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WILLINGNESS TO PAY ESTIMATION FOR RIVERS BIODIVERSITY CONSERVATION, CASE STUDY OF GUILAN PROVINCE, NORTH IRAN

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Abstract

This study attempts to value the biodiversity and landscape services provided by four river spots: Khalkaei, Ghaleeroodkhan, Pasikhan and Shemroud of the North region of Iran, Guilan. The Contingent Valuation Method were used for estimation willingness to pay (*WTP*) for conserving these areas. This method tries to define the individual's *WTP* of given hypothetical market. It was estimated with a logit model for which indices were obtained based on a maximum precision criterion. The results show that 79.45 % of people were willing to pay for the landscape and biodiversity value of the rivers. Among the variables of the model presented, monthly expenditure and gender had a negative impact and age, education, environmental opinion and income had a positive impact on the *WTP* at 1 % level. The average monthly *WTP* per visitors was calculated as 21,913 Rials (0.74 $). The annual landscape and biodiversity value in terms of *WTP* for the landscape and biodiversity was estimated for Khalkaei, Ghaleeroodkhan, Pasikhan and Shemroud as 2 milliard, 15 milliard, 2 milliard and 8 million Rials, respectively. One unit change in descriptive variables (Education and Environmental opinion) showed the highest change in the probability of a positive response to the *WTP* among individuals. Therefore, in order to facilitate individual's involvement in public decision-making policies, improvement in perceptions of environmental awareness and educational level would seem desirable.

Key words: bid amount, Contingent Valuation Method, education, environmental opinion, logit model.

Introduction

Human beings can receive many ecosystem services from rivers which provide benefits to them, including water supply for municipal, industrial and agricultural consumption, fish habitat and recreation (Loomis et al. 2000). When considering all ecosystem service values, instead of solely focusing on the economic value of the landscape and biodiversity, a more complete perspective is obtained.

Rivers have been interfered by humans for millennia by diverting water for cropland irrigation (Gopal 2016). According to Millennium Ecosystem Assessment (2005), more than half of the major rivers of the world are seriously polluted. The

presence of these pollutants depletes the capacity of rivers and associated inland and coastal ecosystems to provide clean water for social and economic uses.

Millennium Ecosystem Assessment (MEA) is one of the frameworks that try to highlight the relationship between human and nature and advance a powerful vision for the future (Daily et al. 2009). It's vision is to highlight the central roles of ecosystems and environmental resources in supporting human wellbeing and thus incorporate their values into decision making (Farr et al. 2016).

For many years, economists and environmentalists have tried to develop valuation techniques to estimate the benefits of non-market services associated with the environmental resources in monetary terms (Farr et al. 2016). One of the methods is Contingent Valuation Method (CVM). It is the most commonly used among researchers around the world. CVM was proposed for first time by Ciriacy-Wantrup (1947) who believed that the soil erosion prevention generates some ′extra market benefits′ which define as public goods in nature, and one way to estimate the benefit is to elicit the willingness to pay of individuals by a survey method. The first person who used this method was Robert Kenneth Davis when he investigated the benefits of goose hunting through a survey among the goose-hunters (Venkatachalam 2004).

This obviously showed that biodiversity conservation benefits can be assessed through CVM (Abdullah et al. 2015). It's construction is based on hypothetical markets where individuals are ask to detect their willingness to pay for non-market products such as improve water quality to enjoy swimming or diving (Farr et al. 2016).

