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Application of Nested Logitech Model for Ecosystem Services Valuation (Case Study: Gavkhony Wetland, Isfahan Province, Iran)

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ABSTRACT: Wetlands as a situ for the growth of native plants, as a habitat for certain species of fish and aquatic birds, and because of their potential economic, cultural and recreational services, are valuable heritage so their protection and conservation is very essential. Mostly due to the absence of wetlands services' valuation, lack of special regulations, and lack of guarantee for these properties, resources and services of wetlands are not utilized appropriately, and destructed and evacuated in a free and unrestricted fashion, leading to inefficiency in use. The purpose of this study is the economic valuation of Gavkhony wetland ecosystem attributes, estimation of implicit price for attributes, impact assessment of socio-economic variables such as age, marriage, indigenous, family size and education on willingness to pay (WTP), and analyzing welfare and compensation variation due to variation of hypothetical policy. The approach being used is choice experiment that is a subset of choice modeling procedure and stated preference method. Data were collected from six different choice experiments provided in the questionnaires, which were filled out by 500 randomly selected households in Isfahan and Varzaneh cities in the spring and summer of 2013. Each questionnaire contained 72 hypothetical policies, 36 choice sets, 2442 observations and 7327 rows of data. Nested Logitech models and Hausman-MacFadden test were used in order to estimate the visitors' WTP for improving attribute levels for Gavkhony wetland. This procedure was used on the basis of multinomial discrete choice analysis of preferences, Lancaster's theory of value and the theory of random utility function. The Hausman-MacFadden test results showed that cross-elasticity between the first and third options was the same. Thus, these two options were placed in the second nest. The results further showed that the visitors had WTP for preserving forest diversity and vegetation of wetland and its surrounding; preserve of natural habitats and organisms life of wetland (bird, fish and animals); wetland hygiene (preventing industrial and domestic effluent, and water salinity); and increasing the water surface (increasing wetland water inlet). The values estimated for these four aspects correspondingly were 8636, 12584, 11553 and 4740 Rials. Some socio-economic variables such as gender, marriage, age, family expenditure, education and being native had a positive impact on the visitors' WTP. The surplus welfareresults showed that in 72 hypothetical policies, option 1 had the most positive welfare, and option 5 had the most negative welfare for the users of Govkhony wetland. The surplus welfare results based on WTP estimation provide important tools for policy making.

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1 INTRODUCTION

Wetlands as a situ for the growth of native plants (Fattahi and Ildoromi, 2011), habitat for certain species of fish and aquatic birds, and because of their economic, cultural, scientific and recreational potential, are valuable heritage. So, their protection is very important. Wetlands are amongst the most productive ecosystems (Abebe *et al.,* 2014). Wetlands have been described both as "the kidneys of the landscape", because of the functions they can perform in the hydrological and chemical cycles, and as "biological supermarkets" for their extensive food webs and rich biodiversity they support (Mitsch and Gosselink, 1993). Due to absence of wetlands services evaluation, lack of special regulations, poorly defined and often no guarantee for their property, resources and services of wetlands are utilized, destructed and evacuated in free and unrestricted conditions (Sharzie and Jalili Kamjo, 2013). Loss of environmental resources wetlands leads to economic loss because these environmental resources are scarce (De Groot *et al.,* 2006). Economic valuation of these resources is to assign to quantify monetary values for goods and services provided by the environmental resources though market prices are not available to assist the managers (Lambert, 2003). Valuation is one, but the main element, in the efforts to improve management of the environmental resources of wetlands (Viet and Yabe, 2014). Evaluating many values of the Gavkhony wetland ecosystem services is of primary importance if we want to convince ourselves and others of the importance of these ecosystems as life-supporting. This is a relatively new science but a promising one in evaluating the consequence of attempts in supporting services provided by the Gavkhony wetland ecosystem. As mentioned above, some commodities of wetlands values are not immediately obvious and have no market values such as biological diversity, amenity, aesthetic beauty, and socio-cultural, scientific, and recreational values of wetlands (Barbier *et al.,* 1977). People benefit from wetland functions or services directly and indirectly. As flood water flows out over a flood plain wetland, the water is temporarily stored; this reduces the peak river level, and delays the time of the peak, which can be a benefit to the riparian dwellers' downstream (Lambert, 2003). The value of wetlands and their associated ecosystem services in the world has been estimated at US$14 trillion annually (De Groot *et al.,* 2006). Lack of recognition and legislation for wetlands leads to ill-informed decisions on management and development; this contributes to the continued rapid loss, conversion and degradation of wetlands.

The aims of the present paper were two-folded. First, the results from the choice experiments are presented. The reason for the focus on choice experiments is that the application of attribute-based methods to wetland valuation is relatively new (Holmes and Boyle, 2005). Second, welfare calculations of decision change on the environment could be made by this method (Meyerhoff *et al.,* 2008). To achieve the above objectives, choice experiment approach as a subset of choice modeling procedure and stated preferences methods was used (Jalili kamjo *et al.,* 2014).

