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ECONOMIC VALUATION OF ECOSYSTEM SERVICES FOR THE MAINTENANCE OF TOURISM ACTIVITY IN THE CENTRAL AMAZON, BRAZIL

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Resumo

Valoração econômica de serviços ecossistêmicos para a manutenção da atividade turística na Amazônia Central, Brasil. A valoração dos serviços ecossistêmicos fornece informações essenciais que possibilitam estimar o valor econômico de recursos ambientais e os seus benefícios. O objetivo deste estudo foi estimar o valor dos serviços ecossistêmicos culturais da floresta prestado à manutenção da atividade turística de Presidente Figueiredo, Amazonas. Utilizou-se o método de valoração de contingência (MVC) para estimar a disposição a pagar (DAP) e a disposição a receber (DAR) dos proprietários de terra, comerciantes e outros entrevistados. Os resultados das entrevistas indicam que 71% dos usuários estariam dispostos a pagar um valor, em média, de R$ 16,57 dia^{-1}visita^{-1}, enquanto 100% dos proprietários e outros entrevistados estariam dispostos a receber um valor, em média, de R$ 327,63 ha^{-1}ano^{-1}, como pagamento e compensação pela conservação das florestas na região. Concluiu-se de que a maioria dos entrevistados concordou que valorar os serviços ecossistêmicos da floresta é fundamental para a manutenção da atividade turística.
Palavras-chave: Turismo, método de valoração de contingência, conservação das florestas, Presidente Figueiredo.

Abstract

The valuation of ecosystem services provides essential information that makes it possible to estimate the economic value of environmental resources and their benefits. The aim was to estimate the value of the forest's cultural ecosystem services provided to maintain tourist activity in Presidente Figueiredo, Amazonas. The contingent valuation method (CVM) was used to estimate the willingness to pay (WTP) of users (tourists and visitors) and the willingness to accept (WTA) of landowners, local business owners and other interviewees. The results of the interviews indicate that 71% of users would be willing to pay an average of R$16.57 day^{-1}visit^{-1}, while 100% of interviewees would be willing to conserve the forests in exchange for receiving R$327.63 ha^{-1}year^{-1}. In conclusion, most of the interviewees agreed that valuing the forest's ecosystem services is fundamental to maintaining tourist activity.
Keywords: Tourism, contingent valuation method, forest conservation, Presidente Figueiredo.

INTRODUCTION

Cultural ecosystem services, such as those provided by tropical forests, such as scenic beauty, heritage, leisure and their subjective dimensions associated with tourism, are of great importance in maintaining tourism activity (LA NOTTE *et al*., 2017; BACHI *et al*., 2020). Ecosystem services are decisive for the proper functioning of our planet's life-support system, because they contribute to human well-being in general, both directly and indirectly. However, deforestation and forest degradation destroy the services nature provides, damaging many activities, including tourism, which uses the forest for scenic beauty and recreation.

Pereira e Camargo (2014) point out that ecosystem services produce benefits, both local and regional, that include water and nutrient recycling, fire control, erosion control, scenic beauty, recreation, watershed protection, as well as global benefits that include carbon storage in the earth's system, primary production and maintenance of biodiversity. In addition, there are studies carried out on the economic benefits of a standing tropical forest and the estimation of these lost economic benefits resulting from deforestation (SOARES-FILHO *et al*., 2017). As an example of this, Strand *et al*. (2018) calculated the value that the forest provides and determined that the areas with the highest biodiversity value in the Central Amazon can generate up to US$ 737 ha^{-1} year^{-1}, a much higher total value and benefit than that generated by extensive livestock in the Brazilian Amazon.

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In this context, economically valuing ecosystem services has the potential to be a key element in environmental policymaking, as it turns the benefits of nature that are invisible to society into visible benefits for the population (LARA-PULIDO; GUEVARA-SANGINÉS; ARIAS MARTELO, 2018). In addition, quantifying ecosystem services is an essential part of efforts to ensure that forest conservation is economically rewarded, creating incentives to maintain it rather than destroy it (CRANFORD; MOURATO, 2014; FEARNSIDE, 2018).

