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Cerro de Amalucan: willingness to pay (WTP) of a tariff by the contingent valuation method-double limit

Cerro de Amalucan: Disponibilidad a pagar (DAP) de una tarifa por el método de valoración contingente-doble límite

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Abstract

Introduction: The pressure on green areas within large cities have had in the world negative effects for the population, the Cerro de Amalucan Park (PCA) is no exception has been at risk of being eliminated, from its little more than 200 hectares registered in the 20's to the current 74 hectares, therefore it is important to conduct studies on this ecological reserve to generate information that helps to understand the importance of the PCA. **Objective:** The objective is to estimate the average Willingness to Pay (WTP) of visitors for the implementation of a fee for the execution of a management and conservation program in the area using the Double Boundary (DL) Contingent Valuation Method (CVM) to determine the economic value of PCA and general recommendations for obtaining resources based on socioeconomic aspects (income, education, sex). **Methodology:** Using a simple random sample, a sample of 118 surveys was determined, based on which information was collected through surveys conducted in the city of Puebla and its metropolitan area. **Results:** Linear and logarithmic models were used. The WTP's were estimated and the best one was selected with a result of $10 MXN ($0.51 DLS) and the result is affected by the socioeconomic and environmental perception variables. **Conclusions:** It is concluded that there is a willingness of visitors to pay a fee to access the PCA.

Keywords: *Economic valuation; Willingness to Pay; Environmental Conservation; Social welfare; Inquest.*

Resumen

Introducción: La presión sobre las áreas verdes dentro las grandes ciudades han tenido en el mundo efectos negativos para la población, el Parque Cerro de Amalucan (PCA) no es la excepción ha tenido riesgo de ser eliminado, desde sus poco más de 200 hectáreas registradas en los años 20's a las 74 hectáreas actuales, por ello es importante realizar estudios sobre esta reserva ecológica para generar información que ayude a entender la importancia del PCA. **Objetivo:** El objetivo es estimar la Disponibilidad a Pagar (DAP) media de los visitantes por la implementación de una tarifa para la ejecución de un programa de manejo y conservación del área empleando el Método de Valoración Contingente (MVC) tipo Doble Limite (DL) para determinar el valor económico de PCA y general recomendaciones para la obtención de recursos con base de aspectos socioeconómicos (ingreso, educación, sexo). **Metodología:** Empleando un muestreo aleatorio simple se determinó una muestra de 118 encuestas, con base en ello se realizó la recolección de información por medio de encuestas hechas en la Ciudad de Puebla y su área metropolitana. **Resultados:** Se emplearon los modelos lineal y logarítmico. Se estimó las DAP´s y se seleccionó la que resultó ser mejor con un resultado de $10 MXN ($0.51 DLS) y el resultado se ve afectado por las variables socioeconómicas y de percepción ambiental. **Conclusiones:** Se concluye que existe la disponibilidad de los visitantes a realizar el pago de una tarifa por acceder al PCA.

Palabras clave:*Valoración económica; Disponibilidad a Pagar; Conservación Ambiental; Bienestar Social; Encuestas.*

Introduction

The pressure on green areas in and around large cities around the world, caused by human activity, reduces or eliminates the possibility of enjoying ecological services that are essential to the balance of the city and its growing population.

Barbieri and Fogel (2005) indicate that "The world population has grown exponentially in the last 300 years" and the population of the city of Puebla is no exception, increasing from 1 million to 1.6 million in the period from 1990 to 2020, which has affected the area of the Cerro de Amalucan Park, which has been affected despite having been declared an ecological reserve in 1994 (CONABIO, 2008; INEGI, 2022).

"The Cerro de Amalucan was registered as an ecological reserve with 135.9 ha, of which 65.5% was privately owned, belonging to the businessman J. Petersen W, and the remaining 34.5% was adjudicated to the municipality of Puebla, of the 227 ha in 1925" (Flores Lucero, 2017). The Municipal Urban Development Program registered only 113 hectares in 2016, and for the creation of the current Cerro de Amalucan Park, it only has 74 hectares.

In the city of Puebla there are several natural areas that offer environmental services, according to data from the city council of Puebla there are 185 areas catalogued as parks, one of which is El Parque Ce- rro de Amalucan, a natural area that in addition to having recreational areas for the use of the population of the city in general has great historical value from pre-Hispanic times to the present (CONABIO, 2008).