2 THEORETICAL CONSIDERATIONS

Economic valuation can be a powerful tool to aid and improve the wise use and management of global wetland resources (Barbier *et al.,* 1977). There are at least two good reasons for evaluating wetland services and goods (Lambert, 2003):

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1. In difficult financial times, it is not easy for government decision makers to spend taxpayers' money on environmental activities, especially if there is no broad support from the public. Wetland valuation is a way to estimate ecosystem benefits to people, and allows financial experts to carry out a cost-benefit analyzing, which might be in favor of environmental investment. Cost-benefit analysis compares the benefits and costs to the society of policies, programs, or actions in order to protect or restore an ecosystem. It is, therefore, an important tool for environmental managers and decision makers to justify public spending on conservation activities and wetland management.

2. The other good reason is that people are not always aware of the values of wetlands. Many think that they are no more than mosquito breeding areas! By giving objective evidence to skeptical managers and the public of the monetary and non-monetary benefits of wetlands, environmentalists will gain their support. Most people only care about what they love or what brings economic benefit to them. By helping people to improve their living conditions through using and selling wetland goods and services, we will gain strong supporters for our cause (Lambert, 2003).

In the past, wetlands have been undervalued because many of the ecological services, biological resources and amenity values they provided were not bought and sold, and hence, were difficult to quantify the price for them (Barbier *et al.,* 1977). Choice experiment approach has its roots in Lancaster's characteristics theory of value (Lancaster, 1996), combined with random utility theory (Thurstone, 1927; Manski, 1977) and experimental design. It thus shares strong links with the random utility approach to recreational demand modeling using stated preference data (Bockstael, 1996). Here, the respondents are asked to choose between different bundles of (environmental) goods, which are described in terms of their attributes or characteristics, and the level of those attributes. One of these attributes is usually entrance fee (Hanley *et al.*, 1998). Amemiya (1985) provided an applied discussion of how nested logit model can be derived under the assumption of utility maximization. Hensher *et al.* (2005) showed a nice introduction to choice logit models. Marginal values for the attributes of environmental assets such as forest diversity can be estimated from pair-wise choices. These choice pairs are designed so as to allow efficient statistical estimation of the underlying utility function, and to minimize required sample size (Hanley *et al.,* 1998).

Utility-based choice or choice based on the relative attractiveness of competing alternatives from a set of mutually exclusive alternatives is called a *discrete choice situation* (Lancaster, 1996). Discrete choice models are interpreted in terms of an underlying behavioral model, which are then called *random utility maximization* (RUM) model. The decision-maker chooses the alternative with the highest utility. Characteristics of the decision-maker and of the choice alternatives determine the alternative utilities (Greene, 2012). Choice experiments belong to a group of stated preference methods; they establish a hypothetical market (e.g., in surveys) in order to value environmental changes. In contrast to the contingent valuation method, choice experiments are attribute-based, and ask the respondents to make comparisons and choose between the environmental alternatives characterized by a variety of attributes and their level (Meyerhoff *et al.*, 2008). Modelling discrete choice decisions in the context of random utility theory is usually done with the NLM (Jalili *et al.*, 2014). The idea of the NLM lies, therefore, in the grouping of similar alternatives into nests, and thus creating a hierarchical structure of the alternatives (Manski, 1977). The error terms of alternatives within a nest are correlated with each other, and the error

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terms of alternatives in different nests are uncorrelated (Hausman and MacFadden, 1984).

3 REVIEW OF EMPIRICAL STUDIES

The term "Choice Experiments (CE)" has been first used by Louviere and Woodworth (1983), and the CE technique was first applied to environmental management problems by Adamowicz *et al.* (1994) (Hanley *et al.*, 1998) though many applications in other fields (notably marketing and transport economics) predated this method (see Louviere and Woodworth 1983; Louviere 1988; Louviere 1992).

Adamowicz *et al.* (1994) used the CE for recreational preferences estimation for alternative flow scenarios for the Highwood and Little Bow rivers in Alberta. Boxall *et al.* (1996) applied the CE to recreational moose hunting in the Alberta province. Hanley *et al.* (1998) employed the CE for landscape and wildlife protection in Scotland. Hollis *et al.* (1993) concluded that recharges in the Hadejia and Jama are river basins of northern Nigeria that occurred primarily during the flood flows, since the floodplain provided a large surface area and the river bed was often impermeable.

Xu *et al.* (2003), to eliciting WTP for forest biodiversity in Washington State, used fractional factorial design, and designed four choice sets with each time four management plan alternatives than did not have status quo alternative. Mogas *et al.* (2005) provided two welfare measures from a CE about afforestation; one including drift or status quo or alternative specific constant (ASC), and the other excluding it. The welfare measure in the models that includes the ASC was higher but was positive in the two model welfare measures. Horne (2006) used four attributes including initiator of the contract, restrictions on forest use, compensation/ha/year, duration of contract, and cancellation policy for valuation of forest goods and services nationwide in Finland.