Presidente Figueiredo is one of the municipalities located in the state of Amazonas, specifically in the Central Amazon, made up of tropical forests that provide ecosystem services and possess scenic beauties that are found within its natural tourist attractions, which directly or indirectly benefit all living beings, including human beings. However, there is a lack of information on the economic return for forest conservation associated with tourism in Presidente Figueiredo. Given this situation, authors such as Torres-Miralles *et al.* (2017), Vásquez e De Rezende (2018) recommend applying the Contingency Valuation Method (CVM), a procedure widely used to value ecosystem services by estimating the economic values of non-market goods and services.

Thus, allowing the incorporation of "non-use" or "passive" values, with the purpose of assisting in the policies and decision-making of the actors involved in a given region (ALVES-PINTO *et al.*, 2018). In this approach, participants are usually asked how much they are willing to pay (users) and willing to accept (public or private employees or landowners) in compensation for some change in the quality or availability of ecosystem goods and services (MITCHELL; CARSON, 1990; VAN DEN BERG; GAFNI; PORTRAIT, 2017). In this context, the main hypothesis of the study was that people would be willing to pay or accept, in monetary amounts, for the conservation of forests that provide ecosystem services to maintain tourism activity through the contingency valuation method. Therefore, the aim of this study was to estimate the value of forest cultural ecosystem services provided to maintain tourism activity in Presidente Figueiredo.

MATERIAL AND METHODS

Presidente Figueiredo is located in the state of Amazonas in the Central Brazilian Amazon. It is a municipality that presents a geographical space characterized by the presence of several tourist destinations, recognized for housing natural attributes of great interest and visitation, attracting users (visitors and tourists) from various parts of Brazil (mainly Manaus) and abroad. The attractions are located within the Caverna do Maroaga Environmental Protection Area (APA) in Presidente Figueiredo (Figure 1). According to Reis *et al.* (2018) and Soria-Díaz *et al.* (2022), the Caverna do Maroaga APA is a conservation unit (UC) in the "Sustainable Use" category, covering an area of 409,264.89 ha, with a predominance of dense tropical ombrophilous forest, and its landscape includes rural settlements, roads, biodiversity, rivers, waterfalls, etc.

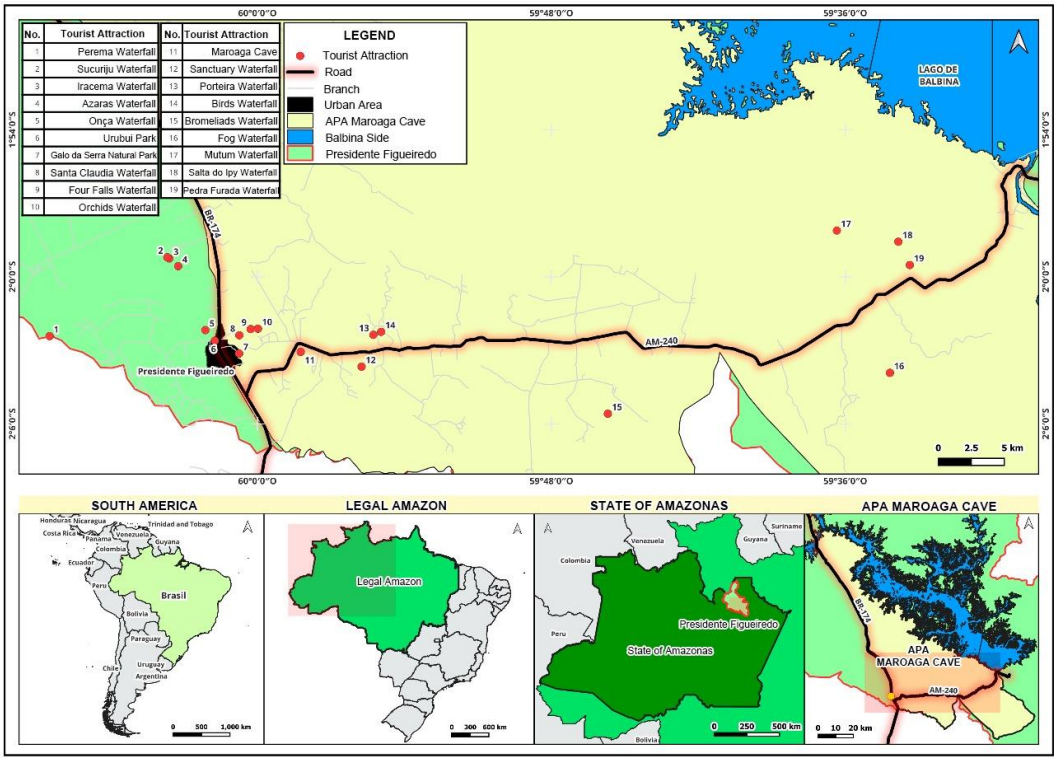

Figure 1. Location of the tourist attractions evaluated in Presidente Figuereido. Source: authors (2024)
Figura 1. Localização dos atrativos turísticos avaliados em Presidente Figuereido. Fonte: autores (2024)