CVM has been applied by many researchers around the world to estimate the economic values of forests and other environmental services. Jain et al. (2017) used CVM to assess the *WTP* of respondents for benefits derived from forests in India. The results showed the average *WTP* was 2.1 € per respondent per month for all five intangible benefits with more than 43 % of total *WTP* for the intangible benefits 'soil conservation and remediation' and 'improvement in underground water level'. Kerna (2012) obtained the median WTP per entry per car for Hrady and Morelos river sides in Colorado with 13 $ and 7 $ respectively. Lehtonen et al. (2003) also showed that 74 % of respondents are willing to pay for biodiversity conservation of forests in southern of Finland with the mean of *WTP* ranged from 60 $ to 223 $ per household per year. Abdullah et al. (2015) assess the biodiversity value of forest research institute in Malaysia with CVM and they found the mean *WTP* ranges from 53.24 RM to 67.22 RM, which could contribute annual revenue ranged from 66.3 million RM to 83.8 million RM.

Tao et al. (2012) evaluated the forest ecosystem services economic value in three counties in Anfu, Yongxin and Lianhua in China using CVM. Analysis resulted from 170 valid questionnaire out of 200, showed that respondents would pay for forest restoration and protection 238 yuan per year. It is shown that social-economic variables such as income, education level, household population and off-farm work members had the significant influence on individuals WTP.

Recently, in Iran, CVM is the environmental tool to assess non-market goods and services with WTP of individuals for conservation value of biodiversity of forests, recreational values of parks, preservation and reclamation of desert areas

and economic valuation of forests animal species (Kolahi et al. 2013; Mansouri et al. 2014; Haghjou et al. 2015a, 2015b; Eslamian et al. 2016). Haghjou et al. (2016) applied CVM to assess the total economic value of Arasbaran forest in Iran. They found the significant positive relation between WTP of respondents and the level of education, income, number of annual visits to the forests, and their friendly attitudes towards Arasbaran forests. Haghjou et al. (2015b) mentioned that variables such as demographic, economic and social influence willingness to pay of respondents for different features of environmental resources. Amiri et al. (2015) also using CVM method estimating the annual conservation value of myrtle (Myrtus communis L.) in Dooreh forest in Iran and estimated average monthly WTP per family as 0.79 $ and 102.525 $ for annual conservation of myrtle forest. They found that education had a positive effect on WTP while family size and bid amount had a negative.

In the other study, Karimzadegan et al. (2007)and the extent to which the human race is vitally dependent on them. Without a firm understanding of the value of these systems we are unlikely to make many of the hard choices and compromises needed to protect them. In this study the least marginal monetary value of eleven forests and rangelands ecosystem services including gas regulation, plants genetic reverse diversity, pollination, soil formation, biological control, flood control, hydrological current control, water erosion control, wind erosion control, and ecotourism in fivefold vegetative regions of Khazar, Arasbaran, Zagros, Iran-toran and Khalij-e Omani (Oman gulf estimate non-market values of fivefold vegetation regions in Iran (Khazar, Arasbaran, Zagros, Iran-Toran and Khalij-e Omani (Oman gulf) with surface area of about 65,624.4 ha equal to 47.9 billion $ per year.

Although many studies have been tried to estimate the conservation value of forest resources in Iran, studies on the conservation value of biodiversity of rivers, similar to this study, are very limited. Our investigation deal with four rivers in the North of Iran, Guilan province which are one of the tourism attraction areas in the north of Iran.

The purpose of this study is to estimate the conservation value of biodiversity of four rivers in Iran in order to provide evidence for policy makers and managers by quantifying the economic values of biodiversity conservation of rivers to support and prevent any further destruction.

Material and Method

Study area

The rivers have been destroyed in recent years in Iran. Large projects are running in Guilan province simultaneously which leads significant problems such as rivers contamination and overexploitation of sand and gravel. It causes loss of the river landscape and tourist attraction.

Khalkaei, Ghaleeroodkhan, Pasikhan and Shemroud rivers are the main tourists' attraction and rivers in Guilan province which face contamination problems recently due to overexploitation of sand and gravel for construction purposes (Nezami Balochi et al. 2007).

