sociedade & natureza

DOI: 10.14393/SN-v32-2020-54557
Received: 21 May 2020 | Accepted: 03 November 2020

Papers

Economic valuation of ecosystem goods and services in the Serra da Capivara National Park: an approach based on the Travel Cost Method

Elinne Nastasha Carvalho Sousa Val[1]
Alain Hernández Santoyo[2]
Deive Ciro de Oliveira[3]
Weimar Freire da Rocha Jr[4]

Keywords:
Environmental economics
Revealed Preferences Method
Recreational Use Value
Consumer Surplus

Abstract
This article aimed to estimate the recreational use value of ecosystem goods and services in the Serra da Capivara National Park, located in the south of the state of Piauí, in the Northeast of Brazil, with a notable attraction of tourism based on nature, history and culture. The Travel Cost Method was used through the application of an online questionnaire for tourists who made visits to the location, whose information was collected during the month of June 2019. It was found that the profile of visitors includes, mostly, people with a higher level of schooling and income level, which rated the observation of the landscape in the viewpoints, visits to the Museum of Nature and the archaeological sites more highly. As a consensus, almost all users and non-users recognize the relevance of this natural space and are willing to pay an entrance fee, which would help in its conservation and support. The recreational use value of the Serra da Capivara National Park estimated from the Cost of Travel Method was R$ 7.1 million per year, a result that although impressive, may still be underestimated, since the estimated potential use value reached R$ 2.1 billion, confirming the importance of investments in infrastructure for the reception of visitors, as well as in environmental protection mechanisms that provide knowledge and maintenance of the ecological integrity of the Park and the economic tourism activity that it sustains.

[1] Universidade Federal de Alfenas – UNIFAL/MG, Programa de Pós-Graduação em Economia (PPGEconomia), Campus Varginha, Minas Gerais, Brazil. elinneval@gmail.com.
[2] Universidade Federal de Alfenas – UNIFAL/MG, Programa de Pós-Graduação em Economia (PPGEconomia), Campus Varginha, Minas Gerais, Brazil. santoyocuba@gmail.com.
[3] Universidade Federal de Alfenas – UNIFAL/MG, Instituto de Ciências Sociais Aplicadas (ICSA), Campus Varginha, Minas Gerais, Brazil. deive.oliveira@unifal-mg.edu.br.
[4] Universidade Estadual do Oeste do Paraná – UNIOESTE, Programa de Pós-Graduação em Desenvolvimento Regional e Agronegócio (PGDRA), Campus Toledo, Paraná, Brazil. wrochajr2000@gmail.com.

INTRODUCTION

Since the end of the 19th century, there are records of the existence of protected natural areas that aim to preserve and avoid environmental degradation. Although they are essential to protect the biophysical space, it is necessary to involve society in this purpose, through cultural, educational, scientific, socioeconomic and recreational activities, which, according to Mesquita et al (2015), have commercial purposes capable to generate financial income, social and economic development in different locations around the world. Among the multiple activities mentioned, recreational activities have experienced a relevant expansion in people's demand to make use of a high-quality environment that offers services for leisure and the enjoyment of nature (JUAREZ; CAÑETE, 2013).

As a result, tourism intentions become an opportunity to raise money as people of different origins visit and consume products and services (AGUIAR; CARVALHO, 2012, apud MESQUITA et al, 2015). Thus, tourism and culture became the two most profitable activities of the 20th century (RICHARDS, 2010, apud MESQUITA et al, 2015). The cultural dimension of tourism, therefore, involves visiting historic sites, archaeological sites, museums, and other locations that enable experiences of knowledge and participation in the history of the visited heritage (FERREIRA, 2013, apud MESQUITA et al, 2015). Recreation areas offer several benefits, from those that can be valued in formal markets to those considered intangible, which require the application of techniques to estimate their values. Thus, considering the socioenvironmental advantages they represent, economic valuation studies intending to quantify them are extremely important to support the management process of public environmental policies (SOUSA; MOTA, 2006).