Method

The calculation of the sample size was a complement to the justification of the study's objective, intending to estimate the value of WTP in a hypothetical scenario, a methodology adapted from authors such as Ogunjinmi *et al.* (2022) and Silva-Flores *et al*. (2010). In this case, a total of 420 people were used as the average population who visit the main tourist attractions each weekend (without considering the holiday days, nor the high frequency in the seasons of January and July of each year) for the WTP scenario. The qualitative equation was applied to a finite population:

$$n = \frac{N * Z^2 * p * q}{d^2(N-1) + Z^2 * p * q} \quad (1)$$

Where:
n = size of the sample.
N = minimum average population size of people (420) and maximum average population (900) who visit the tourist attractions each weekend (Saturday and Sunday), according to information from the Municipal Department of Tourism, Entrepreneurship and Commerce (SEMTEC). The minimum average population was taken (N = 420).
Z = Level of confidence (95% = 1.96).
p = proportion of the phenomenon under study in the reference population (positive variability). In this case, no information from previous studies was used, so a value of 50% (0.5) was assumed.
q = proportion of the reference population that does not show the phenomenon under study (negative variability). In this situation, information from previous studies was not used and therefore the value of 50% (0.5) was assumed.
d = error or precision (5% = 0.05).

The resulting sample size was 200 people. In addition, the WTA sample calculation was not performed, because it was considered to apply the structured interview to a person (public official, private or landowner) of each selected tourist attraction, according to the methodology adapted from Silva and Lima (2004). Nevertheless, a pilot test was carried out beforehand in order to distribute the WTP scenario to the participants.

A structured interview was applied according to the proposal of Nascimento *et al.* (2013), which is a data production technique that is based on the use of a questionnaire or survey with closed questions as a data collection instrument. In this study, WTP interviewees were randomly recruited at strategic points in each tourist attraction, such as the entrance, resting places in the resort and forest trails every weekend. Data collection took approximately five months, starting in February and ending in June 2018. In the case of WTA, the interviews were applied in the offices of each public and private tourist attraction. The data collection time was 2 weeks. People ≥ 18 years of age were considered for both WTP and WTA scenarios.

Among the socio-economic characteristics of the participants in the WTP/WTA, the methodology of Silva e Lima (2004) was adapted in this study, where variables such as nationality, gender, age group, schooling and average monthly income were taken into account, in order to apply statistical tests of normality (*Kolmogorov-Smirnov*) and check whether or not the data has a normal distribution. In addition, the *Spearman* correlation method was used on the WTP to check the degree of association between two variables. Finally, based on the methodology adapted from Silva-Flores *et al.* (2010), a *Goodness-of-Fit* was performed on the WTP/WTA (in the event that they did not show a normal distribution). Mehrannia and Pakgohar (2014) indicate that the purpose of goodness-of-fit is to measure the disagreement between the observed values and the expected values under a probability distribution model. The database was processed and analyzed descriptively in R-Studio and EasyFit.

One of the characteristics of ecosystem goods and services is the absence of a market that makes it possible to determine a price or value that signals the use of the resource (MOTA, 2014). In this sense, the CVM was chosen because it is a method widely used for these types of studies (OGUNJINMI *et al*., 2022), being low budget and the most practical to apply, in addition to not requiring a relatively high sample size than other methods, such as the travel cost method (ARMBRECHT, 2014).