The economic valuation of natural areas allows quantifying the positive externalities they produce for society in general, for this research the Cerro de Amalucan Park area was determined because it is an area that currently offers recreational services (viewpoint, reading areas, barbecue grills, among others) and sports activities (hiking and athletics) that are the most used by park users (Ceja García, 2017; Nicholson, 2008).

Since environmental aspects cannot be understood without the relationship between economic and social spheres in order to relate them, the Contingent Valuation Method (CVM) is used by the double boundary model employed by Cahui-Cahui et al. (2019), Gelo & Koch (2015), Ikeuchi et al. (2013) and Tudela-Mamani (2017) to demonstrate the benefit of incorporating an additional question in the Willingness to Pay (WTP) survey.

The main objective is to estimate the WTP of people in the city of Puebla with respect to a fee for access to the Cerro de Amalucan park, taking into account the perspective of conservation of the area, knowledge of environmental problems and socioeconomic aspects, using the double-bounded contingent valuation method (CVM). With the hypothesis, if a program for conservation and improvement of the environmental services offered by the PCA is proposed, the double affirmative answers (yes-yes) will be greater than the affirmative-negative answers (yes-no) based on the information provided to the respondents.

THEORETICAL FRAMEWORK

The creation of the Cerro de Amalucan park was consolidated in 2017 with an investment of 17 million Mexican pesos, with contributions from the municipal government of Puebla and the government of the State of Puebla, with the construction of recreational, cultural and sports areas, for the benefit of the city's population and particularly for visitors from the surrounding neighborhoods.

Figure 1.
Children's playground and water catcher at the PCA.

Source: Taken on site.

The construction of areas such as those shown in Illustration 1 is aimed at making the PCA more attractive to visit, as well as generating conservation and preservation infrastructure in the 74 ha that make up the park, in order to achieve the objective of its designation as an ecological reserve, which has been affected by the loss of forest area and therefore, by the year 2022, a major maintenance plan was proposed for the park.

Due to its location northeast of the city, visitors are constant from Monday to Sunday from 7 am to 7 pm throughout the year and according to data from the Directorate of Green Infrastructure of the Secretariat of the Environment of the municipal government of Puebla the annual number of visitors is approximately 436,800 people considering that the average weekly number of visitors ranges from 7,250 to 9,440, these numbers may vary because it was taken in the second year of the Covid-19 survey.

The Contingent Valuation Method (CVM) is classified as a direct method, in which a hypothetical market situation is presented based on an amount or rate to be paid and is posed in a questionnaire addressed to a population sample, and where a question of willingness to pay for the variation in environmental quality or a policy that positively affects the environment is asked. The answers obtained for the sample as a whole make it possible to estimate the monetary valuation for the good presented in the constructed market. Econometric techniques are used to

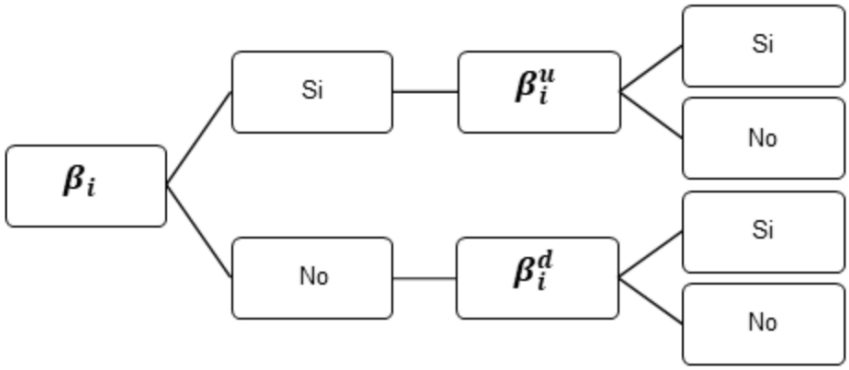
the estimation of the moments (mean and median) of the statistical distribution of environmental benefits (Tudela-Mamani & Leos-Rodriguez, 2017; Young & Loomis, 2014).

The CVM is recurrently used to perform valuations of goods and services without a defined market and therefore do not have a determined monetary value (Hernández Ávila et al., 2018). The use of CVM in its referendum modality has been widely used to obtain WTP and proof of this are the studies of Lugo Sandoval et al. (2020) who obtained the WTP of visitors to Mount Tlaloc in the State of Mexico using CVM; Hernández Ávila et al. (2018) analyzed the environmental problem in the municipality of León, Gto, and obtained the willingness to pay for the creation of a fund to mitigate this problem by means of CVM.