It is in this context that the creation of the Serra da Capivara National Park in 1979 is inserted, as a way of protecting more than a thousand of archaeological sites in the region (PESSIS; GUIDON, 2007, apud MESQUITA et al, 2015; ICMBIO, 2019) housing over 40,000 cave paintings (OLIVEIRA FILHO; MONTEIRO, 2009, apud MESQUITA et al, 2015). Because it is geographically wide, the Park extends over four municipalities: Brejo do Piauí, Coronel José Dias, João Costa and São Raimundo Nonato, all in the state of Piauí, in the Northeast region of Brazil.

Given the magnitude and the valuation search, the economic analyzes of the natural environment, which has emerged in the 1960s and 1970s to promote the best use of resources (ANGELO; CARVALHO, 2007) and discovering the importance that individuals give to environmental functions, will serve as an instrument to achieve the objective of this research. Thus, this research sought to estimate the recreational use value of the ecosystem goods and services of the Serra da Capivara National Park using a revealed preference method, specifically the Travel Cost Method (TCM), through the expenses incurred by tourists who frequent the region, in order to investigate the explanatory variables about the tourist profile and perception, and what the experience, cultural products and services have to offer. The hypothesis underlying this research is that the rate and frequency of visits are influenced by travel costs and visitation decreases with increasing distance to go.

MATERIALS AND METHODS

Study Area

Created by Decree 83.548, of June 5, 1979, with 129,139 hectares of area, the Serra da Capivara National Park is the center of attention of archaeologists and scholars from all over the world (SETUR-PI, 2019). Located in the northeastern semiarid, bordering two geological formations, with mountains, valleys and plains, the Park is home to a fauna and flora specific to the caatinga (ICMBIO, 2019). It has a variety of objects registered and under study, which have helped to clarify the settlement of the Americas, such as funerary urns, indigenous burials, fossils of mastodons, horses, llamas, saber-toothed tigers, sloths and giant armadillos and human fossils, dating from four thousand and a half years ago (SETUR-PI, 2019). The discoveries took on such a dimension that in 1986 the American Man Museum Foundation - FUMDHAM was created, directed by the São Paulo archaeologist Niède Guidon, responsible for searching new traces and cataloging discoveries, as a manifestation of the wealth left by prehistoric civilizations through their cave paintings representing hunting rituals, animals of the time, everyday scenes and human figures (SETUR-PI, 2019).

According to the Ministry of Tourism, the Park can receive two million tourists per year, given that it has infrastructure with access to one hundred and seventy-three archaeological

sites open to visitors (MTUR, 2019). However, currently the annual average of just twenty thousand visits is far below that potential (MTUR, 2019). As for access, it has three hundred kilometers of car trails and approximately one hundred kilometers marked for pedestrians, as well as adaptations to serve people with reduced mobility (CARVALHO, 2012, apud MESQUITA et al, 2015). In terms of human resources, the reference survey indicated the availability of thirty-five tour drivers (OLIVEIRA FILHO; MONTEIRO, 2009, apud MESQUITA et al, 2015). Currently, there is no admission fee. The guide service (mandatory in circuit activities) is paid separately to registered drivers (ICMBIO, 2019). As for the economic activities developed in the surroundings, the relevant presence of the craft trade deserves to be highlighted, which portrays the culture of the cave people and their legacy (OLIVEIRA FILHO; MONTEIRO, 2009, apud MESQUITA et al, 2015). Subsistence agriculture and animal breeding are also notable, since the practice of tourism gained strength in the region only after the 1990s (MESQUITA et al, 2015).

Endowed with an extraordinary beauty, the main attraction of the Park are the landscapes and archaeological sites with rock paintings and graphisms engraved on the sandstone walls (ICMBIO, 2019). In addition to the formation of canyons and gigantic walls, it preserves panels that portray the life of the former inhabitants, the fauna and flora of the countryside. The complex also includes the American Man Museum which holds a valuable collection of lithic pieces, skeletons, ceramics and artifacts from archaeological excavations, the result of more than four decades of research in the region by universities in Brazil and the world (MTUR, 2019). In Coronel José Dias, there is the Nature Museum, which offers tourists an interactive tour showing the creation of the universe, the climatic impacts and the constant transformations of fauna and flora (MTUR, 2019).