The willingness to pay (WTP) and the willingness to accept (WTA) are estimates that make it possible to know the economic value of the demand for many ecosystem goods and services, allowing to determine the most important factors that encourage people to pay/accept certain compensation for the increase in the quality of the service (SILVA; LIMA, 2004). To this end, the following equations were applied: equation 2 calculates the probability of WTP or WTA occurring, equation 3 determines the mean of a probability distribution (WTP/WTA), equation 4 estimates the variance of a probability distribution (WTP/WTA), and finally equation 5 calculates the standard deviation of a probability distribution (WTP/WTA):

$$P(x) = \frac{n(x)}{N} \quad (2)$$

$$\mu = \sum [x * P(x)] \quad (3)$$

$$\sigma^2 = \sum [x^2 * P(x)] - \mu^2 \quad (4)$$

$$\sigma = \sqrt{\sum [x^2 * P(x)] - \mu^2} \quad (5)$$

Where:
x = Represents the amount (R$) of WTP / WTA.
P(x) = Probability of occurrence of an event "x";
n(x) = Number of times the event “x” occurs (number of favorable cases);
N = Total number of realizations or repetitions (number of possible cases);
μ = Average of a probability distribution.
σ^2 = Variance of a probability distribution.
σ = Standard deviation of a probability distribution.

Hypothetical WTP scenario

In this WTP scenario, two types of users were included: visitors and tourists. According to Beni (2000), the term “*visitor*” refers to people who travel to a different place in less than 24 hours, while the term “tourist” includes people who visit a place for a minimum of 24 hours and a maximum of 6 months. In this context, one of the main questions in the structured interview was whether the user would be willing to pay an additional amount in monetary terms for forest conservation when visiting the tourist attractions of Presidente Figueiredo, as well as other questions related to environmental commitment.

Hypothetical WTA scenario

In the case of the WTA, the public of interest were public or private employees or landowners of the attractions. In this sense, one of the main questions in the structured interview was whether the interested party would be willing to receive a payment in monetary terms as compensation for the conservation of forests (m^2, ha, km^2) in the tourist attractions of Presidente Figueiredo.

RESULTS

Socioeconomic characteristics of participants

Among the aspects observed among the participants, the most prominent were: the percentage of gender and the average monthly income. There was a high percentage of male participation in WTP and WTA, representing 58% and 70% of interviewees respectively. The distribution of the average monthly family income of the most frequent participants ranged from < R$900 to R$1500, with a predominance of those individuals with “Higher Education” and employees with an income of up to one minimum wage (R$954 in 2018) distributed in the 18 to 34 age group (Table 1).

In addition, according to the data from the “Schooling” variable, it can be said that the higher the level of education (Higher Education and Postgraduate), they tend to have greater environmental responsibility and commitment to forest conservation than those interviewed with “High School” or only “Elementary School”. In addition, it was found that the values of WTP and WTA, as well as the other variables, do not have a normal distribution (p-value <0.05), according to the *Kolmogorov-Smirnov* normality test.

Finally, according to the *Spearman* correlation coefficient in the WTP, the variables “Age - Average monthly income”, “Age - Schooling” and “Schooling - Average monthly income” were those with a “moderate” intensity of 0.56, 0.44 and 0.38, respectively. However, there was no significant correlation (p-value > 0.05) in all the variables selected and evaluated from the WTP.

Table 1. Socio-economic characteristics of the participants.
Tabela 1. Características socioeconômicas dos participantes.

VARIABLE	WTP (n = 206)			WTA (n=20)		
	Type/Index	**Amount**	**Percentage**	**Type/Index**	**Amount**	**Percentage**
Tourist	Yes	46	22%	Official/Public	9	45%
	No	18	9%	Official/Private	9	45%
Visitor	Yes	101	49%	Landowner	2	10%
	No	41	20%			
Nationality	Brazilian	203	98.5%	Brazilian	20	100%
	Foreigner	3	1.5%			
(*) Gender	Male	119	58%	Male	14	70%
	Female	87	42%	Female	6	30%
(*) Age group (Age)	18 to 34 years old	194	94%	26 to 40 years old	10	50%
	35 to 60 years old	9	4%	41 to 60 years old	8	40%
	> 60 years old	3	1%	> 60 years old	2	10%
(*) Schooling	Elementary School	1	0.5%	Elementary School	2	10%
	High School	14	6.8%	High School	12	60%
	Higher Education	173	84%	Higher Education	6	30%
	Postgraduate	18	8.7%			
(*) Average monthly income (R$)	< R$900	146	70.9%	< R$900	4	20%
	R$900 and $1,500	34	16.5%	R$900 and $1,500	6	30%
	R$1,500 and $3,000	21	10.2%	R$1,500 and $3,000	4	20%
	R$3,000 and $5,000	1	0.5%	R$3,000 and $5,000	4	20%
	> R$5,000	4	1.9%	> R$5,000	2	10%

(*) NOTE ON WTP: Answer = Yes; N = 147; Average = 16.57; Standard deviation = 16.62.