The referendum-type CVM has some criticisms regarding the ability to make reliable and accurate estimates of WTP. Hernández Valdivia et al. (2019) mention the problems that referendum-type CVM can present. Hanemann et al. (1991) suggest using a double dichotomous format, as a way of reducing these aspects, which is known as *double bounded*, for the use of this format a second question on the willingness to pay is added, also of a dichotomous nature (Yes/No).

When the willingness-to-pay question is asked to respondent *(i),* an initial amount *βi* is asked and another question is asked depending on the first answer cataloged by β_i^u which is the first amount in case the answer is affirmative or β_i^d which represents the second amount if the answer is negative (Kanninen, 1993). Figure 1 shows the process of choosing the double-bounded MCV.

Figure 2.
Mode of application of the dichotomous double-bounded type choice.



Source: Own elaboration based on Cahui-Cahui et al. (2019).

There are studies that have employed double-boundary type CVM, such as those developed by Gelo & Koch (2015) who employ both referendum and double-boundary type CVM to assess the welfare on community forest plantations in Ethiopia; Cahui-Cahui et al. (2019) who estimated the WTP of implementing the sustainability of a rural drinking water and sanitation service program in Paxa, Peru; Song et al. (2019) where they employed it to estimate and analyze the factors

affecting the WTP of households for improving water quality in Bac Nich province, Vietnam. The application of the method is not only used for environmental valuations an example is the one conducted by Ikeuchi et al. (2013) that employs the double boundary CVM to validate the application of cost-benefit analysis in public library services in Japan.

Calia and Strazzera (2000) demonstrated that the double boundary type CVM format is more efficient than the referendum, as more efficient and accurate WTP estimates are obtained, and the results obtained by Brugnaro (2010), Gelo & Koch (2015) and Tudela-Mamani (2017) in their studies confirm that statement.

METHODOLOGY

The methodology was used in the following steps: design of the questionnaire, application of the survey and analysis of the data from the population sample. The research was conducted in the city of Puebla, Mexico.

To obtain a statistically correct sample, simple random sampling was applied, using the formula developed below and which has been used in other studies (Hernández Valdivia et al. (2019), Larqué Saavedra et al. (2004) and Lugo Sandoval et al. (2020)), for finite populations where n elements are part of the universe N and all samples have the same probability of being selected. A sample of 118 individuals to be interviewed was obtained from a population of 436 800 people, with a confidence level of 95%:

$$n = \frac{N\sigma^2 Z^2}{(N-1)e^2 + \sigma^2 Z^2}$$

Where n = selected sample (118), N = total annual visitors (436 000), σ = population standard deviation (0.5 in this case), Z = value of the standardized normal distribution (1.96) and e = acceptable sample error limit of 9%.

The questionnaire used to collect the data needed to estimate the WTP in the Cerro de Amalucan Park in the city of Puebla, includes a question about whether or not they know the park, as well as socioeconomic questions such as: age of the respondent, place of residence, sex, schooling, marital status, income, whether the household is headed by a female or male head of household, and number of household members. The survey also includes aspects of environmental perception and recreational aspects offered by the park (conservation of forest areas, water catchment and creation of recreational areas).

In the elaboration of the question related to the hypothetical scenario for estimating the WTP, about charging a fee for the park's operation and maintenance, respondents were asked about their opinion on the creation and management of the park by the park. In addition, they were asked about the respondent's opinion of the park's creation and management by the park's management team.

The company's management is responsible for determining whether or not it is appropriate.

The main characteristic of the double-limit type of MVC is that this format leaves the individual with the decision of whether or not to pay a given fee for accessing the park and then asks another question of the same type as shown in Figure 1.

In order to calculate the WTP, we need to ask the following question: Would you be willing to contribute an amount of $ for each visit to Cerro de Amalucan Park, to finance the conservation and maintenance activities of all the areas of Cerro de Amalucan Park?

The established rates with which the economic valuation was obtained and these amounts were $6, $8, $10 and $12 will be considered as β'_{xi} to enter the park; if the answer is affirmative, the following amounts are asked: 8, 10, 12, and 14 Mexican pesos and are considered βx^{u}; if the answer is negative, the following amounts will be asked 4, 6, 8 and 10 Mexican pesos and would represent β'_{xi}.

