

Economic assessment of the environmental services of PNA Cerro Mohinora, Guadalupe y Calvo, Chihuahua

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Abstract

The Cerro Mohinora Protected Natural Area (PNA) located in Guadalupe y Calvo, Chihuahua, Mexico has ecosystems in a good state of conservation that include trees of genera such as *Picea*, *Abies* and *Pseudotsuga*. The objective was to determine the willingness to pay (WTP) by the visitors through the Contingent Valuation Method (CVM) in order to conserve the environmental services (SA) provided by the area and to know their perception of the current state of the Hill. 210 surveys were carried out to simulate a hypothetical market, where they asked what is the maximum amount they would be willing to pay to preserve and/or improve the SA of the PNA. The main results show that 90.48% of the visitors gave a positive WTP, 48.57% of the visitors are local and 55.24% have a university degree. 60.48% of the visitors do ecotourism on the Hill. The main suggestion to improve the area was the maintenance of the roads (55.00%) and the provision of more environmental education (32.69%). The only variable that influenced a positive WTP and that was statistically significant was the "Perception of good ecosystem quality (PGEQ)". The average WTP calculated was 90.48 MXN, with a minimum and maximum of 68.12 MXN and 97.60 MXN, respectively, and a standard deviation of 5.55 MXN. The WTP should be established according to the number of visitors and use of the place, considering that it currently has no cost and that most visitors are willing to pay to enter and show concern for conservation.

Keywords: contingent valuation; ecotourism; entrance fee to the area; natural protected areas; sustainable development; Willingness to pay (WTP)

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Introduction

Buckley (2016) states that the protection and conservation of natural areas often becomes a political game between those who defend them and those who oppose them. Therefore, conservation organizations should not support classification or compensation. The goal of these approaches is to obtain a balance between economic development and environmental conservation. However, this means that as long as there are profits, environmental degradation is considered acceptable. However, the development of tourism within these protected areas involves a complex network of legal, political, economic, social, and environmental linkages between the management authority, commercial tourism companies, the local community, and non-governmental organizations, each of these groups of power having their own interests at stake (Buckley, 2017).

Since tourism and recreation can have significant negative environmental impacts, it is important to consider these factors in the management of protected natural areas (Rankin *et al.*, 2015). According to IUCN, (2015), many protected areas in different parts of the world fail to be financially self-sufficient, which in turn prevents them from achieving their goals of conservation as well as development. Assigning an economic value to natural resources should be understood as a means to conserve and sustainably use them, furthermore, the economic valuation of environmental goods and services is an important tool for assessing the pros and cons in the use of natural ecosystems, which support human life (Herrera, 2009).

The economic valuation of environmental goods and services can guide the development of public policies that generate greater trust in society, before implementing conservation programs that involve payment from visitors to a certain area (Aoun, 2015). However, environmental services are intangible benefits, meaning they are known to exist, but their quantification and valuation are complicated, unlike other environmental goods or products such as wood (CONAFOR, 2015).

Currently, the economic valuation of the environment is carried out through various methods and techniques such as the market value method, the revealed preference method, the benefit transfer technique, and the stated preference method, for the latter, one of the most commonly used is the contingent valuation method (CVM) (MINAM, 2015). According to Valdivia (2009) the CVM allows for the simulation of hypothetical markets through direct surveys of consumers of recreational services generated by natural assets.

The CVM offers wide applicability in Protected Natural Areas (PNA) to evaluate the Direct Use Value (UDV), which refers to the benefits obtained from the use or consumption of ecosystem goods and services, such as wood, seeds, and recreation. In addition, the Indirect Use Value (VUI), which extends to other individuals in society and is related to characteristics such as erosion, water, and climate regulation. Also, the Legacy Value (VL), which implies leaving benefits to future generations, such as the protection of habitats, and the Existence Value (VE), which attributes value to ecosystems by their mere existence, such as the conservation of the bear panda. (MINAM, 2015). In Mexico, it has been used to measure the economic value of different environmental services (Lugo *et al.*, 2020; Torres, 2020; Vásquez *et al.*, 2009). In the State of Chihuahua, no work of this type was found for protected areas.

Due to the, the objective of this study was to determine the willingness to pay (WTP) by visitors to the Cerro Mohinora National Protected Area (NPA) in order to conserve the environmental services provided by this area, using the Contingent Valuation Method (CVM), as well as to understand the perception of the current state of the area. We believe that this analysis will be valuable for all key stakeholders, both in the public and governmental sector, who are involved in the sustainable management and planning of protected natural areas. Additionally, the findings of this study will be of great use to academics, as it offers a general overview and perspective on nature-based solutions related to the development of sustainable tourism within protected areas, which in turn will lay the groundwork for future research.

This type of analysis is valuable for key stakeholders, both in the public and governmental sectors, who are involved in the sustainable management and planning of natural protected areas. In addition, the findings of these studies are of great use to academics as they offer an overview and perspective on nature-based solutions related to sustainable tourism development within protected areas, which in turn can be lays the foundation

for future research. Therefore, the objective of this study was to determine the willingness to pay (WTP) of visitors to the Cerro Mohinora National Protected Area (PNA) to conserve the environmental services provided by this area, using the Contingent Valuation Method (CVM), as well as understand the perception of the current state of the area. It is expected that most visitors will be willing to pay and show concern for the conservation of the area.