Hypothetical WTP scenario

The results obtained from the WTP indicate that 71.4% of users would be willing to pay for the conservation of forests that provide ecosystem services for the maintenance of tourist activity. The minority of users (28.6%) indicated that they would not be willing to pay, citing economic reasons or the government's obligation to conserve forests. In this sense, the result of this study estimated a value of R$16.57 day^{-1} $visit^{-1}$ (observed value) according to the application of equation 3, a weighted amount per weekend for a frequency of one or two times a year each time you visit Presidente Figueiredo (Figure 2).

It should be noted that 59% of participants (86 users) would be willing to pay up to R$ 10 $visit^{-1}day^{-1}$, 24% (36 users) would pay up to R$20 $visit^{-1}day^{-1}$, 6% (9 users) up to R$30 $visit^{-1}day^{-1}$, and 10% (16 users) would be willing to pay between R$ 40, 50, 60 and 100 $visit^{-1}day^{-1}$ (Figure 2).

In addition, the "Generalized Gamma" probability distribution was the best fit for this case (R$11.72 $day^{-1}visit^{-1}$). The *Kolmogorov-Smirnov* test (D= 0.15432; p-value = 0.0016) was applied to determine the fit adequacy of the probability distribution.

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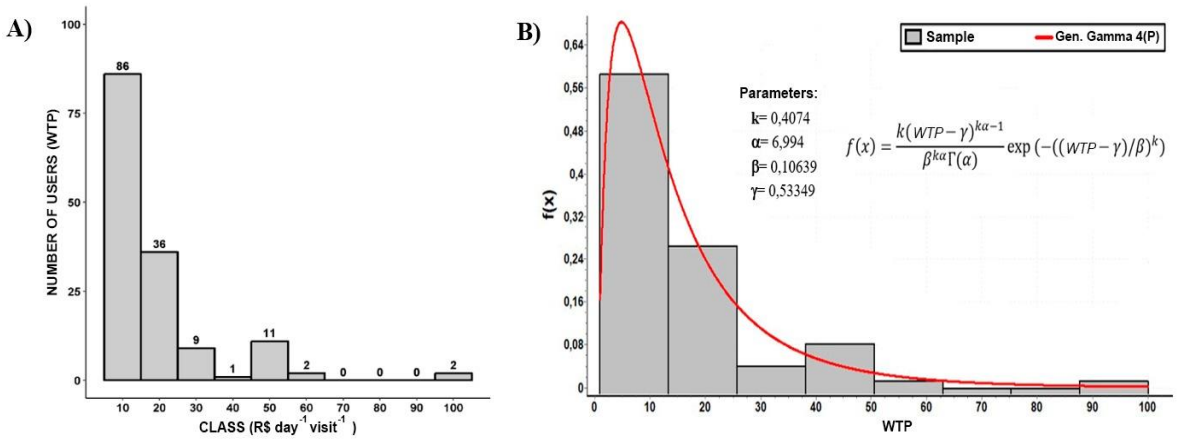

Figure 2. WTP of users: A) Frequency distribution; B) Adequacy of fit of the probability distribution.
Figura 2. DAP dos usuários: A) Distribuição de frequências; B) Adequação de ajuste da distribuição de probabilidade.

Hypothetical WTA scenario

Figure 3 shows that 100% of the participants (public or private employees or landowners) declared that they were willing to accept payment as compensation for conserving forests in tourist attractions, benefiting from the cultural ecosystem services provided by them. In this sense, 60% said they were willing to accept amounts up to R$200, 20% accepted amounts between R$200 and R$600, and the rest (20%), amounts between R$1,000 and R$1,200, based on hectares per year. In addition, the "Fréchet" probability distribution was the best fit for this case (R$105.22 $ha^{-1}year^{-1}$). The *Kolmogorov-Smirnov* test (D= 0.15432; p-value = 0.0016) was applied to determine the fit adequacy of the probability distribution.