In the case of the double question, Hanemann et al. (1991) and Kanninen (1993) indicate that the answers in terms of probability can be expressed and solved as follows:

$$Pr\ Pr\ ob\ (si, si) = 1 - F(\beta' x_i^u)$$
$$Pr\ Pr\ ob\ (no, no) = F(\beta' x_i^d)$$
$$Pr\ Pr\ ob\ (si, no) = F(\beta' x_i^u) - F(\beta' x_i)$$
$$Pr\ Pr\ ob\ (no, si) = F(\beta' x_i) - F(\beta' x_i^d)$$

The econometric estimation problem for the double-bounded case can be solved through the log-likelihood function based on Hanemann et al. (1991) and is expressed as:

$$LL = \sum_{i=1}^{n} \left\{ d_i^{ss}\ ln\ ln \left[1 - \frac{1}{1 + exp^{-(\beta' x_i^u)}}\right] + d_i^{sn} \right.$$
$$ln\ ln \left[1 - \frac{1}{1 + exp^{-(\beta' x_i^d)}} - 1 \frac{1}{1 + exp^{-(\beta' x_i)}}\right] + d_i^{ns}$$
$$ln\ ln \left[1 - \frac{1}{1 + exp^{-(\beta' x_i)}} - 1 - \frac{1}{1 + exp^{-(\beta' x_i^d)}}\right] + d_i^{nn}$$
$$\left. ln\ ln \left[1 - \frac{1}{1 + exp^{-(\beta' x_i^d)}}\right] \right\}$$

Where diss, disn, dins and dinn are the binary variables for when the answers are yes-yes, yes-no, no-yes and no-no respectively, taking into account that the answers are dichotomous (yes/no).

The maximum likelihood estimator is obtained by maximizing the above function with the parameters of the decision variables. Hanemann et al. (1991) mention that the double dichotomous model predicts a gain in the accuracy of the variance matrix.

The results showed that the point estimator of the mean WTP of the double dichotomous models is smaller than that of the single dichotomous model. In addition, they found that the point estimator of the mean WTP of the double dichotomous models is smaller. Several studies have shown that the double-bounded format presents better estimates for WTP, making it more efficient and accurate Cahui-Cahui et al. (2019), Song et al. (2019) and Tudela-Mamani & Leos-Rodriguez (2018).

RESULTS

In order to calculate the WTP, data collection had to be carried out, a representative sample of 118 people was calculated; to obtain a greater amount of information, 136 surveys were carried out, yielding the following data: The age ranged from 19 to 73 years, with the range of 19 to 39 years having the highest concentration of respondents with 84% of the total; 39% of those with a partner, either married or in union, and 61% of those without a partner; The educational level of those who did not attend school was 3%, primary school 3%, secondary school 5%, preparatory school 19%, University Higher Technician 13%, Bachelor's Degree 49%, Master's Degree 7% and Doctorate 1%; in terms of income, this is between 3,600 to more than 25,000 Mexican pesos; people who receive a monthly income of 3,600 to 10,000 MXN is 66% of the total number of respondents.

During the interview, a brief explanation was given about the purpose of applying a hypothetical fee to access the PCA and thus prevent the area from suffering more damage and lack of conservation. They emphasize the importance of maintaining areas like the park and that the fee is a direct way to support the implementation of management, conservation, and outreach programs.

According to the answers obtained from the survey for the Contingent Valuation Method and the analysis of the WTP for the implementation of a management and conservation program in the PCA, obtained by applying the double limit format, 73.5% of the respondents answered affirmatively (yes-yes and yes-no) to the payment of an access fee, the remaining 26.5% answered negatively (no-yes and no) to the payment of a fee, with more people willing to pay than not. Table 1 shows in detail the responses obtained.

Table 1.
Responses to WTP-double-boundary questions for charging a PCA access fee.

Tafira de acceso	Respuestas					
	Si	No	Si-Si	SI-No	No-Si	No-No
4					4	2
6	28	6			2	11
8	21	13	27	1	2	5
10	27	7	16	5	0	10
12	24	10	21	6		
14			21	3		
Total	100	36	85	15	8	28

Source: Own elaboration with data from the respondents.