In order to assess the willingness of visitors to protect the landscape and diversity of main rivers in Guilan province, four rivers – Khalkaei, Ghaleeroodkhan, Pasikhan and Shemroud were studied (Fig. 1). The source of Khalkaei River is from the mountains of Masal city, locat-

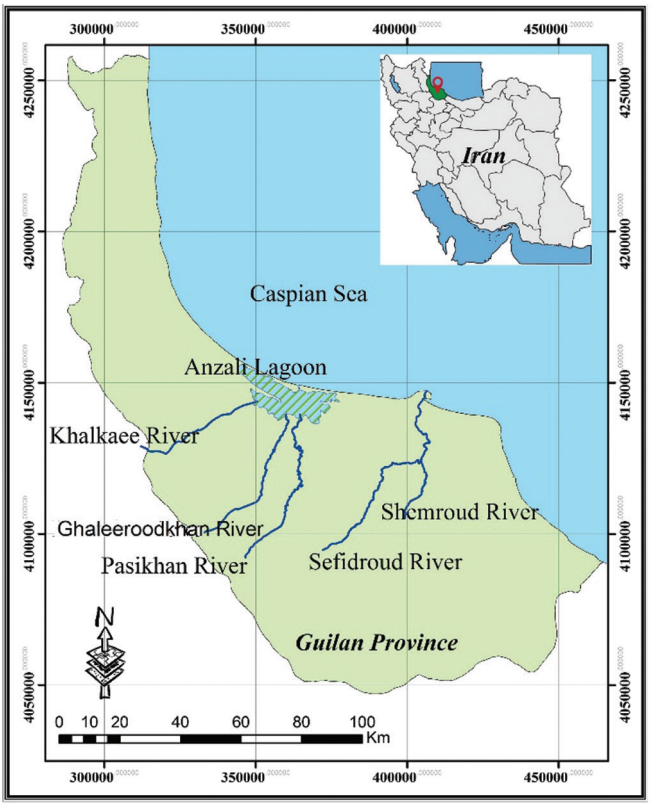

Fig. 1. The map of the study area.

ed in Guilan province. The river length is 40 km and the average annual discharge is 4.77 m^3/s. Ghaleeroodkhan and Pasikhan rivers origin from Fouman city and the average annual discharge are 0.93 and 22.6 m^3/s, respectively. The source of Shemroud river is from the mountains of Siyahkal city, located in the Guilan province. The river length is 101.72 km and the average annual discharge is 4.05 m^3/s.

Methodology

In this paper, CVM was used to estimate the economic value of conserving biodiversity of rivers.

Therefore, the well-known CVM with logit model are used to evaluate the conservation purpose (Loomis 1989, Jain et al. 2017). The identified intangible benefits of biodiversity and landscape of four rivers were surveyed by asking questions of tourists who visited rivers annually whether they are willing to pay for rivers conservation or not.

In early application of CVM, the respondents usually were asked an open-ended questions about their *WTP*, whether they would be willing to pay for the services they receive or not. The respondents were ask if they are interested to contribute biodiversity conservation of rivers by choosing 'Yes' or 'No' with respect to a proposed price in a hypothetical market in a double bounded dichotomous choice approaches.

Dichotomous choice format is the most widely sued approach to eliciting respondents *WTP*. The amount in questions depends on the regular market where usually people purchase or decline to purchase. The questionnaire used in this study were taken from Amiri et al. (2015).

Regards to the question whether the individuals willing to pay for biodiversity conservation of rivers and to find the proper charge, a pilot study with forty questionnaire (open questions) without a proposed price were distributed randomly among individuals. In the pilot study on 40 respondents, the lowest *WTP* given by respondents was 10,000 Rials, the highest *WTP* was 40,000 Rials and the main bid was 20,000 Rials.

According to Cultural Heritage, Handicrafts and Tourism Organization (2013) the number of tourists who visited Khalkaei, Ghaleeroodkhan, Pasikhan and Shemroud rivers in 2013 were 9,074, 58,245, 10,000 and 320, respectively. In order to analyse the visitors *WTF*, questionnaires were distributed among visitors.