Meyerhoff *et al.* (2008) presented the results from two choice experiments that were employed to measure the benefits of changed levels of biodiversity due to nature-oriented silvi-culture in Lower Saxony, Germany. They also discussed different variants of calculating welfare measures for forest management strategies. The results showed that avoiding an underestimation or an overestimation would require differentiation between the respondents who demanded compensation for a move away from the status quo, and the respondents who would not suffer a loss but chose the status quo alternative because of choice task complexity, for instance.

Fleuret and Poirier (2010) used the CL and *Random Parameters Logit* (RPL) models for valuing improvements in water quality to four recreation sites of a river basin in France, in the context of the water framework directive. The results showed that people are willing to pay for improvements in water quality. However, they found that total benefits accruing from such improvements are not sufficient to cover costs of measures. They finally showed that protest bids affected the results. In addition, Viet Khai and Yabe (2014) investigated the economic value of biodiversity attributes that could provide the policy makers with reliable information to estimate welfare losses due to biodiversity reductions and analyze the trade-off between biodiversity and economics. To obtain the non-market benefits of biodiversity conservation, an indirect utility function and WTP for biodiversity attributes were applied using the approach of choice modeling with the analysis of multinomial logit model. The study found that Mekong Delta residents accepted their willingness to pay of 913VND monthly for a 1% increase in healthy vegetation, 360VND for an additional mammal species, and 2,440VND to avoid the welfare losses of 100 local farmers.

Abebe *et al.* (2014) estimated the value of improvement of wetland quality using choice experiment approach of stated preference valuation techniques. The study was based on household level data collected in 2011 from 120 randomly drawn respondents living around two wetlands within a radius of five kilometers in southwestern Ethiopia. The results showed that the local communities were highly concerned about the environmental problems of the wetlands, and they were willing to pay for the improvement of selected attributes of the wetlands. The most preferred attribute was found to be fish stock. Marginal willingness to pay for fish stock was about 5.04 Ethiopian Birr (ETB) while this value was about 2.05 ETB for water purification attributes of the wetland. The compensating surplus, which reflects the overall WTP of respondents for changes from the status quo to alternative improved scenarios, showed that the respondents were willing to pay 39.6 ETB for the improved wetland management interventions.

4 MODEL, DATA AND ETHODOLOGY

The CE method was used to estimate the value of improvements in three components of ecological conditions. The CEs are becoming more and more popular means of environmental valuation (Bennett and Blamey *et al.*, 2001; Hanley, *et al.*, 2001). They are one example of the stated preference approach for environmental valuation, since they involve eliciting responses from individuals in constructed hypothetical markets, rather than the study of actual behavior (Hanley *et al.*, 2006). The CE method is a variant of conjoint analysis (Fleuret and Poirier, 2010). In the context of discrete choice modeling, the most common approach is based on random utility theory (McFadden, 1977). In a RUM theory, by consumption alternatives n that they are attributes of wetland, decision makers i that they are questionnaires responder, so the RUM is:

$$U_{in} = V_{in}\left(Z_i, X_{in}\right) + \boldsymbol{\varepsilon}_{in} = a_n + X_{in}\beta_n + Z_i\lambda_n + \boldsymbol{\varepsilon}_{in} \qquad (1)$$

Where, V_{in} is the deterministic part of utility, ε_{in} is the random part, X_{in} denotes alternative-specific variables of wetland and z_i represents case-specific variables; the probability that individual n will choose option i over other options j is given by (Hanley *et al.*, 1998):

$$\text{Prob}\,(i|\kappa) = \text{Prob}\{V_{in} + \boldsymbol{\varepsilon}_{in} \succ V_{jn} + \boldsymbol{\varepsilon}_{jn}, \forall i, j \in \kappa, i \neq j\} \qquad (2)$$

Depending on the assumptions made for the distribution of the random error term, different models can be derived (Ortúzar and Willumsen, 1994). The set of errors are assumed to follow the generalized extreme-value (GEV) distribution (Greene, 2012):

$$Pr_{jt} = Pr_{j/t}.Pr_t \qquad (3)$$

$T{:}\,\{t = 1, 2\}$ is the number of nests. Let us suppose that the first nest called R_1 with two options, and R_2 had only one option; so $R_1 = (1,2)\ and\ R_2 = (1)$ are symbolically defined options. So if branch t is selected, the probability of choosing option j would be as follows (Greene, 2012; Hausman and MacFadden, 1984):

$$\Pr\,(C_2 = j / C_1 = t) = \frac{\exp(x_{tj}\,\beta_j)}{\sum_{m\in R_t}\exp(x_{tm}\,\beta_m)} \qquad (4)$$

And the probability of choosing branch t is:

$$\Pr\,(C_1 = t) = \frac{\theta_t\{\sum_{m\in R_t}\exp(\eta_{tm}/\tau_t)\}^{\tau t}}{\sum_{k\in T}\theta_k\{\sum_{m\in R_k}\exp(\eta_{km}/\tau_k)\}^{\tau k}} \quad k = 1,\ldots T \qquad (5)$$