The results of the double limit model (linear and logarithmic) took into account the variables corresponding to the access fee, income level, sex, presence of children, educational level, perception of the environmental problems in the PCA, and the quality of conservation of the park area for each of the interviews conducted. The parameters are significant (P=0.01). The joint significance is high in terms of likelihood ratio (LR=312.19).

Table 2.
Econometric estimates of the double-bound (linear and logarithmic) model for charging a PCA access fee.

	Lineal		Logaritmo	
Variable	**valor**	**Error estándar**	**valor**	**Error estándar**
Constante	-2.2202	1.0931	-30.1525	6.0134
Tarifa	-0.5372	0.0666		
Ingreso	0.0003	0.0006		
Logaritmo tarifa			-4.8450	0.5810
Logaritmo ingreso			4.0719	0.7028
Sexo	-0.1723	0.3937	-0.1822	0.3993
Hijos	0.1723	0.1797	0.3075	0.1847
Nivel educativo	0.1639	0.2343	0.1871	0.1390
Problemática ambiental	0.2358	0.2343	0.2538	0.2420
Calidad de conservación	0.8020	0.3036	0.7129	0.3105
Logaritmo de verosimilitud	153.0958		151.474	
Razón de verosimilitud	312.1916		302.9481	

Source: Own elaboration based on the results obtained in NLogit.

The results observed in Table 2 correspond to what is expected and are similar to those obtained by Cahui-Cahui et al. (2019), Song et al. (2019) and Tudela-Mamani & Leos-Ro- dríguez (2018), for example the negative sign obtained in the tariff variable means that in the face of an increase in it the probability of obtaining an affirmative response of paying an access fee is lower, agreeing with Hernández Valdivia et al. (2019), Melo-Guerrero et al. (2022) and Monroy et al. (2011).

DISCUSSION

The sign of the variable corresponding to the sex of the respondent is negative and based on the coding for the analysis of that response, it can be explained that there is a greater probability that the person responds affirmatively to the collection of a fee if the respondent is female, a result similar to that obtained by Brugnaro (2010) and Hernández Valdivia et al. (2019) for their respective studies.

If the respondent has children, and taking into account the positive sign of this variable, it is possible to affirm that the respondent has children.

The study found that they are more likely to answer yes to charging an access fee, agreeing with Cahui-Cahui et al. (2019) and van der Bergh et al. (2004).

The educational level presents a variable with a positive sign, which can be explained by the fact that the higher the educational level, the greater the probability of obtaining an affirmative response, similar to the results obtained by Brugnaro, (2010), Hernández Valdivia et al. (2019), Larqué Saavedra et al. (2004) and Lugo Sandoval et al. (2020).

Regarding the variables of perception of environmental problems, as well as the quality of conservation of the Cerro de Amalucan Park, they have a positive sign, consistent with results such as those obtained by Brugnaro (2010) Gelo & Koch (2015) and Shrestha et al. (2007) and is interpreted as that the greater the perception of the situation of the PCA, the more likely it is to obtain an affirmative response regarding the collection of an access fee.

With the data obtained, the WTP is calculated using the linear and logarithmic models, and the following equations are solved:

$$DAPDL = \frac{-2.2201+0.0003INGRESO_i-0.1723SEXO_i+0.3395HIJOS_i+0.1339EDUCA_i+0.2358CONOC_i+0.802CALI_i}{0.5372}$$

$$DAPDLG = \frac{-30.1525+4.072INGRESO_i-0.1822SEXO_i+0.3074HIJOS_i+0.1871EDUCA_i+0.2538CONOC_i+0.713CALI_i}{4.8451}$$

$$i = 1, 2, 3, \ldots, 136$$

The WTPs obtained from the above formulas yield average tariffs of 9.67 and 9.85 Mexican pesos for the linear and logarithmic models, respectively.

Comparing the WTP results (Table 2) shows that the likelihood ratio is very close to that of the linear model, therefore, the most appropriate PAC access fee is determined to be 10.00 MXN. This agrees with the results for the WTP obtained by Cahui-Cahui et al. (2019), Calia & Strazzera (2000), Gelo & Koch (2015) and Tudela-Mamani, (2017) who calculated different WTP's, using the double limit method and make comparisons between them to determine which one best meets the statistical parameters and in this case both methods are adequate due to the similarity of the statistical results. In order to observe which MXN 10.00 is the most appropriate value, the normal distribution of the WTP values of a PCA access fee for both methods is presented.