To estimate the landscape and biodiversity value of the rivers, tourists were asked to participate as part of our sample population. The required sample size for simple random sampling was calculated according to Cochran (1977) (Equation 1).

$$n = \frac{\frac{z^2 \cdot p \cdot q^2}{d^2}}{1 + \frac{1}{N}\left[\frac{z^2 \cdot p \cdot q}{d^2} - 1\right]} = 380 \quad (1),$$

where: N is population; p is the acceptance (0.5); q is the rejection (0.5); z = 1.96; d is error part.

Therefore, for each river, 95 questionnaires were distributed among visitors, 370 accepted and were surveyed in the analysis.

SHAZAM and Excel were used to calculate the logit model parameters.

Results

Socioeconomic aspects of individual respondents is one of the most important part in the questionnaire, therefore the first section contained questions regarding age, gender, marital status, education, occupation, family size, place of residence, income, monthly expenditure and environmental opinion (Table 1).

Table 1. Definition of variables.

Variable	Definition
Age	Scale variable
Gender	0: Female, 1: Male (Nominal scale)
Marital status	0: Single, 1: Married (Nominal scale)
Education	Years of the education from illiterate, to PhD (Ordinal scale)
Occupation	Level of occupation from Expert to no job (Ordinal scale)
Family size	Number of family members (Scale factor)
Place of residence	Size of the household (Scale variable)
Income	Average monthly income in Rial (Scale variable)
Monthly expenditure	Average monthly expenditure in Rial (Scale variable)
Environmental opinion	Whether the respondent feeling responsibility towards natural resource protection or not (Nominal scale)

The statistical result of socioeconomic characteristics of respondents are presented in Table 2. The average age of about 40.64 represents the high average age between visitors. It is showed that 88 % of visitors were married and 85 % were male and the average education years were 13.05. 54 % of respondents showed their environmental opinion and responsibility towards natural resource protection which showed the importance of environment among visitors. The average monthly expenditure was almost 10 million Rials and the average monthly income was about 13 million Rials.

Table 2. Statistical Results of Socioeconomic Characteristics.

Variable	Mean	Standard deviation	Max	Min
Age, years	46.64	12.2	91	20
Education	13.05	3.12	22	0
Household size	2.95	1.47	6	1
Monthly expenditure, million Rials	10	6	40	1
Monthly income, million Rials	13	8	70	2

Out of 370 respondents, 294 (79.45 %) were willing to pay something for the landscape and biodiversity of the rivers, while the other 76 (20.55 %) respondents were not interested to pay anything. Out of the 88 persons, who were asked to pay 20,000 Rials, only 12 people were willing to pay less than 10,000 Rials and the remaining 76 individuals were not willing to pay anything. Out of the 282 people who accepted the first offer of 20,000 Rials, 113 people agree to pay the amount less than 40,000 Rials bid and the rest agreed to pay 40,000 Rials (Table 3).

Table 3. Response to three proposed bids for the purpose of rivers landscape and biodiversity.

Response	Indicator	Bid 1, 20,000 Rials	Bid 2, 10,000 Rials	Bid 3, 40,000 Rials
Yes	Frequency	282	12	169
	Percent	76	3	46
No	Frequency	88	76	113
	Percent	24	21	30
Total	Frequency	370	88	282
	Percent	100	24	76

The logit regression method provided the following model for the landscape and biodiversity value of the rivers (Equation 2):

$$WTP_i = \alpha_0 + \alpha_1 \cdot x_1 + \alpha_2 \cdot x_2 + \\ + \alpha_3 \cdot x_3 + \alpha_4 \cdot x_4 + e_i \quad (2),$$

where: WTP_i is the willingness of respondent i to pay; x_1 represents education; x_2 is household size, x_3 is household income in million Rials; and x_4 represents the bids in Rials (0, 10,000, 20,000 and 40,000 Rials).