Where, τ_k is the dissimilarity variable. If p_k be the correlation coefficient of selection set, then $\tau_k = (1 - p_k)^{1/2}$. Therefore, if $\tau_k = 0$, the correlation is complete, and if $\tau_k = 1$, the distribution reduces to the product of independent extreme-value distributions, and (5) reduces to the multinomial logistic function. We define the inclusive values I_t as:

$$I_t = Ln\left\{\sum_{m\in R_t}\exp\left(x_{tm}\frac{\beta_m}{}\tau_t\right)\right\} \qquad (6)$$

$Where, m$ is the number of options in nest t or R_t. As a result, the likelihood utility function is extracted in this way:

$$Log\ \iota = \sum_{i=1}^{N}\sum\nolimits_{k\in T}\sum\nolimits_{m\in R_k} y_{ikm}\, Log \left\{\Pr(C_{i1}=i)\Pr\left(C_{i2}=\frac{m}{C_{i1}}=1\right)\right\} = \sum_{i=1}^{N}\sum\nolimits_{k\in T}\sum\nolimits_{m\in R_k} y_{ikm} \begin{bmatrix} z_{ik}\alpha_k + \tau_k I_{ik} - Log\left\{\sum_{l\in T}\exp(z_{il}\alpha_l + \tau_l I_{il})\right\} \\ + x_{ikm}\beta_m/\tau_k - Log\left\{\sum_{m\in R_k}\exp(x_{ikm}\beta_l/\tau_k)\right\} \end{bmatrix} \quad (7)$$

y_{ikm} is selected option m at k branch in collection set i, and if option i is chosen, then value of one is given to it, and under other options, the value of zero will be given to this variable. y_{ikm} is a dependent variable, N is the number of choice sets, and i $= 1, 2, \ldots N$.

The Hausman-MacFadden test results showed that cross-elasticity between the first and third options is the same. Thus, the above two options were placed in the second nest. The full information maximum-likelihood estimation for nested logit models was used. The case of correlation between alternatives was assimilated under certain restrictions by the NLM, yielding a block diagonal and homoscedastic covariance matrix (Munizaga and Ortúzar, 1999 a and b).

4.1 Data and demographic characteristics of respondents

Data were extracted from six different choice experiment questionnaires filled out by 500 random households in Isfahan and Varzane cities in 2013. Each questionnaire contained 72 hypothetical policies, 36 choice sets, 2442 observations and 7327 rows of data. Table 1summarises details of demographic characteristics of the respondents.

Figure 1: Decision trees in nested logit model for the present study

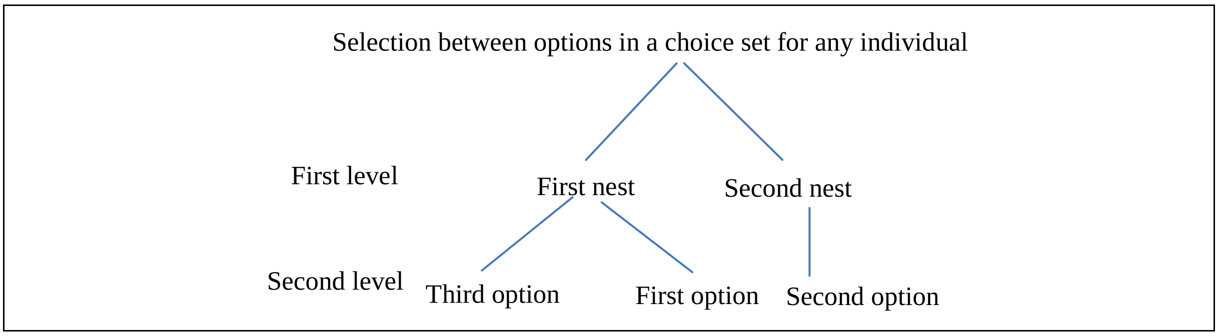

Table 1: Demographic characteristics of the respondents

Family expenditure (10000 Rials)	Frequency %	Age	Frequency (%)	Education level	Frequency (%)	Respondents' other characteristics	Frequency (%)
450 ≤	11.68	70 ≤	2.93	Below Diploma	2.96	Married	73.1
450- 650	23.08	70- 60	22.63	Diploma	3.44	Unmarried	26.9
650-900	29.86	60- 50	15.04	Associate Degree	23.58	Male	88.3
900- 1200	19.90	50- 40	12.37	Bachelor Science	50.85	Female	11.7
1200- 1500	11.06	40- 30	28.05	MSC and above	19.16	Native	71.1
≤ 1500	1.72	≤ 30	18.98			Not native	28.9

4.2 Study area, questionnaire design and choice sets

Wetlands, as defined by the Ramsar Convention (1971), cover a wide variety of habitat types, including rivers and lakes, coastal lagoons, mangroves, peat lands, and even coral reefs (Lambert, 2003). In addition, there are human-made wetlands such as fish and shrimp ponds, farm ponds, irrigated agricultural lands, salt pans, reservoirs, gravel pits, sewage farms, and canals (Lambert, 2003). Gavkhony wetland in the past was a very productive environment. It is cradle of biological diversity, providing the groundwater and primary productivity upon which countless species of plants and animals depend for survival. Gavkhony supports high concentrations of birds, mammals, reptiles, amphibians, fish and invertebrate species. Like other wetlands, Gavkhony wetland is also an important storehouse of plant genetic material (Fattahi and Ildoromi, 2011).