Materials and Methods

The Flora and Fauna Protection Area “Cerro Mohinora” is recognized as the highest mountain in the Chihuahua region and was designated as a Flora and Fauna Protection Area in 2015 through an official decree. It is located in the municipality of Guadalupe y Calvo, Chihuahua, Mexico (Figure 1). This space covers an altitudinal range that goes from 2,100 to 3,307 meters above sea level and is home to a wide diversity of ecosystems. In addition to its ecological importance, it stands out for receiving abundant rainfall, playing a fundamental role in the 10-Sinaloa hydrological region and the needs of drinking water supply to the town of Guadalupe y Calvo. Coniferous forests in their pristine state are prominent in this area, including species associations such as *Abies - Picea*, *Abies - Pseudotsuga*, *Pinus - Quercus*, and *Quercus - Pinus*. These forests provide habitat for numerous species, some of which are endemic or at risk (CONANP, 2017).

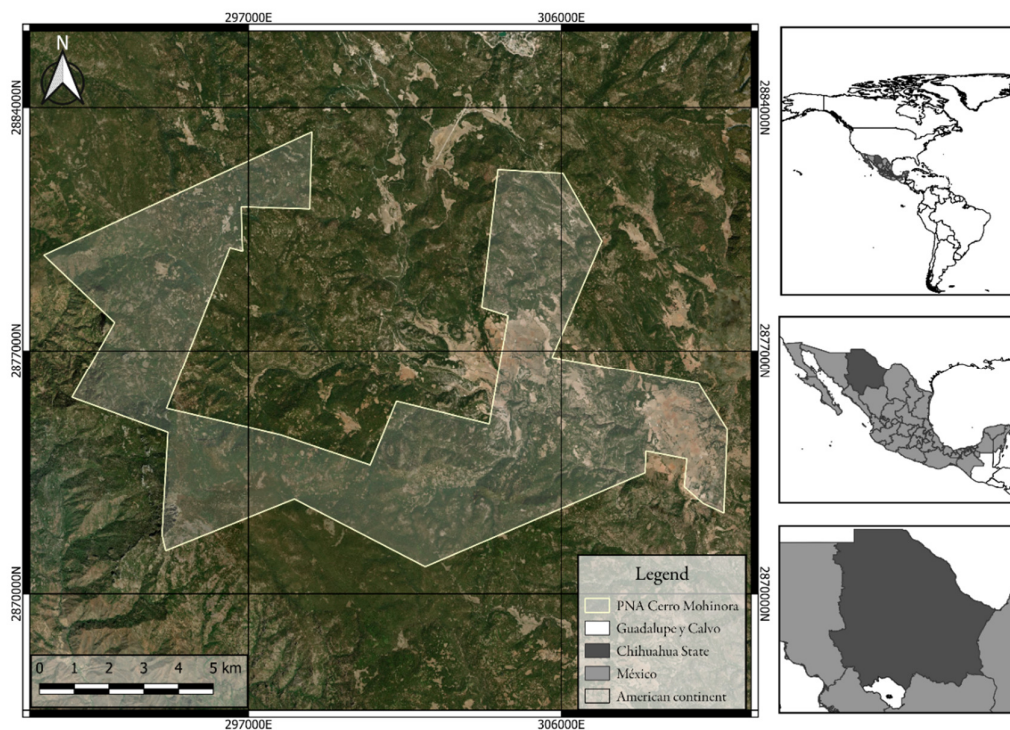


Figure 1. Location of the ANP Cerro Mohinora in Guadalupe y Calvo, Chihuahua, Mexico

The main objective of the CVM is to estimate the non-use value of environmental goods and services through direct questioning of individuals, using surveys, questionnaires, and/or interviews, to obtain a monetary estimate of the change in their well-being as a result of a potential change in the supply of the environmental good (Herrera, 2009).

The sample size was defined by estimating the population mean and the N (target population). Since the population is infinite or unknown, simple random sampling, better known as SRS (Cochran, 1984), was used, with the following equation:

$$n = \frac{Z_a^2 * p * q}{d^2}$$

Where:

n = Sample size

Z = Confidence level

a = Significance level

p = Probability of success or expected proportion

q = Probability of failure

d² = Precision (Maximum allowable error in terms of proportion)

A pilot sampling of 25 individuals selected at random was carried out to statistically determine the variance of the sample and substitute it in the formula for obtaining the sample size. A significance level of 95% was used, which provides a Z value of 1.96; the probability of success (p) was 0.72, while the probability of failure (q) was 0.18. By substituting the pilot sample data, a sample size of $n = 200$ surveys was calculated, with an error of 5%. For this research, a sample of 210 surveys was used. Subsequently, a logistic distribution econometric model was used to determine which factors explain the willingness to pay (WTP) (Habb and McConnell, 2002; Vaughan and Russell, 1999) of visitors to Cerro Mohinora and to observe the influence of socioeconomic variables and their environmental perception. The proposed empirical model of logistic regression was as follows:

$$WTP = \alpha + \beta_1AGE + \beta_2LED + \beta_3PEC + \beta_4PED + \beta_5PGEQ + e$$

Where:

WTP = Willingness to pay to conserve and/or improve the environmental services of Cerro Mohinora;
“Would pay” = 1 or “Would not pay” = 0.