Table 4 shows the estimated coefficients, levels of statistical significance and the effect of descriptive variables of the logit model on the dependent variable (based on maximum likelihood estimation).

Table 4. Estimated regression coefficient of the most effective variables of logit model.

Variable	Estimated coefficient	*t*-value	Elasticity	Marginal effect
Constant	-1.6772	-1.8858	-0.6004	-
Age	0.25408E-01***	2.9083	0.36963	0.58394E-02
Gender	-0.70411***	-2.5201	-0.22071	-0.16182
Education	0.88215E-01***	2.8174	0.41197	0.20274E-01
Environmental opinion	0.94869***	5.4362	0.18	0.21
Monthly expenditure, million Rials	-0.40419E-06**	-2.15	-0.15	0.92×10^{-7}
Monthly income, million Rials	0.50110E-06***	3.0904	0.24	0.11×10^{-6}
BID, Rials	-0.54037E-05	-0.7253E-01	-0.51×10^{-2}	-0.12×10^{-5}

Note: Likelihood ratio statistic = 67.432, probability (LR statistic) = 0, McFadden square = 0.91, Percentage of right predictions = 89.85; ** – Statistical significance at 5 % level, *** – Statistical significance at 1 % level.

The results also show that variable of monthly expenditure was effective in accepting the bids at 5 % statistical level. As well, it should be noted that the variable of gender had a negative effect, while age, education, environmental opinion and income had a positive effect on the *WTP*.

Moreover, the variables age, gender, education, environmental opinion and income were statistically significant at one per cent level of significance and were the most important factors in *WTP* to conserve the landscape and biodiversity of rivers. Besides that, monthly expenditure was negatively significant at 5 % level. As the amount of the bid increased, *WTP* of people reduced substantially. This means that their elasticity to pay is inversely related with the price of perceived services provided, since their low income levels have a negative effect on their support to conserve the landscape and biodiversity of rivers.

In order to determine changes in the probability of *WTP* in estimating the landscape and biodiversity value due to one unit change in one of the independent variables, it was necessary to calculate their marginal effect. We also calculated elasticity to show the relative importance of descriptive variables of the model in response to changes in *WTP* for the landscape and biodiversity of river ecosystem.

The proposed bid was the most important descriptive variable for determining the probability of *WTP* for the landscape and biodiversity of rivers. It showed that one unit change in the amount of proposed bid changed the probability of accepting the bid by 0.51×10^{-2} per cent. Furthermore, due to the marginal effect of this variable, one unit change in the amount of the proposed bid changed the probability of a positive response to the *WTP* by 0.12×10^{-5} in favour of the landscape and biodiversity of rivers.

The estimated coefficient for the income variable was significant at 1 % statistical level. With its positive sign, as expected, it means that one per cent change in income, the probability of accepting the amount of the proposed bid would be changed by 0.24 per cent. Also, in terms of the marginal effect of this variable, one

unit change in the income of the respondent, the probability of positive response to conserve the river, changed by 0.11×10^{-6} per cent.

It is found that there is a positive relationship between age and probability of *WTP* that is significant at 1 % level. In other words, every one unit (year) increase in age, the probability of willingness to pay increases 0.58×10^{-2} units. Besides, again as one percent increase occurs in age variable, willingness to pay increases 0.36 per cent.

Education and probability of *WTP* showed a positive relationship which is significant at 1 % level. In other words every one percent increase in Education, the probability of accepting the amount of the proposed bid would be increased by 0.41 per cent. Besides, one unit change in education (one year) the probability of positive response to *WTP* increases by 0.02027 units.

Sex variable was negatively significant at 1 % level and showed that female participants were more willing to pay than men. The probability of *WTP* among females was 0.16 units more than that of males. In other words, one percent increase in the number of male respondents, the probability of accepting of *WTP* decreases by 0.22071 per cent.