The interactions of physical, biological and chemical components of a wetland, such as soils, water, plants and animals, enable the Gavkhony to perform many vital functions, for example: water storage, storm protection, flood mitigation, prevention of soil erosion (Parvari *et al.*, 2011), groundwater recharge (the movement of water from the wetland down into the underground aquifer), groundwater discharge (the movement of water upward to become surface water in a wetland), water purification through retention of nutrients (Sakizadeh, 2014), sediments, pollutants, and stabilization of local climate conditions, particularly rainfall and temperature. Based on the characteristics theory of value (Lancaster's theory of value) as shown in Table 2, we describe Gavkhony wetland with five attributes, and by making one of these attributes an entrance fee, the marginal utility estimates can be converted into estimated WTP for changes in attribute levels, and welfare estimates obtained for combinations of attribute changes (Hanley *et al.*, 2006). The focus groups helped identify the attributes used in the questionnaire and THE attributes were chosen based on previous studies on wetlands.

Attributes and their levels resulted in a fractional factorial design of $(3^4 \times 4) \times (3^4 \times 4)$ different combinations (Table 2).

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They were then assigned into choice sets using a fractional factorial design (Hanley *et al.*, 2006). With the use of the fractional factorial design, 72 hypothetical policies or options were selected for designing the 36 choice sets in six questionnaires. So each choice set consisted of a three-way choice (hypothetical policies): option A, option B, and drift or status quo or alternative specific constant (ASC). Each respondent answered 6 choice sets. The respondents were asked to choose their preferred alternative in the choice sets (Table 5).

Table 2: Description of the study characteristics (attribute or feature) and the corresponding levels

Attribute \ Levels	1	2	3	4
Preserving the forest diversity and vegetation of wetland and its surroundings	....	% 30 Better*	Status quo**	% 30 Worse***
Preserving the natural habitats and organisms life of wetlands (birds, fish and animals)	....	% 30 Better	Status quo	% 30 Worse
Wetland hygiene (preventing industrial and domestic effluents and water salinity)	......	% 30 Purer	Status quo	% 30 More dirty
Increasing the water surface(increasing wetland water inlet)	....	% 30 Better	Status quo	% 30 Worse
Entrance fee to the wetland area	150000 Rials	10000 Rials	5000 Rials	Status quo[a]

Quality was ***low, **medium *and high

4.3 Hausman-MacFadden test

Conditional logit (CL) model is defined such that it includes only choice-specific characteristics as explanatory variables (Poirier and Fleuret, 2010). An important implication of CL specification is that selections from the choice set must obey the ‘independence from irrelevant alternatives’ (IIA) property (Luce’s Choice Axiom; Luce, 1959). This property states that the relative probabilities of two options being selected are unaffected by the introduction or removal of other alternatives. This property follows the independence of the error terms across the different options contained in the choice set. If a violation of the IIA hypothesis is observed, then more complex statistical models are necessary that relax some of the assumptions used (Hanley, *et al.*, 2006) such as NLM. According to the results reported in Table 3, the Hausman-MacFadden test (1984) statistic at 1% significant level and 5 degrees of freedom becomes $\chi^2_5 = 7.26$ that is smaller than the table statistics $\chi^2_5 = 11.07$. So the null hypothesis cannot be rejected; $\text{Prob} > chi2 = 0.20,$ and the difference between the coefficients of the constrained and unconstrained model is not significant and systematic.

Therefore, in the present study, in order to compare the results, both conditional and nested logit models were used. NLM relaxes the independence of irrelevant alternatives assumption inherent in the conditional logit model by clustering similar alternatives into the nests. NLM estimates a CE model in the presence of IIA.

4.4 Estimation of WTP

When the market prices are not available (e.g., for flood control services, disaster mitigation services or erosion avoidance), the value is established by the WTP for the goods or services, whether or not we actually make any payment (Lambert, 2003):

$$IP_{Product\_attribute} = -\left(\frac{\beta_{Product\_attribute}}{\beta_{monetary\_attribute}}\right) \quad (4)$$

Where, $\beta_{Product\_attribute}$ represents the coefficient of the corresponding non-monetary attribute, and $\beta_{monetary\_attribute}$ represents the marginal utility of income (Meyerhoff *et al.*, 2008). These values enable some understanding of the relative importance people place on various attributes (Bennett and Blamey, 2001).