α = Intercept of the function

β_1, \dots, β_5 = Coefficients of the respective explanatory variables:

AGE = Age of the survey respondent

LED = Level of education

PEC = Presence of environmental concern

PED = Perception of ecosystem degradation

PGEQ = Perception of good ecosystem quality

e = Error

The model was estimated in SPSS Statistics 27 (IBM, 2020) software and manipulated in Excel for the corresponding calculations. The survey was developed in “Google Forms” and applied virtually to visitors in general (residents and tourists). The selection of respondents was random, searching for keywords such as “Cerro Mohinora”, “Mohinora”, and “Cerro Mohinora, Guadalupe y Calvo” on social media platforms such as Facebook, Instagram, and Twitter. Once photographs were identified in the study area, contact was made with respondents to ensure that they had visited Cerro Mohinora and the survey was sent to them.

The survey design was based on what was presented by Osorio and Correa (2009), where they indicate that economic value results from asking about the WTP for an improvement in the quality or quantity of the ecosystem service, in a hypothetical scenario.

The survey was structured into five sections:

1. Introduction to the nature of the research, the institution conducting the study was named, and it was explained that the purpose of the study is to identify the economic value that visitors assign to Cerro Mohinora.

2. A detailed description of the current situation of the environmental asset, with the purpose of contextualizing the respondent to be able to evaluate changes or maintenance in the quality of the area to be valued.
3. A set of questions about the respondent, seeking personal information that helps us explain why they answered the way they did.
4. Questions about the respondent's experience in the area, their main activity, perception of the current situation, and possible improvements detected to maintain the quality of environmental services. These questions are used to conduct statistical analysis and estimate the econometric model.
5. The economic valuation scenario was presented, where a dichotomous question was used, offering respondents the possibility to decide whether or not to pay to conserve and/or improve the environmental services of Cerro Mohinora. If the respondent answered negatively to the dichotomous question, they had to explain the reason for their response. Finally, they were asked how they would like the payment to be (voluntary or mandatory).

After conducting the surveys, univariate analyses (Chi-square test) and multivariate analyses (logistic regression models) were used to determine which variables considered could determine the WTP and thus describe and predict the behavior of the population. For the latter, the WTP was considered as the response variable (in a binary way: “would pay” = 1 or “would not pay” = 0), and as explanatory variables, those included in the survey”.

Results and Discussion

Relationship between the age of visitors and their willingness to pay (WTP)

According to the surveys conducted, 190 visitors (90.48%) would be willing to pay to conserve and/or improve the environmental services of the protected natural area (PNA), while only 20 (9.52%) responded negatively. On the other hand, in the question regarding the type of payment, whether it should be voluntary or mandatory, the responses were very similar, with 99 (51.03%) choosing the “Voluntary” option and 95 (48.97%) opting for mandatory payment.

Regarding gender, 54% of visitors to Cerro Mohinora are women and 46% are men. Analyzing willingness to pay by gender, it can be observed that only 10 (8.77%) women and 10 (10.42%) men opted not to pay for the improvement of environmental services on the hill, while 104 (91.23%) women and 86 (89.58%) men responded positively.

Figure 2 shows the different age ranges of the corresponding visitors and their percentage. It is worth noting that 41.33% of the visitors are between 30 and 41 years of age, being the most common group. The 14-20 age range showed a total WTP (100%). For the age range of 21-30, eight (9.20%) people responded negatively, while 79 (90.80%) responded positively. In the age range of 31-40, eight (16.67%) people did not consider paying, while 40 (83.33%) showed a willingness to pay. In the 41-50 age range, two (5.71%) people surveyed would not pay, while 33 (94.29%) would. Similarly, in the 51-60 age range, two (13.33%) people would not pay, while 13 (86.67%) would. Finally, two (100%) people over 60 years old expressed their willingness to pay to conserve the environmental services provided by the Mohinora hill.

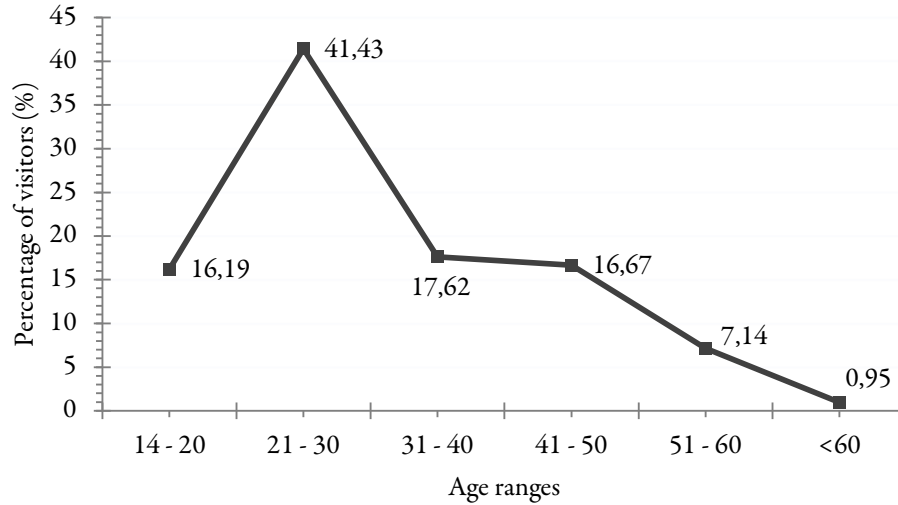


Figure 2. Age ranges of visitors to Cerro Mohinora

Place of residence of visitors and willingness to pay (WTP)