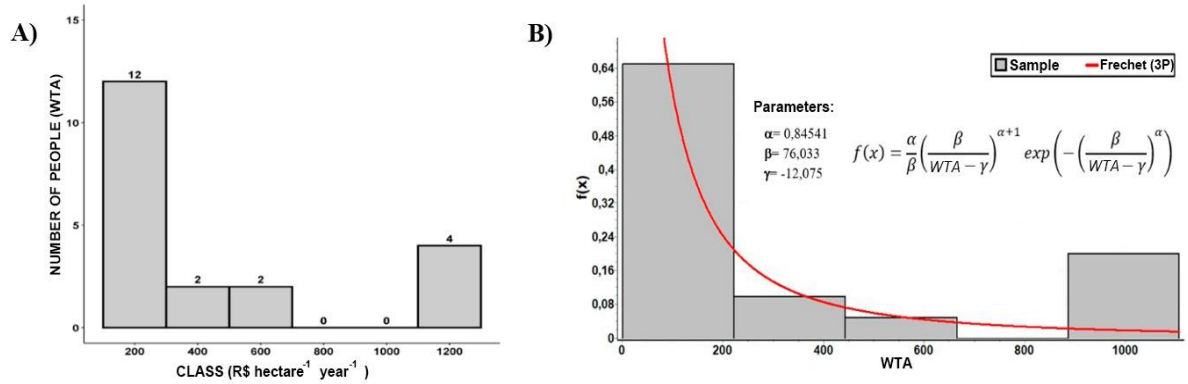

Figure 3. WTA of participants: A) Frequency distribution; B) Adequacy of fit of the probability distribution.
Figura 3. DAR dos participantes: A) Distribuição de frequências; B) Adequação de ajuste da distribuição de probabilidade.

DISCUSSION

Socioeconomic characteristics of participants

Regarding the users' WTP, the less educated interviewees showed less environmental commitment to forest conservation, claiming that users have no obligation to pay for forest conservation in the tourist attractions of Presidente Figueiredo. In this context, users with "Elementary School" education expressed that this competence to pay for forest conservation is totally an obligation of public institutions. In this sense, Nascimento *et al*. (2013) stated that 73% of their interviewees with a "Higher Education" level had a higher degree of environmental understanding in the WTP. However, the study by Silva e Lima (2004) shows the opposite, stating that whatever the type of "Schooling", it is not feasible to say that the more educated people are, the greater their environmental commitment.

On the other hand, although the variable "average monthly income" of the majority of interviewees who expressed their willingness to pay (87.4%) was concentrated in groups 1 (< R$ 900) and 2 (R$ 900 and R$ 1,500), it is not possible to state that the higher the average monthly income (for example > R$ 2,500), the greater the

willingness to pay. Studies by Silva-Flores *et al.* (2010), Nascimento *et al.* (2013) and Silva and Lima (2004) found that the majority of interviewees with an "average monthly income" of R$600, R$1,000 and R$1,800 would be willing to pay for ecosystem services. However, Silva and Lima (2004) observed a positive relationship between income and WTP, i.e. the higher the "average monthly income" of the family, the higher the WTP, due to the fact that they have higher levels of education and are more aware of their environmental commitment. However, this does not mean that it applies to all cases.

As for the results found in the socio-economic analysis of the WTA participants, it was observed that all the interviewees would be willing to accept a monetary value as compensation for the conservation of forests that provide cultural ecosystem services. This is because all WTA interviewees would consent to conserve forests for the use of tourism, provided that the compensation they receive is very high compared to the monetary values that would be obtained for exercising another activity (livestock or agriculture), a process known as "opportunity cost" (MITCHELL; CARSON, 1990; SILVA-FLORES *et al*., 2010).

Hypothetical WTP scenario

Results with values close to this study that used the CVM in other tropical regions, Silva-Flores *et al*. (2010), estimated a WTP of $17.18 per month (Mexican peso), equivalent in Brazilian currency to R$5.13, respectively, with exchange rates of R$0.30 for 1 Mexican peso in 2024. In Brazil, Nascimento *et al*. (2013) determined a WTP of R$1.21, which would be used to conserve the scenic beauty and maintain the tourist equipment and infrastructure at the Mãe Bonifácia State Park in Cuiabá (Mato Grosso). In addition, Silva e Lima (2004) reported a WTP of R$7.88 per month, which would be earmarked for the conservation and maintenance of the Chico Mendes Environmental Park, Rio Branco/AC. It should be noted that the results found for WTP mostly represent estimated values that are very low in relation to the amount estimated in this study (R$16.57 $day^{-1}visit^{-1}$).

