological Economics,* 60, 145- 156.

7- Birol, E., Karousakis, K., & Koundouri, P. (2006b). Using economic valuation techniques to inform water resources management: A survey and critical appraisal of available techniques and an application. *Science of Total Environment*, 365, 105-122.

8- Boxall, P. C., & Adamowicz, W. L. (2002). Understanding heterogeneous preferences in random utility models: A latent class approach. *Environmental and Resource Economics,* 23, 421-446.

9- Brey, R., Riera, P., & Mogas, J. (2007). Estimation of forest values using choice modeling: An application to Spanish forests. *Ecological Economics*, 64, 305-312.

10- Carlsson, F., Frykblom, P., & Liljenstolpe, C. (2003). Valuing wetland attributes: An application of choice experiments. *Ecological Economics*, 47, 95- 103.

11- Collins, J. P. (2007). *Choice experiments: Application to air quality policy options and investigation of method's incentive compatibility*. Unpublished dissertation, University of Tennessee, Knoxville.

12- Czajkowski, M., Buszko-Briggs, M., & Hanley, N. (2009). Valuing changes in forest biodiversity. *Ecological Economics*, 68, 2910-2917.

13- Eggert, H., & Olsson, B. (2009). Valuing multi-attribute marine water quality. *Marine Policy*, 33, 201- 206.

14- Eimanifar, A., & Mohebbi, F. (2007). Urmia Lake (Northwest Iran): a brief review. *Saline Systems*, 3, 5. Retrieved from http://www.salinesystems.org/content/3/1/5.

15- Firouzzareh, A., & Ghorbani, M. (2011). Investigating welfare effects of air pollution related strategies in Iran, Mashhad. First Conference of Urban Economics. Mashhad, Iran, November.

16- Greene, W. H. (2003). *Econometric analysis,* (5th ed). Macmillan, New York.

17- Hanley, N., Mourato, S., & Wright, R. (2001). Choice modeling approaches: A superior alternative for environmental valuation. *Journal of Economic Surveys,* 15, 435-462.

18- Hanley, N., Wright, R. E., & Alvarez-Farizo, B. (2006). Estimating the economic value of improvements in river ecology using choice experiments: An application to the water framework directive. *Journal of Environmental Management,* 78, 183-193.

19- Hausman, J. A., & McFadden, D. (1984). Specification tests for the multinomial log it model. *Econometrica*, 52, 1219-1240.

20- Hensher, D. A., & Greene, W. H. (2003). The mixed log it model: The state of practice. *Transportation,* 30, 133-176.

21- Hensher, D., Rose, J., & Greene, W. (2005). *Applied choice analysis: A Primer.* Cambridge University Press.

22-Horne, P., Boxall, P. C., & Adamowicz, W. L. (2005). Multiple-use management of forest recreation sites: A spatially explicit choice experiment. *Forest Ecology and Management*, 207, 189-199.

23- Jin, J., Wang, Z., & Ran, S. (2006). Comparison of contingent valuation and choice experiment in solid waste management programs in Macao. *Eco-*

logical Economics, 57, 430-441.
24- Kuhfeld, W. F. (2010). *Marketing research methods in SAS.* SAS institute Inc. Cary, NC, USA.
25- Lancaster, K. (1966). A new approach to consumer theory. *Journal of Political Economics*, 74, 217-231.
26- Lehtonen, E., Kuuluvainen, J., Pouta, E., Rekola, M., & Li, C. (2003). Non-market benefits of forest conservation in southern Finland. *Environmental Science and Policy,* 6, 195-204.
27- Liu, X., & Wirtz, K. W. (2010). Managing coastal area resources by stated choice experiments. *Estuarine, Coastal and Shelf Science*, 86, 512-517.
28- Louviere, J. J., Hensher, D., Swait, J., & Adamowicz, W. (2000). *Stated choice methods: Analysis and applications.* Cambridge University Press, Cambridge.
29- Luce, D. (1959). *Individual choice behaviour*. John Wiley, New York, NY.
30- Maddala, G. S. (1999). *Limited dependent and qualitative variables in econometrics.* Cambridge University Press, Cambridge.
31- Maliki, M. (2011). Estimating Conservative Value of Lake Urmia. Unpublished dissertation, University of Tabriz . Iran.
32- Manski, C. (1977). The Structure of random utility models. *Theory and Dicision*, 8, 229-254.
33- Meyerhoff, J., Liebe, U., & Hartje, V. (2009). Benefits of biodiversity enhancement of nature-oriented silviculture: Evidence from two choice experiments in Germany. *Journal of Forest Economics,* 15, 37-58.
34- McFadden, D. (1974). *Conditional logit analysis of qualitative choice behavior*. In: Zarembka, P., Frontiers in Econometrics. Academic Press, New York.
35- National Population and Housing Census, (2011). Selected findings, The President's Office, Deputy of Strategic Planning and Control, Statistical Center of Iran.
36- Nielsen, A. B., Olsen, S.B., & Lundhede, T. (2007). An economic valuation of the recreational benefits associated with nature-based forest management practices. *Landscape and Urban Planning*, 80, 63-71.
37- Othman, J., Bennett, J., & Blamey, R. (2004). Environmental values and resource management options: A choice modeling experience in Malaysia. *Environment and Development Economics*, 9, 803-824.
38- Paulrud, S., & Laitila, T. (2010). Farmers' attitudes about growing energy crops: A choice experiment approach. *Biomaass and Bioenergy*, 34, 1770-1779.
39- Revelt, D., & Train, K. (1998). Mixed log it with repeated choices: Households' choice of appliance efficiency level. *Review of Economics and Statistics*, 53, 647-657.
40- Romano, D., de Groot, D., Grafakas, S., Hein, L., Nocella, G., & Tassone, V. (2008). *Internet-based valuation and group valuation methodologies*. SENSOR Report Series. Retrieved from http://www.sensor-ip.eu, ZALF, Germany.
41- Smyth, R. L., Watzin, M. C., & Manning, R. E. (2009). Investigating public preferences for managing Lake Champlain using a choice experiment. *Journal of Environmental Management,* 90, 615-623.
42- Taylor, T., & Longo, A. (2010). Valuing algal bloom in the Black Sea Coast of Bulgaria: A choice experiments approach. *Journal of Environmental Management,* 91, 1963-1971.
43- Train, K. (1998). Recreation demand models with taste differences over people. *Land economics*, 74, 230-239.
44- Train, K. (2003). *Discrete choice methods with simulation.* Cambridge University Press.
45- Wallmo, K., & Lew, D.K. (2011). Valuing improvements to threatened and endangered marine species: An application of stated preference choice experiments. *Journal of Environmental Management*, 92, 1793-1801.
46- Westerberg, V. H., Lifran, R., & Olsen, S. (2010). To restore or not? A valuation of social and ecological functions of the Marais des Baux wetland in Southern France. *Ecological Economics,* 69, 2383-2393.
47- Whitehead, J. C. (2006). A practitioner's primer on contingent valuation. In: Alberini, A., Kahn, J., contingent valuation handbook. Edward Elgar.
48- Wielgus, J., Gerber, L. R., Sala, E., & Bennett, J. (2009). Including risk in stated preference economic valuations: Experiments on choices for marine recreation. *Journal of Environmental Management*, 90, 3401-3409.
49- West Azerbaijan Department of Environment. (2008). *Zoning of Lake Urmia national park and satellite wetlands*. Department of Environment, West Azerbayjan.