The majority of visitors to Cerro Mohinora are locals from Guadalupe y Calvo, accounting for 48.57% of visits, followed by the municipalities of Chihuahua and Hidalgo del Parral with 29.05% and 8.57% respectively. Twelve other origins were recorded by the respondents, but these did not exceed 7 visitors (Table 1). Analyzing the three places of origin of the visitors, it was observed that out of the 102 visitors from Guadalupe y Calvo, 13 (12.75%) of them were not willing to pay to conserve or improve the environmental services of the PNA, and 89 (87.25%) of them were. Similarly, out of the 61 visitors from Chihuahua, Chihuahua, 6 (9.84%) showed negativity towards payment, and 55 (90.16%) would pay. Finally, 18 (100%) visitors from Parral, Chihuahua expressed willingness to pay.

Table 1. Place of residence of visitors to PNA Cerro Mohinora

Place of residence	Visitors	Relative frequency (%)
Guadalupe y Calvo, Chihuahua, México	102	48.57
Chihuahua, Chihuahua, México	61	29.05
Parral, Chihuahua, México	18	8.57
Guachochi, Chihuahua, México	7	3.33
Delicias, Chihuahua, México	4	1.90
Culiacán, Sinaloa, México	3	1.43
Durango, Durango, México	3	1.43
Juárez, Chihuahua, México	3	1.43
Badiraguato, Sinaloa, México	3	1.43
Balleza, Chihuahua, México	1	0.48
Cuernavaca, Morelos, México	1	0.48
Oklahoma, Oklahoma, EE.UU.	1	0.48
Obregón, Sonora, México	1	0.48
Texas, EE.UU.	1	0.48
Torreón, Coahuila, México	1	0.48
Total	210	100.00

Relationship between the educational level of the respondents and willingness to pay (WTP)

In relation to the education of the respondents, it is observed that 55.24% of them have a university degree, 18.57% have completed high school and 10.48% have obtained a master's degree, these three levels represent 84.29% of the total number of visitors (Figure 3).

Regarding the above, there were 116 visitors with university studies, of which 8 (6.90%) responded negatively to WTP and 108 (93.10%) responded positively. On the other hand, 39 respondents with secondary education were registered, of which 5 (12.82%) responded negatively and 34 (87.18%) responded positively, finally for those with a master's degree, there were 22 respondents, of which 3 (13.64%) were not willing to pay and 19 (86.36%) were willing to pay.

It can be observed that the level of studies, in general, is not a variable that directly influences the willingness to pay of PNA visitors, since almost all of them will acquire a percentage higher than 80%, except for the doctorate level. However, this may be due to the small number of surveyed visitors with that level of education.

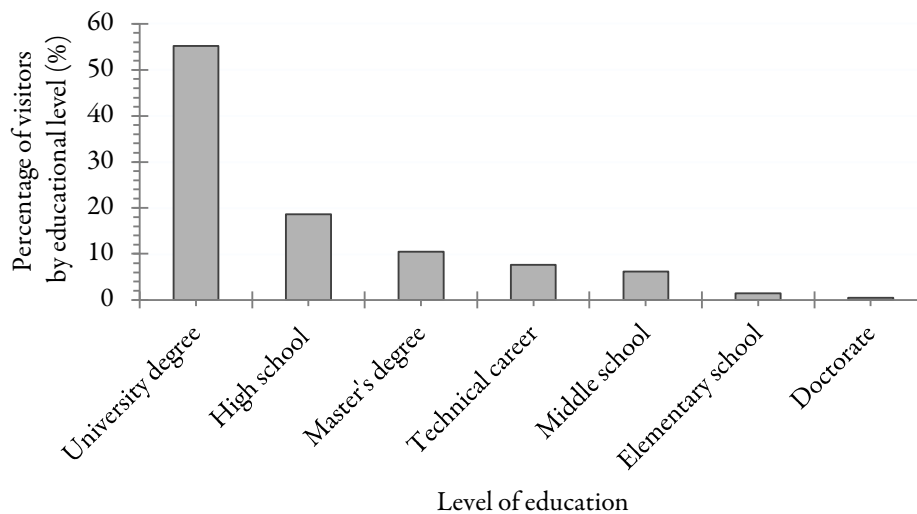


Figure 3. Level of education of the respondents (ordered in descending order)

Main activities carried out by visitors to the PNA and their willingness to pay (WTP)

The main activities carried out in Cerro Mohinora are ecotourism with 60.48%, according to Sectur (2016). This type of activity includes wildlife and flora observation, observation of special nature phenomena and attractions, and interpretive hiking. Adventure tourism was the second most relevant activity in the area (26.67%), which includes hiking, spelunking, rock climbing, mountain biking, high-altitude mountain activities, horseback riding, as well as enduro, picnics, and camping. Other main responses from the survey participants regarding their activities in Cerro Mohinora were research (5.24%) and conservation activities (3.81%). Analyzing the willingness to pay of the respondents who mainly engage in the two main activities, out of 121 ecotourism visitors, 11 (9.09%) of them are not willing to pay for the conservation and/or improvement of the environmental services of the mountain, while 110 (90.91%) would; on the other hand, out of the 56 adventure tourism visitors, 4 (7.14%) of them did not provide a WTP response, and 51 (92.86%) did (Figure 4).