CONCLUSIONS

With this research, the WTP of visitors was determined by charging an access fee for the implementation of a management and conservation program in the Cerro de Amalucan Park.

and a comparison of the results between the linear and the logarithmic model was made, with the linear model yielding the best parameters; however, any of the models meet the theoretical requirements to be used to make recommendations for setting the amount of a park access fee. The WTP is affected by the variables proposed in relation to socioeconomic aspects such as income and educational level, and the higher the level of any of these variables, the higher the WTP increases in relation to sex, If the person interviewed has children, the answer is affirmative because of the access fee, in some cases the second answer is negative, subject to the number of children, this part was not taken as part of the study, but arguments were found in this regard when the interview was conducted. The responses obtained reflect that there is a high probability that visitors would be willing to pay for an access fee to Cerro de Amalucan Park, if it is for the implementation of a management and conservation program for the area, since the vast majority of those interviewed believe that conservation and improvement of natural areas within the city of Puebla are a generator of well-being for all.

References

Barbieri, M., & Fogel, R. W. (2005). The Escape from Hunger and Premature Death, 1700-2100. *Population 60*(3). 367-390. https://doi.org/10.2307/4150823

Brugnaro, C. (2010). Valuing riparian forests restoration: A CVM application in Corumbatai river basin. *Revista de Economia e Sociologia Rural,* 48(3), 507–520. https://doi.org/10.1590/S0103-20032010000300001

Cahui-Cahui, E., Tudela-Mamani, J. W. & Huamaní-Peralta, A. (2019). Determinantes socioeconómicos en la estimación de la disponibilidad a pagar del proyecto de agua potable y saneamiento en el centro poblado de Paxa, distrito de Tiquillaca – Puno 2017. *Comuni@cción: Revista de Investigación en Comunicación y Desarrollo, 10*(1), 81–91. https://doi.org/10.33595/2226-1478.10.1.332

Calia, P. & Strazzera, E. (2000). Bias and efficiency of single versus double bound models for contingent valuation studies: a Monte Carlo analysis. *Applied Economics, 32*(10), 1329–1336. https://doi.org/10.1080/000368400404489

Ceja García, X. (2017, 16 de agosto). Gaceta Parlamentaria. Cámara de Senadores. https://www.senado.gob.mx/64/gaceta_comision_permanente/documento/74525

CONABIO. (2008). *Capital natural de México, vol. I: Conocimiento actual de la biodiversidad.* Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, México. https://ceiba.org.mx/publicaciones/Centro_Documentacion/Capital_Natural_Mx/2008_CapNatMx_I_Conocimiento.pdf

Flores Lucero, M. de L. (2017). Pérdida irreversible de reservas ecológicas. La ilegalidad autorizada en el Cerro de Amalucan. *Revista Brasileira de Estudos Urbanos e Regionais, 20*(1), 104. https://doi.org/10.22296/2317-1529.2018v20n1p104

Gelo, D., & Koch, S. F. (2015). Contingent valuation of community forestry programs in Ethiopia: Controlling for preference anomalies in double-bounded CVM. *Ecological Economics, 114,* 79–89. https://doi.org/10.1016/j.ecolecon.2015.03.014

Hanemann, M., Loomis, J. & Kanninen, B. (1991). Statistical Efficiency of Double-Bounded Dichotomous Choice Contingent Valuation. *American Journal of Agricultural Economics, 73*(4), 1255–1263. https://doi.org/10.2307/1242453

Hernández Ávila, A., Valdivia Alcalá, R., Romo Lozano, J. L., Hernández Ortiz, J. & Cuevas Alvarado, C. M. (2018). Valoración económica para un mejoramiento ambiental en León, Guanajuato. *Revista Mexicana de Ciencias Agrícolas, 9*(1), 37–49. https://doi.org/10.29312/remexca.v9i1.846

Hernández Valdivia, M. S., Valdivia Alcalá, R. & Hernández Ortiz, J. (2019). Valoración de servicios ambientales y recreativos del Bosque San Juan de Aragón, Ciudad de México. *Revista Mexicana de Ciencias Forestales, 10*(54). https://doi.org/10.29298/rmcf.v10i54.557

Ikeuchi, A., Tsuji, K., Yoshikane, F., & Ikeuchi, U. (2013). Double-bounded Dichotomous Choice CVM for Public Library Services in Japan. *Procedia - Social and Behavioral Sciences, 73,* 205–208. https://doi.org/10.1016/j.sbspro.2013.02.042