Table 3: Hausman-MacFadden test

Test: Ho:	**Difference between the constrained and unconstrained model coefficients is not significant and systematic**
chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)	$\chi^2_5 = 7.26$
Prob > χ^2	0.20

Table 4: Estimation of nested logit model (NLM) and conditional logit model

Attribute	CL Model Coefficient [Prob.]	NL Model Coefficient [Prob.]	CL Model WTP (Rials)	CL Model WTP Index	NL Model WTP (Rials)	NL Model WTP Index
Preserving the forest diversity and vegetation of wetland and its surroundings	0.329 [0.000]	0.415 [0.000]	10797.3	64.65	8636.1	68.63
Preserving the natural habitats and organisms life of wetlands (birds, fish and animals)	0.509 [0.000]	0.605 [0.000]	16698.7	100	12584.2	100
Wetland hygiene (preventing industrial, domestic effluents and water salinity)	0.445 [0.000]	0.555 [0.000]	14617.6	87.53	11553.0	91.81
Increasing the water surface (increasing wetland water inlet)	0.170 [0.001]	0.228 [0.022]	5587.8	33.46	4740.1	37.67
Entrance fee to the wetland area	-0.305E-4 [0.002]	-0.481E-4 [0.095]	-	-	-	-
Dummy variable of the first choices	0.575 [0.000]	-	-	-	-	-
Dummy variable of second choices	0.461 [0.000]	-	-	-	-	-
First nest	-	0.6644 [0.000]	-	-	-	-
Second nest	-	0.6650 [0.000]	-	-	-	-

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Table 4 presents the estimates of the two study models. In the following, the results of the NLM are analyzed. Optimization method in NL model was Newton-Raphson and numbers of iterations were 11. Table 4 shows the implicit prices for the significant biodiversity attributes for wetland in both the CL and NL models. The 95% confidence intervals were also reported. All variables were significant at 10% level.

Four attributes in both models had the expected positive signs, and all were statistically significant under the 5% level. Likewise, in both models, entrance fee had the expected negative sign. Entrance fee was not statistically significant at 5% level in the NLM but was significant at 10% level. Table 5 shows the response profile of the questionnaires.

Comparison of the CL and NL models showed that the implicit prices for all attributes in the NLM are less than in the CL model. Also the implicit prices indicated that the attributes preserved the natural habitats, and the organisms life of the wetland (birds, fish and animals) was more important for the respondents than the other three attributes as its implicit prices was highest in both models. The WTP index in Table 4 confirms this actuality. Table 6 indicates the measures of goodness-of-fit in NLM.

4.5 Socioeconomic variables

Assessment of socio-economic variables such as age, marriage, indigenous, family size and education on the attribute values and implicit prices, which are summarized in Table 7, showed that some socio-economic variables had a positive impact on the respondents' WTP. Non-significant socio-economic variables were not entered into the socio-economic conditional logit model, and then the same variables were entered in the socio-economic nested logit model.

Table 5: Discrete response profile

Index	Set	Frequency	Frequency
0	1	1011	41.40
1	2	968	39.64
2	3	463	18.96

Table 6: Goodness-of-fit measures

Measure	Value	Formula
Likelihood Ratio (R)	455.55	2 * (LogL - LogL0)
Upper Bound of R (U)	5365.6	- 2 * LogL0
Aldrich-Nelson	0.1475	R / (R+N)
Cragg-Uhler 1	0.4589	1 - exp(-R/N)
Cragg-Uhler 2	0.1788	(1-exp(-R/N)) / (1-exp(-U/N))
Estrella	0.1649	1 - (1-R/U)^(U/N)
Adjusted Estrella	0.1605	1 - ((LogL-K)/LogL0)^(-2/N*LogL0)
MacFadden's LRI	0.0788	R / U
Veall-Zimmermann	0.2146	(R * (U+N)) / (U * (R+N))

N =Number of observations, K =Number of regressors
L =Likelihood Value in restricted model, L0= Likelihood Value in unrestricted model

Table 7: Estimation model with socioeconomic variables

Independent socioeconomic variables	NL model coefficient [Prob.]	CL model coefficient [Prob.]
Preserving the forest diversity and vegetation of wetland and its surroundings	0.780 [0.017]	.556 [0.000]
Preserving the natural habitats and organisms life of wetlands (birds, fish and animals)	1.356 [0.000]	1.094 [0.000]
Wetland hygiene (preventing industrial, domestic effluents and water salinity)	0.908 [0.006]	.843 [0.000]
Increasing the water surface (increasing wetland water inlet)	0.524 [0.074]	.230 [0.051]
Entrance fee to the wetland area	-.791E-6 [0.092]	-.294E-4 [0.003]
First nest to NLM's dummy variable of the first choices to CL model	0.570 [0.000]	.550 [0.000]
Second nest to NLM's dummy variable of the second choices to CL model	0.528 [0.000]	.449 [0.000]
Gender-preserve forest diversity and vegetation of wetlands	0.551 [0.001]	.294 [0.004]
Marriage- preserving the natural habitats and organisms life	0.455 [0.002]	.355 [0.000]
Gender- preserving the natural habitats and organisms life	0.415 [0.009]	.185 [0.070]
Family expenditure- preserving of natural habitats and organisms life	0.061 [0.156]	.055 [0.059]
Marriage- wetland hygiene	0.179 [0.264]	.250 [0.010]
Gender- wetland hygiene	0.537 [0.001]	.261 [0.011]
Education- wetland hygiene	0.146 [0.052]	.087 [0.085]
Family expenditure- increasing the water surface (increasing wetland water inlet)	0.172 [0.000]	.138 [0.000]
Being native- increasing the water surface (increasing wetland water inlet)	0.369 [0.004]	.253 [0.005]