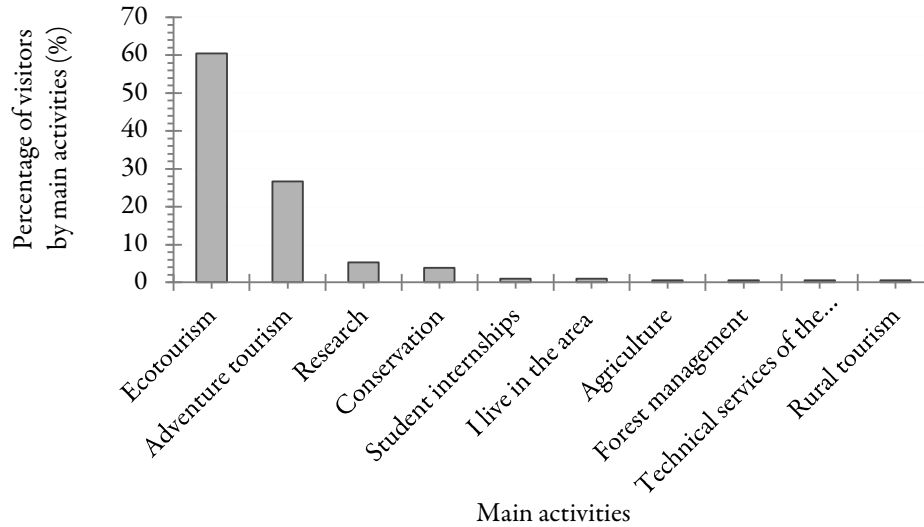


Figure 4. Main activities of the respondents in Cerro Mohinora (sorted in decreasing order)

Main problems detected by visitors to the PNA and their willingness to pay (WTP)

Regarding the perception of problems in the area, the main response was the poor condition of the roads (30.39%), as visitors indicate that only 4x4 vehicles can access the top of the PNA. Another mentioned problem was litter (29.41%) and illegal logging (10.78%). Despite visitors identifying some issues in the area, their willingness to pay is not affected. From the 110 respondents who indicated that there is poor road condition, 13 (11.82%) do not have a willingness to pay, while 97 (88.18%) would pay. Meanwhile, of the 30 respondents who mentioned litter as one of the main problems in the area, only two (6.67%) would not be willing to pay to improve the area, but 28 (93.33%) would (Figure 5).

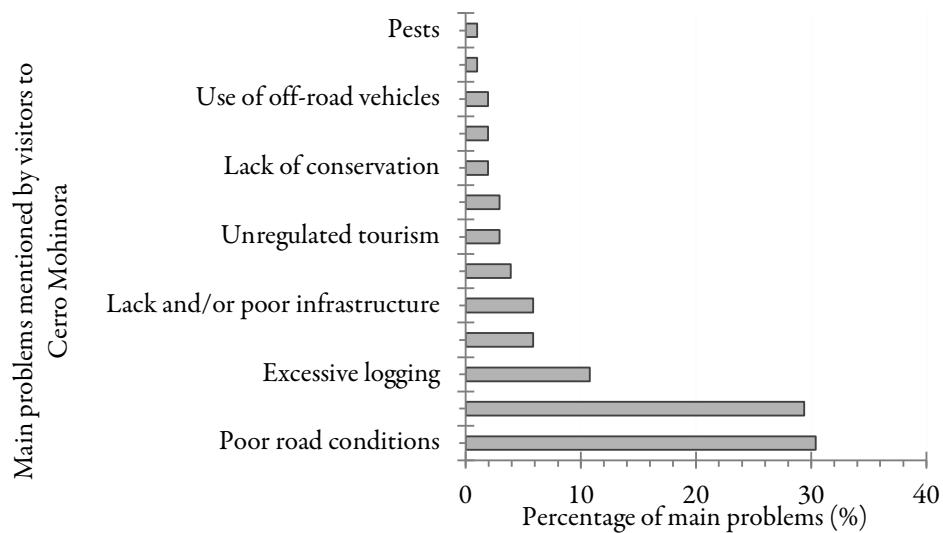


Figure 5. Main problems mentioned by visitors to Cerro Mohinora

Main suggestions proposed by visitors to the PNA

After detecting the problems, visitors were asked to make some suggestions that, according to their vision, could improve the state of the area (Figure 6). Among the main suggestions is road maintenance

(55.00%), which was one of the main problems. Similarly, establishing garbage deposits (16.00%), providing greater security for visitors (9.00%), and improving infrastructure were suggested. Within the latter, they commented that existing cabins could be improved, a viewpoint could be enabled, bathrooms could be installed, among others. A direct relationship can be observed between the detected problems and the suggestions proposed by the visitors to improve the current state of the PNA.