INEGI. (2022, noviembre 11). *Instituto Nacional de Estadística y Geografía* (INEGI). INEGI. https://www.inegi.org.mx/

Kanninen, B. J. (1993). Optimal Experimental De-

sign for Double-Bounded Dichotomous Choice Contingent Valuation. *Land Economics, 69*(2), 138–146. https://doi.org/10.2307/3146514

Larqué Saavedra, B. S., Valdivia Alcalá, R., Islas Gutiérrez, F. & Romo Lozano, J. L. (2004). Valoración Económica De Los Servicios Ambientales Del Bosque Del Municipio De Ixtapaluca, Estado De México. *Revista Internacional De Contaminación Ambiental, 20*(4), 193–202. https://www.revistascca.unam.mx/rica/index.php/rica/article/view/22602

Lugo Sandoval, M., Valdivia Alcalá, R., Monroy Hernández, R., Hernández Ortiz, J., Sandoval Romero, F. & Contreras Castillo, J. M. (2020). Valoración económica de los servicios ambientales del Monte Tláloc, Texcoco, Estado de México. *Revista Mexicana de Ciencias Forestales, 11*(61), 176–195. https://doi.org/10.29298/rmcf.v11i61.672

Melo-Guerrero, E., Hernández-Ortiz, J., Valenzuela-Núñez, L. M., Valdivia-Alcalá, R., González-Juárez, A., & Luna-Cervantes, J. O. (2022). Disponibilidad a pagar por servicios turísticos en el Parque Nacional Los Mármoles, México. *Ecosistemas y Recursos Agropecuarios, 9*(2), 1–10. https://doi.org/10.19136/era.a9n2.2858

Monroy, R., Valdivia, R., Sandoval, M. & Rubiños, J. E. (2011). Valoración económica del servicio ambiental hidrológico en una reserva de la biosfera. *Terra Latinoamericana, 29*(3), 315–323.

Nicholson, W. (2008). Teoría Microeconómica. Principios básicos y ampliaciones (9a. ed.). CENGAGE Learning.

Shrestha, R. K., Alavalapati, J. R. R., Seidl, A. F., Weber, K. E. & Suselo, T. B. (2007). Estimating the local cost of protecting Koshi Tappu wildlife reserve, Nepal: A contingent valuation approach. Environment, Development and Sustainability, 9(4), 413–426. https://doi.org/10.1007/s10668-006-9029-4

Song, N. Van, Huyen, V. N., Dung, L. T. P. & Thuy, N. T. (2019). Using Double-Bounded Dichotomous-Choice to Estimate Households' Willingness to Pay for Improved Water Quality in Bac Ninh Province of Vietnam. *Journal of Environmental Protection, 10*(11), 1407–1418. https://doi.org/10.4236/jep.2019.1011083

Tudela-Mamani, J. W. & Leos-Rodríguez, J. A. (2017). *Herramientas metodológicas para aplicaciones del método de valoración contingente.* Universidad Autónoma Chapingo.

Tudela-Mamani, J. W. & Leos-Rodríguez, J. A. (2018). Estimación de beneficios económicos por mejoras en los servicios de saneamiento básico mediante experimentos de elección. *Revista Chapingo, Serie Ciencias Forestales y del Ambiente, 24*(2). https://doi.org/10.5154/r.rchscfa.2017.05.037

Tudela-Mamani, J. W. (2017). Willingness to pay for improvements in wastewater treatment: application of the contingent valuation method in Puno, Peru. *Revista Chapingo Serie Ciencias Forestales y del Ambiente, 23*(3), 341–352. https://doi.org/10.5154/r.rchscfa.2016.11.059

Van der Bergh, J. C. V. M., Hoekstra, J., Imeson, R., Nunes, P. A. L. D. & Blaeij, A. T. (2004). THE COST OF EXOTIC MARINE SPECIES: A JOINT TRAVEL COST – CONTINGENT VALUATION SURVEY. *En Bioeconomic Modelling and Valuation of Exploited Marine Ecosystems, 28*. 229–240. Springer Dordrecht. https://doi.org/doi.org/10.1007/1-4020-4059-8_12

Young, R. A., & Loomis, J. (2014). *Determining the Economic Value of Water* (Second edi, p. 337).