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Table 8: Calculation of welfare change for NLM

Option / Attribute	1	2	3	4	5	6	7	8	9	10
Preserving the forest diversity and vegetation of wetland and its surroundings	Status quo	Status quo	Status quo	% 30 Better	% 30 Worse	Status quo	% 30 Better	% 30 Better	Status quo	% 30 Better
Preserving the natural habitats and organisms life of Wetland (birds, fish and animals)	% 30 Better	Status quo	% 30 Better	% 30 Better	% 30 Worse	% 30 Better	Status quo	Status quo	Status quo	Status quo
Wetland hygiene (preventing industrial, domestic effluents and water salinity)	Status quo	% 30 Purer	% 30 More dirty	% 30 Purer	% 30 Purer	Status quo	% 30 Purer	% 30 More dirty	% 30 Purer	% 30 Purer
Increasing the water surface (increasing wetland water inlet)	% 30 Better	Status quo	% 30 Better	% 30 Worse	% 30 Worse	% 30 Better	Status quo	% 30 Better	Status quo	% 30 Worse
Entrance fee to the wetland area	10000 Rials	15000 Rials	5000 Rials	10000 Rials	5000 Rials	15000 Rials	5000 Rials	15000 Rials	10000 Rials	5000 Rials
Calculation of welfare (Rials)	7324	-20771	-10781	12261	-47440	16731	-2135	-33365	-270	-1103

4.6 Calculation of welfare change

Since CE models share the same random utility framework as Dichotomous Choice (DC) CVM models (Hanemann, 1994), the welfare estimates from each are directly comparable (Hanley *et al.*, 1998). This study provides details of the various hypothetical policies to planning and managing and putting the results into a wider decision-making framework. Logit models use utility function changes before and after movement in attribute levels to calculate the welfare changes (Bateman; 2003, Hanemann, 1994):

$$CS = \frac{ln\sum_i \exp(V_{i1}) - ln\sum_i \exp(V_{i0})}{\beta_{monetary\_attribute}} \quad (6)$$

CS is the compensation surplus welfare, $\beta_{monetary\_attribute}$ is marginal utility of income, and V_{i0} and V_{i1} are utility function before and after attribute changes, respectively. According to the results reported in Table 8, from all 72 hypothetical policies, 10 options were randomly selected to calculate the welfare changes. The results showed that in 72 hypothetical policies, option 1 had the most positive welfare, and option 5 had the most negative welfare for the users of Govkhony wetland.

5. RESULTS AND CONCLUSION

Choice experiment approach that was used in this study is a subset of choice modeling procedure and stated preferences methods. The purpose of paper was valuation of Gavkhony wetland attributes and estimation of their implicit prices. The impacts of socio-economic variables such as age, marriage, indigenous, family size and education on implicit prices were evaluated. Also the welfare of hypothetical policies change was evaluated. Data were extracted from six different choice experiment questionnaires filled out by 500 random households in Isfahan and Varzane cities in the spring and summer of 2013. There were 6 different questionnaires that contained 72 options, 36 choice sets, 2442 observations and 7327 rows of data. Nested and condition logit models and Hausman-MacFadden test were used in order to estimate the WTP of visitors for improving or degradation of the attribute levels for Gavkhony wetland. These models are on the basis of multinomial discrete

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choice analysis of preferences, Lancaster's theory of value, and the theory of random utility function.

The results of logit models showed that significant portion of the general public values, enriched levels of wetland attributes and WTP for these attributes support the need for management of the attributes obtained from the wetlands. Wetlands provide tremendous economic benefits; for example, water supply (quantity and quality); fisheries (over two third of the world's fish harvest is linked to the health of coastal and inland wetland areas); agriculture (through the maintenance of water tables and nutrient retention in floodplains); timber production; energy resources (such as peat and plant matter; wildlife resources); transport; and recreation and tourism opportunities. Of course, valuing the Gavkhony wetland is not limited only to valuing the economic and monetary benefits. It includes attribute values to all kinds of benefit to humans and/or to nature, including religious values, social values, environmental values (biodiversity, climate change, intrinsic value, etc.), aesthetic values, economic values and alike. The Hausman-MacFadden test showed that we should use nested logit model, and that cross-elasticity between the first and third options was the same; thus, these two options are placed in the second nest. Also it was revealed that the respondents had significant WTP for all attributes. These attribute levels were combined to result in different management options, each associated with a monetary price. So four attributes were selected to represent the concept of Govkhony wetland. Environmental goods and services preserve forest diversity and vegetation of wetlands and their surroundings, preserve natural habitats and organisms life of wetland (birds, fish and animals), wetland hygiene (preventing industrial, domestic effluents and water salinity) and increase the water surface. The implicit prices were 8636.1, 12584.2, 11553.0 and 4740.1 Rials in the nested logit model (NLM). Preserve of natural habitats and organisms life of wetland has maximum WTP and its index was 100 %. In contrast, increase in the water surface had minimum WTP, with the index of 37.67%. Calculation of welfare change results showed that in 72 hypothetical policies, option 1 had the most positive welfare, and option 5 had the most negative welfare for the users of Govkhony wetland. Socio-economic variables such as family expenditure, marriage, education, gender and being native had a positive impact on WTP in the NLM.