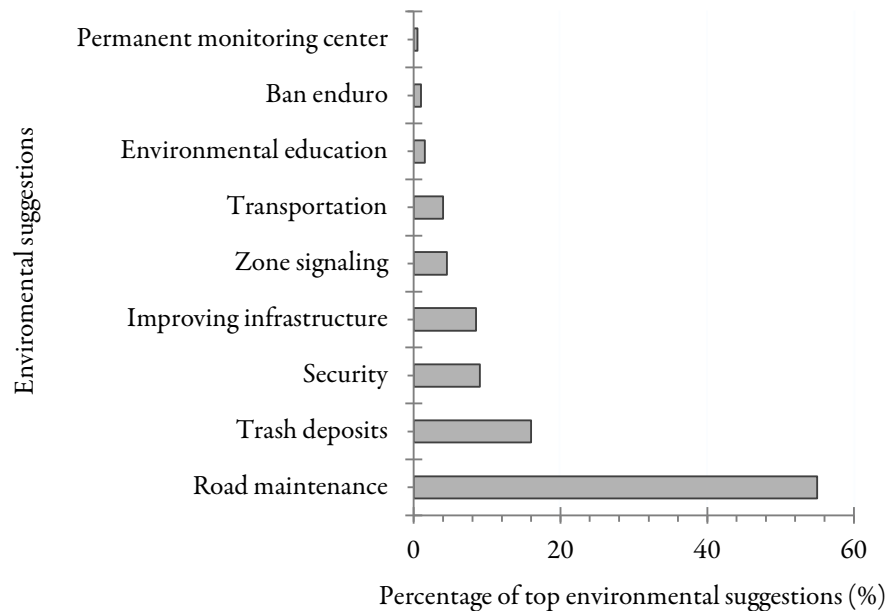


Figure 6. Suggestions from visitors to improve the current state of Cerro Mohinora

Main environmental suggestions proposed by visitors to the PNA

In terms of suggestions for environmental improvements, the most important suggestion made by visitors was to provide more environmental education (32.69%), while reforestation (30.13%) was the second most recommended action (Figure 7). Taking care of flora and fauna and preventing forest fires received 19.87% and 10.26% of the suggestions, respectively. Out of the 51 visitors who suggested more environmental education, 3 (5.88%) did not express their willingness to pay (WTP), while 48 (94.12%) of them did. On the other hand, there were 52 visitors who suggested more reforestation, out of which 3 (5.88%) gave a negative response to WTP, while 48 (94.12%) responded positively. This shows a great willingness on the part of visitors to conserve and/or improve the environmental services provided by Cerro Mohinora.

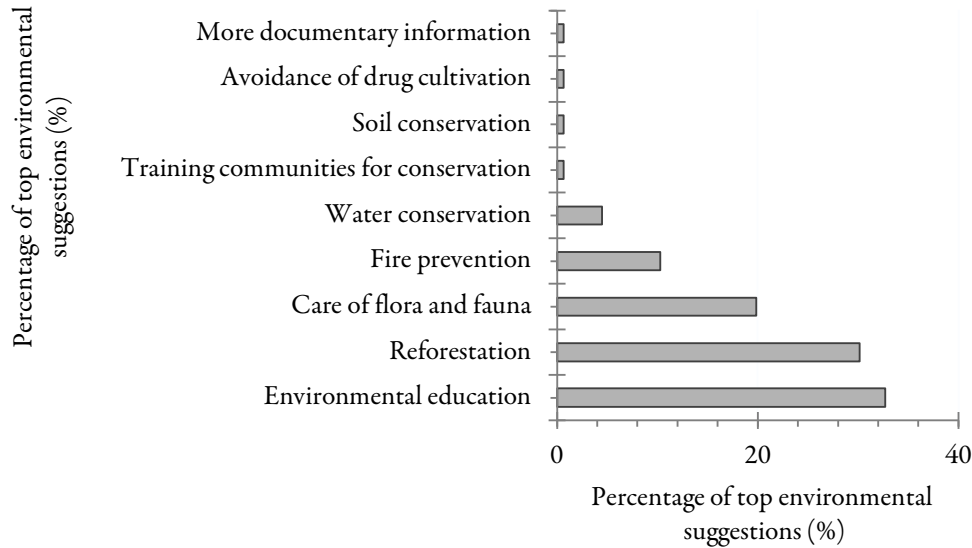


Figure 7. Environmental suggestions from visitors to improve the current state of Cerro Mohinora

Econometric model of logistic distribution and influence of factors on willingness to pay (WTP)