In this sense, it should be borne in mind that the comparison of data related to WTP with the studies mentioned above is somewhat limited, due to the different socio-economic and cultural aspects of the places where the studies were carried out. However, the data found in these studies allows us to know an approximation of the estimated value and to check the state of environmental commitment of those interviewed. For example, in relation to the level of education, interviewees with higher education had a higher expectation of being willing to pay, despite the fact that most of them did not have a high average monthly income. The uncertainty of payment affected expectations due to factors such as a lack of real knowledge of the problem in Presidente Figueiredo or a lack of interest in the study, as well as the way in which the financial resources will be managed by the institutions.

On the other hand, the results of the WTP values do not have a normal distribution, so an adjustment fit (*Goodness-of-Fit*) was carried out to measure the disagreement between the observed and expected values. The "Generalized Gamma" probability distribution was the most accurate and adjusted model in relation to the observed data, producing an estimated value of R$11.72 $day^{-1}visit^{-1}$, which represents the "median" of the data, which according to Silva-Flores *et al.* (2010), is a measure considered "robust" in non-parametric probability distributions. In this case, the probability density function curve of the "Generalized Gamma" type showed a trend towards a frequency distribution with positive asymmetry (Average > Median). This behavior is similar to that observed in the results of Mitchell and Carson (1990) and Silva-Flores *et al.* (2010), who presented an exponential distribution trend curve. This means that in the WTP scenario emphasizing the importance of ecosystem services, there was this tendency because most users preferred to be willing to make relatively low payments rather than high ones.

Hypothetical WTA scenario

The estimated value of the WTA using equations (3 and 5) was R$327.63 $ha^{-1}year^{-1}$ (standard deviation of ± 411.29). As in the case of the WTP, the data does not have a normal distribution, so an adjustment was applied to the WTA. The "*Fréchet*" probability distribution was the most appropriate and adjusted model in relation to the observed data, according to the *Kolmogorov-Smirnov* adjustment adequacy. Thus, the result of this adjustment adequacy produced an estimated value of R$105.22 $ha^{-1}year^{-1}$, which represents the "median" of the data. In this context, the result is moderately different but still has the same trend as the WTP (Average > Median). The WTA curve shows that most of the interviewees (public or private employees or landowners) agreed to receive a slightly high payment or compensation (R$327.63 $ha^{-1}year^{-1}$) instead of accepting a moderately acceptable payment or one adjusted to reality, a result similar to those found by Silva-Flores *et al.* (2010).

There are three probable reasons for this. The first is that there could have been a failure of market valuation, i.e. a deficient and imperfect knowledge of the importance and real value of the ecosystem services that forests provide to maintain tourism activity in the region. Furthermore, the intangible benefits that could become tangible benefits for society's well-being are unknown. The second is that the sample size evaluated for estimating the WTA was relatively small, in order to achieve the acceptable distribution levels found in other studies. Finally,

the third is that the information may have reflected a very common problem in studies that use CVM, according to Silva-Flores *et al.* (2010): the presence of hypothetical errors that stand out with small samples.

According to Silva and Lima (2004) and Silva-Flores *et al.* (2010), the value offered in the WTA has always been higher than the value granted as WTP, due to the fact that the tendency of individuals to accept a high amount of WTA is because they reject the implicit role of WTP. In this case, most individuals would agree to always protect a natural resource, as long as the compensation they receive is significantly high compared to the gains they would get from carrying out another activity, reflecting the "opportunity cost (ALVES-PINTO *et al.*, 2018; WEST *et al.*, 2018)." Additionally, authors such as Mitchell and Carson (1990) indicate that when individuals manifest themselves in an environment of risk, uncertainty or caution and do not have the time available to make a decision, they offer a low level of WTP (high WTR) compared to a high level of WTP (low WTA).

CONCLUSION

- The estimated and adjusted value of the WTP was R$11.72 $day^{-1}visita^{-1}$, while 100% of the WTA interviewees declared an adjusted value of receiving R$105.22 $ha^{-1}year^{-1}$ as payment and compensation.
- The CVM applied to the conservation of standing forests in the Amazon made it possible to check people's level of environmental commitment and identify the main concerns with environmental problems (deforestation, forest degradation, human pressure) that occur and influence tourism activity in Presidente Figueiredo.
- The estimated WTP found in this study could contribute as a reference for further research, with a view to its incorporation into the Management Plan for the "Caverna do Maroaga" Environmental Protection Area by actors involved in environmental governance in Presidente Figueiredo.

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