Environmental opinion showed a positive significant effect on *WTP*. It means that one percent change in environmental opinions of individuals, the probability accepting of *WTP* would be changed by 0.18 %. Besides, one unit change in environmental opinion the probability of positive response to *WTP* increases by 0.21 units.

The monthly expenditure was significant at 5 % level, but it was negative and with increasing one per cent of monthly expenditure, the probability of accepting *WTP* decreases by 0.15 %.

In addition, McFadden coefficient of determination was calculated as 0.91, suggesting that the explanatory variables of the model explained the dependent variable very well. Another useful criterion for goodness of fit of the model was the classification of the respondents in two groups, i.e., those who accepted the bid for river landscape and biodiversity and those who rejected it. The proportion of correct predictions of the model was 91 %, implying that 91 % of the respondents indeed correctly answered 'Yes' or 'No' when asked about their willingness to pay.

The expected average *WTP* according to the logit model, using maximum likelihood was calculated by numerical integration in the range of zero to the maximum amount of the proposed bid as follows (Equation 3):

$$WTP = \int_{0}^{40000} \frac{1}{1+\exp\left[-\left(-0.1930566-0.00000056A\right)\right]}dA = 21913 \quad (3),$$

Based on Eq. (3), the expected *WTP* per household for the landscape and biodiversity of rivers, was estimated to be 21,913 Rials per month.

The overall landscape and biodiversity value of the rivers (*LBV*) were calculated using the following relationship (Equation 4):

$$LBV = AAWH \cdot NHD \quad (4),$$

where: *AAWH* is the annual average of *WTP* per visitor and *NHD* is the number of tourists to visit the river annually.

The number of visitors of Khalkaei, Ghaleeroodkhan, Pasikhan and Shem-

roud rivers is annually 9,074, 58,245, 10,000 and 320 person per year, respectively (Cultural Heritage, Handicrafts and Tourism Organization 2013). Based on the number of visitors currently visited the rivers in Guilan we obtained conservation value for one year is shown in Table 5.

Table 5. The overall conservation value of the rivers in Guilan (*LBV*).

River	*AAWH*	*NHD*	*LBV*, Rials
Khalkaei	21913	9074	2,386,062,744
Ghaleeroodkhan	21913	58245	15,315,872,220
Pasikhan	21913	10000	2,629,560,000
Shemroud	21913	320	84,145,920

Discussion

The econometric analysis shows that respondents with higher incomes, greater environmental values, and those who are older and female are more likely to be willing-to-pay. However this result is in contract by Loomis et al. (2000) who mentioned that age, income and education has not a significant effect on individual willing to pay for ecosystem conservation in South Platte river. They also showed that people who are in environmental group are more willing to pay for ecosystem conservation which is in agreement with this study. Abdullah et al. (2015) also stated that respondents who are familiar with the issues related to the environment would be willing to pay more.

Regards to the gender, the results showed that female are more willing to pay for river conservation and biodiversity compare to men which is in contract with (Mansouri et al. 2014) who found that men are more willing to pay for recreational value of forest park. In agreement with this study, Lee and Han (2002) found that the probability of WTP 'Yes' is likely to be higher in female than male respondents. The results of Eslamian et al. (2016) also showed that female participants were more willing to pay than men.

Age, education and income had the highest impact on the elasticity of *WTP*. In other words, as incomes rise, the tendency to pay more for the landscape and biodiversity of the river and elasticity for the *WTP* to preserve their environment increased. This result is in agreement with Kerna (2012), Tao et al. (2012), Amiri et al. (2015) and Abdullah et al. (2015) who mentioned that the higher the income, the more likely the respondents accept the proposed bid.

Education also had a positive effect on willingness to pay which shows the same result with Kolahi et al. (2013), Tao et al. (2012) and Mansouri et al. (2014). Jorgensen et al. (2001) also conducted that lower levels of education tended to be unwilling to pay. Compared to income, with increase of one unit of income (1 Iranian Rial) individual's willingness to pay increase by 0.11×10-6 units, but by increasing one year of education, the probability of WTP increases by 0.202 units.