Table 1 shows the results of the logistic model where not all variables behaved as expected, and the model had a low Nagelkerke R² of 0.068. The inconsistencies observed in these results may be due to the survey format used, which can introduce biases such as protest response bias, upward social desirability bias, and hypothetical bias. These biases can influence how individuals respond, leading them to present themselves in a more favorable light to others rather than being completely honest or accurate in their responses (Azqueta, 1994; Champ and Bishop, 2001; List *et al.*, 2004). For the present study, it is possible that the respondent ignored the idea that simulates an improvement in the environmental services of the protected natural area or induced errors in the formulation of the questions, as well as the means by which it was conducted. Despite this, the significance level of the model according to the Hosmer and Lemeshow test was 0.228 (>0.05), with a chi-squared value of 10.55 with eight degrees of freedom, so the null hypothesis that there are no significant differences between observed and expected frequencies is accepted. It can be seen that, according to the results of the logistic regression analysis, the variables “Perception of good ecosystem quality (PGEQ)” and “Perception of ecosystem degradation (PED)” are the only ones that seem to influence a positive WTP by of the visitors. However, when examining the P values, we found that only the PGEQ variable is statistically significant (p = 0.044). This tells us that the perception of good quality of the ecosystem is an important factor that motivates a positive WTP of the visitors. On the other hand, the variables “Age”, “Level of studies” and “Presence of concern for the environment (PEC)” seem to influence a negative response in the WTP. However, none of these factors reach statistical significance according to the model (P values of 0.294, 0.772 and 0.717 respectively). This suggests that, in this particular context, age, educational level and concern for the environment do not have a significant impact on the WTP of visitors.

The estimated coefficients in Table 2 were used to develop the following equation and determine the visitors' willingness to pay for the mountain.

$$DAP = -.20026192 - 0.020848AGE - 0.028695LED + 1.171766PGEQ + 0.996295PED - 0.393599PEC + e$$

Table 2. Estimated coefficients of the model and marginal effects

Variable	Coefficient	Standard error	Wald	P Value	Exp (B)
AGE	-0.020848	0.019847	1.103427	0.294	0.979
LED	-0.028695	0.098987	0.084035	0.772	0.972
PGEQ	1.171766	0.583140	4.037717	0.044	3,28
PED	0.996295	0.570592	3.048767	0.081	2.78
PEC	-0.393599	1.087843	0.130911	0.717	0.675
Constante	2.482624	1.862156	1.777419	0.182	11,973

*LED = Level of education, PGEQ = Perception of good ecosystem quality, PED = Perception of ecosystem degradation, PEC = Presence of environmental concern, and Exp (B) = Marginal effects.

Even though the obtained model was not significant, the average WTP calculated was 90.48 MXN as the economic value assigned by visitors to preserve the environmental services of Cerro Mohinora. The WTP had a minimum and maximum of 68.12 MXN and 97.60 MXN, respectively, and a standard deviation of 5.55 MXN.

Several national-level studies have used this methodology to value environmental or recreational services. For instance, Lugo *et al.* (2020) calculated a WTP of 9.00 MXN for valuing environmental services of Monte Tláloc in Texcoco, State of Mexico, using the same methodology. Similar to this study, the variables that had the most impact on the model were the environmental perception, level of education, concern for the environment, and level of family income.

De Yta-Castillo (2013) estimated the economic value of recreational and tourism services associated with the use value of the cloud forest in the Pluma Hidalgo area. The WTP for preserving the ecosystem was 85.12 MXN, and the study mentioned that the probability of people accepting the offered payment increases with higher education and income levels. In our study, despite expecting that the level of studies would influence the WTP, this was not the case, but the perception of good quality of the ecosystem did influence it.

In the Conchos River in Chihuahua, willingness to pay for recreational services associated with the river was estimated, resulting in a WTP of \$0.60 MXN per capita (Valdivia *et al.*, 2009). Similar to the present study, the authors mention possible biases generated by design errors in the hypothetical market for environmental services and in the survey application, although they obtained a very low WTP.

Tecpan *et al.* (2016) aimed to estimate the WTP for the conservation of Tezcutzing Hill in Texcoco, State of Mexico, detecting problems such as vegetation coverage reduction, deforestation, visitor waste pollution, erosion, poor garden conditions, and forest resource extraction. They obtained a value of 41.89 MXN per capita, which was influenced similarly to ours by environmental perception, price, income, and visitor gender.

The Sierra La Laguna Biosphere Reserve has also been valued by calculating the WTP, determining an extra amount to pay for entry ranging from 69.00 MXN to 108.00 MXN through probit models of the Contingent Valuation Method. The results show that the most influential variable was the price, where the probability of accepting payment decreases as the proposed tariff increases (Almendarez *et al.*, 2016). In the present study, no price was proposed, but rather respondents were given the freedom to propose their own willingness to pay.

In Mexico City, the San Juan de Aragón Forest was valued, resulting in a WTP of 7.36 MXN per person per entry (Hernández *et al.*, 2019). The most significant variables in the proposed price were age, gender, marital status, family income, number of members, current situation, and level of satisfaction. The only variable that coincides with this study is the “Perception of ecosystem degradation (PED)” variable, which was positive but not significant.

Worldwide, this methodology has also been used to determine the economic value of natural goods or services. Ghanbarpour *et al.* (2011) determined the WTP of visitors to the recreational park Baba Aman in Iran, which is surrounded by valleys and a mountainous area with potential for environmental and recreational

exploitation. Possible entry fees were associated with two scenarios containing current conditions and proposed improvements to recreational services. They obtained an average WTP of 751.9 IRR (0.32 MXN/0.018 USD) and 1147.7 IRR (0.49 MXN/0.027 USD) for scenarios one and two, respectively. The WTP for scenario one had a correlation with the variables of monthly income ($\alpha = 0.01$) and education ($\alpha = 0.05$), while the WTP2 had no relation with any variable. The calculated WTP values are immensely lower than ours; however, the method adapts to the conditions that each place lives in.