The results further showed that in 72 hypothetical policies, option 1 had the most positive welfare, and option 5 had the most negative welfare for the users of Govkhony wetland. The surplus welfare results based on WTP estimation can provide important tools for policy making.

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کاربرد مدل لاجیت آشیانه‌ای در ارزش‌گذاری خدمات اکوسیستمی (مطالعه موردی: تالاب گاوخونی اصفهان، ایران)

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چکیده تالاب‌ها به‌عنوان محل رشد نباتات بومی، زیستگاه گونه‌های خاص حیوانات از جمله آب‌زیان و پرندگان آبزی و به‌دلیل پتانسیل‌های اقتصادی، فرهنگی، علمی و تفریحی- گردش‌گری میراث با ارزشی هستند که حفاظت و حراست آن‌ها اهمیت ویژه‌ای دارد. به‌دلیل فقدان ارزش بازاری خدمات محیط زیستی تالاب‌ها، نبود قوانین و مقررات ویژه، عدم تعریف و تضمین مالکیت، منابع و خدمات اکوسیستمی، تالاب‌ها به‌طور آزاد و نامحدود مورد بهره‌برداری، تخریب و تخلیه قرار گرفته است. هدف این مطالعه برآورد ارزش حفاظتی ویژگی‌های مختلف اکوسیستمی تالاب گاوخونی، برآورد قیمت‌های ضمنی، ارزیابی اثر متغیرهای اقتصادی- اجتماعی هم‌چون سن، تاهل، بومی بودن، بُعد خانوار و تحصیلات بر تمایل به پرداخت نهایی و اثرات رفاهی تغییرات سیاست‌های فرضی با استفاده از روش آزمون انتخاب است. این روش مبتنی بر رویکرد الگوسازی انتخاب و تکنیک ترجیحات بیان شده است. مدل اقتصادسنجی مورد استفاده لاجیت آشیانه‌ای است. داده‌های این مطالعه از ۵۰۰ پرسشنامه آزمون انتخاب که در بهار و تابستان ۱۳۹۲ در شهر اصفهان و ورزنه تکمیل شد، استخراج گردید. هر پرسشنامه شامل ۷۲ سیاست فرضی، ۳۶ مجموعه انتخاب که در نهایت ۲۴۴۲ مشاهده و ۷۳۲۷ ردیف داده استخراج شد. مدل لاجیت آشیانه‌ای و آزمون هاسمن‌مک فادن مبتنی بر تئوری تحلیل انتخاب گسسته چندجمله‌ای ترجیحات، تئوری ارزش لانکستر و تئوری تابع مطلوبیت است. آزمون هاسمن‌مک فادن نشان داد که کشش‌های متقاطع بین گزینه‌های اول و سوم یکسان است و به این دلیل این دو گزینه در یک آشیانه قرار داده می‌شود. هم‌چنین نتایج نشان می‌دهد که بازدیدکنندگان به‌منظور حفظ تنوع و پوشش گیاهی و جنگلی تالاب و محیط اطراف آن، حفظ زیست‌گاه‌های طبیعی و حیات موجودات تالاب (پرندگان، آبزیان و حیوانات)، حفظ بهداشت تالاب (جلوگیری از ورود پسآب‌های صنعتی، خانگی و جلوگیری از شوری آب) و افزایش سطح آب تالاب (افزایش آب ورودی به تالاب) به‌ترتیب ۸۶۳، ۱۲۵۸، ۱۱۵۵ و ۴۷۴ تومان تمایل به پرداخت نهایی دارند. متغیرهای اقتصادی- اجتماعی مانند جنسیت، تاهل، سن، تحصیلات، طبقه مخارج ماهیانه خانوار و بومی بودن باعث افزایش تمایل به پرداخت‌ها شده‌اند. نتایج مازاد رفاه نشان داد که از بین ۷۲ سیاست فرضی، گزینه اول دارای بیش‌ترین مازاد رفاه و گزینه ۵ بیش‌ترین زیان در رفاه را در پی خواهد داشت. نتایج محاسبات مازاد رفاه مبتنی بر تمایل به پرداخت‌های برآورد شده ابزار کاربردی مهمی در اختیار سیاست‌گذاران قرار می‌دهد.

کلمات کلیدی: تحلیل چندجمله‌ای انتخاب گسسته، تئوری لانکستر، مدل‌سازی انتخاب، آزمون هاسمن- مک‌فادن

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