The result of this study showed that older people are more willing to pay for environmental conservation. Jain et al. (2017) also found the same result in India and they concluded that the older people willing to pay due to the environmental se-

curity for their next generation. In contrast, Abdullah et al. (2015) found that when the age of the individuals increases, the probability to accept WTP decreases. Lee and Han (2002) also conducted that the probability of WTP 'Yes' is likely to be higher in younger people than that of older people.

Using Eq. (3), the mean *WTP* was calculated at the mean of the other independent variables. The resulting mean monthly *WTP* per individual was 21,913 Rials (0.734 $[1]) per month for landscape and biodiversity conservation value of rivers. Loomis et al. (2000) assessed the mean monthly willingness to pay per household to increase five ecosystem services (dilution of wastewater, natural purification of water, erosion control, habitat for fish and wildlife, and recreation) along 45 miles of South Platte River which was about 21 $ higher as water bill. It means that households are willing to pay 21 $ more in their monthly bill to increase ecosystem services. The differences between this two studies might be due to the differences in the purpose of the investigation. In our study, only the biodiversity and landscape valuation has been evaluated, but Loomis et al. (2000) asked five main aspects of river sides which is very important for rural and urban citizens. Besides that, stronger currency, higher income and education might be the reasons of differences in *WTP* in these two studies.

Mansouri et al. (2014) found the mean WTP of recreational value of forest park equal to 17,919 Rials per person. Apparently, this was because, in their study this amount is only for visiting the park, but in our study the mean WTP is for conservation of the rivers biodiversity and landscape which is more valuable for visitors.

The mean *WTP* of this study and Amiri et al. (2015) showed almost the same amount (0.79 $), this was because they evaluated the conservation value of myrtle (*Myrtus communis*) as a medicine species in Iran. The same result might be due to the same income and educational level, age and environmental opinion which has a main effect on *WTP*.

The mean monthly willingness to pay of recreational value of 33 parks across Iran from 2004 to 2011 showed the amount of 1.4 $ per person (Kolahi et al. 2013). The differences of *WTP* between previous study and our study might be due to the fact that their study was done 2 years earlier when the economic situation was better[2].

Conclusion

This study determined the biodiversity and landscape value of four rivers in the North of Iran based on tourists *WTP* for rivers conservation through CVM model and a dichotomous questionnaire. Although the level of income in Iran is modest, 79.45 % of respondents are willing to contribute for rivers biodiversity and landscape conservation. It showed the highest potential and willingness of people to contribute to environmental conservation decision- making policies. The rest (20.55 %) who are not willing to pay, believe that paying for environmental quality is the responsibility of governments or local agencies not individuals or other social groups such as polluters or users should take responsibility for that. This finding is in accordance with Jorgensen et al. (2001) and Abdullah et al. (2015).

The mean *WTP* for rivers conservation was calculated as 21,913 Rials. The results showed that age, education, environmental opinion and income had a posi-

[1] 1 USD = 29854.8 IRR in the year of 2015

[2] 1 USD = 12285.6 IRR in the year of 2013

tive effect on the *WTP*, while the variables of gender and income had the highest effect on *WTP*.

The descriptive variables education and environmental opinion showed better assess in marginal effects which with changing one unit in education and environmental opinion, the willingness to pay increases by 0.202 and 0.218 units which are higher than other quantitative variables. Therefore, rising level of education and environmental awareness influence on environmental protection by individuals.

The result of this study revealed that the individuals were consciously aware of the role and the significance of rivers, and also they would like to contribute for natural resources conservation and willing to pay for its maintenance and protection. In addition, they were interested in protecting such ecosystems for next generation. Therefore, the effort and interest of individuals to preserve natural resources, must convince the government and local agencies to preserve natural resources and prevent them from destruction.

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