Samdin (2008) also estimated the recreational value of the Baba Aman Natural Park in northeastern Iran. He found that international visitors were willing to pay 18.47 RYM (75.99 MXN/4.18 USD) for entry permits, while locals only paid 6.32 RYM (26.00 MXN/1.43 USD). The study does not mention what influenced this WTP; however, 65.1% are willing to pay to conserve and preserve the national park for future generations, thus showing environmental concern for the area. The calculated WTP for international visitors is relatively close to that expressed in this work, although it does not mention any generated model.

Adams *et al.* (2008) used the same methodology to determine the WTP to conserve the Morro do Diabo State Park and the Atlantic Forest areas in São Paulo, Brazil. According to the results, there was a high percentage (35.9% and 38.5%) of people who showed no willingness to pay and voted as a form of protest. However, the population is willing to pay USD 1.68 (MXN 30.52) for the conservation of the park and USD 1.31 (MXN 23.80) for the Atlantic Forest. According to the results, there is a significant relationship between the population's ability to pay and the conservation value, which increases as the income level increases. It is worth noting that in this study, there were few zero payments (9.52% of respondents). Protest votes are usually presented when respondents believe that conserving natural areas is the government's responsibility.

In the Annapurna Conservation Area (ACA), Nepal, Baral *et al.* (2008) applied the contingent valuation method (CVM). The results of the logistic regression showed that the amount offered, family size, visitor satisfaction, use of a guide, and group size were the most significant predictors of willingness to pay for the conservation of the area. The average WTP was 69.2 USD and the most common reason given by respondents for having a positive WTP was the desire to better protect the environment. On the other hand, the most common reason for not being willing to pay was the high cost of the offer. This WTP is much higher than the one determined here, because the ACA receives many visitors annually as it is managed by an autonomous non-governmental organization, the National Trust for Nature Conservation (Baral *et al.*, 2008). Additionally, the easy access and well-developed infrastructure of the destination have made it one of the most popular trekking destinations in the world. Due to the elevation varying from 1000 m to over 8000 m, there is a wide variety of forests (22 types), including the world's largest rhododendron forest, and 1140 plant species. Additionally, there is a high amount of wildlife species, including 101 mammal species, 478 bird species, 32 reptile species, and 21 amphibian species (Baral *et al.*, 2008); the high diversity contained adds tourist attraction that increases the WTP by visitors, mainly from abroad.

According to the aforementioned, the amount of income that can be generated from charging an entrance fee to the Cerro Mohinora PNA must be strongly accompanied by improving the attraction and facilities of the place, as is the case with ACA in Nepal (Baral *et al.*, 2008). One strategy could be to start by taking into account the issues mentioned in these results, where the poor state of the roads and the presence of garbage are identified as the main problems (Figure 5), coinciding with suggestions to improve the current state of the hill, such as maintaining the roads and installing garbage containers (Figure 6), where safety and improving infrastructure are also mentioned, which would be vital to creating suitable conditions for visitors. The results demonstrate that visitors to the hill are willing to maintain and/or improve its conditions, and they also see the need for environmental education, which goes hand in hand with the problems and suggestions mentioned.

In their study on the Bali province of Indonesia, Setini *et al.* (2021) mention that income generation, environmental education, community participation, economic and infrastructure development, as well as service and control, are essential factors to consider in ecotourism practice to improve its performance. These

aspects are considered strategic management priorities to build quality tourism experiences and promote sustainable tourism.

Conclusions

The present study provides information on the willingness to pay of visitors to the Cerro Mohinora Protected Natural Area, thus offering a first approach to understanding the current situation of the mountain and its possible areas for improvement from the perspective of visitors, both local and foreign. Although the statistical analysis did not faithfully yield what was expected, the research in general adheres to the expected hypothesis, it reveals that visitors are concerned about the conservation of the area and are willing to pay for it, since 90.48% (190 respondents) answered affirmatively to the question about their disposition. The estimated willingness to pay (90.48 MXN) appears to be a reasonable payment that can be used as a basis for establishing an entry fee in future management plans for the ANP. This possible payment would represent direct income from ecotourism and adventure tourism, sectors that represent 87.14% of visits, which would substantially contribute to the improvement of the studied site, especially in the main problems detected, such as the poor condition of the roads and the presence of garbage, jointly manifested by 59.80% of respondents. This study suggests that the entrance fee to the mountain should be analysed and consistent with the values of use of the place. A low fee would generate little income for park administration and might not achieve the objective of conservation, and the current problems might persist. On the other hand, a high fee could decrease the number of visits and affect the execution of the main activities of the mountain. We can conclude that the determination of the entrance fee should be established in proportion to the number of visitors and the values of use provided by the mountain, considering that currently it has no cost and 90.48% of visitors are willing to pay to enter.

Authors' Contributions

Responsible for research idea, designing the experiment, and writing the manuscript: SAGG. Support in experiment design and overall coordination: EAR. Support in data analysis: EAR, OAAC, and JRS. General revisions and corrections: EAR, OAAC, JRS, EJTG, LGCR, ACCC.

All authors read and approved the final manuscript.

Ethical approval (for researches involving animals or humans)

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Conflict of Interests

The authors declare that there are no conflicts of interest related to this article.

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