The Boqueirão da Pedra Furada, a geological monument symbol of unity and the largest natural panel of rock paintings on the planet, contains graphic forms of communication from prehistory (MTUR, 2019). In addition, the Park also reserves historical sites, such as houses of former *maniçobeiros* (maniçoba tree latex extractors) that inhabited the place, who lived from the collection of input until the mid-twentieth century, concentrated in the Serra Branca region - on the Maniçobeiros Trail. The fauna is varied with a record of armadillos, anteaters, ocelots, jacus, cotias, red deer, wild pigs, capuchin monkeys, jaguars, various species of birds, lizards, and snakes (ICMBIO, 2019).

According to a study on Tourism Demand in 2012, Piauí is the main source of tourists for the Park, accounting for 56.3% at the time, followed by Maranhão (17.3%) (OSMAN; ASANO, 2012). In a previous analysis, Oliveira Filho and Monteiro (2009) described the attractiveness of the site as ecological, adventure, scientific, aimed at the elderly and educational, whose visit includes the following activities: 1) Visiting the archaeological and historical sites; 2) Walk; 3) Observe the landscape in the viewpoints; 4) Cycling tourism; 5) Birdwatching; 7) Visit the American Man Museum; 8) Know the production of ceramics; 9) Admire the night lighting; and 10) Visit the Visitor Center, which has support infrastructure with bathrooms, food, auditorium and souvenir shop, as well as an exhibition hall (ICMBIO, 2019).

Travel Cost Method

According to the theory of utility maximization, the optimization problem presented in the Travel Cost Method (TCM) can be described, according to Torres-Ortega et al (2018), as follows:

$$Max\ U(q, I, z)$$
$$sa: TC * q + z = I$$

Where:

- U is the utility obtained from consuming a quantity of the good.
- I is the income.
- q is the amount consumed of the good.
- z corresponds to the consumption of other goods.
- TC is the Travel Cost.

Thus, the Marshallian demand for a given destination is represented as:

$$R = f(q, TC, z, I)$$

The recreational value estimated by the travel cost was obtained by multiplying the sum of the consumer surplus of each place of origin (or zone) by the number of visits per year, which corresponds to approximately twenty thousand tourists per year.

To achieve the objective, the first stage consisted of applying questionnaires divided into three blocks of questions: socioeconomic

profile (age, nationality, education level and monthly income) and information on the cost of travel (origin, frequency of visits, length of stay, expenses for transportation, food, accommodation, etc.), and perceptions about the activities developed during the tour. Then, descriptive analyzes were used to characterize the profile of visitors.

Regarding the use of MVC, there are two classic variants (AZQUETA et al. 2007; ROBERT, 2017; VOLTAIRE et al., 2017), which can be the Zonal Travel Cost Method (ZTCM), whose objective is to estimate the average propensity to visit a given destination from the different zones in which its area of influence is divided, or the Individual Travel Cost Method (ITCM), which seeks to discover the individual demand for leisure services at a destination. The main difference is that one uses individual data instead of zonal data, revealed from surveys applied to its visitors. In the present study, we opted for the use of ZTCM.

ZTCM Procedure

The application of the travel cost method took place in five phases:

Phase 1: The number of visitors (Vi) was determined and the frequency of visits to the Park was analyzed using a questionnaire distributed online.

Phase 2: The visits rate to the Park (VRi) was calculated. The formula corresponds to the rate of visits per thousand people per year (ANGELO; CARVALHO, 2007).

$$\frac{VR_i}{1000} = \frac{[(\frac{V_i}{n}) * N * 1000]}{P_i}$$

Where:

- V_i: is the number of people to visit zone i;
- n is the sample size (total number of people interviewed);
- N is the total of visitors per year;
- P_i is the total population of zone i.

Phase 3: Determination of Total Travel Cost (TCi), measured from the sum of the travel cost (expenses with fuel and / or tickets to reach the destination) and the cost of stay (accommodation, food, admission to the Park and other extra expenses), from visitors. The opportunity cost of time was not evaluated, because, as Tahzeeda, Khan and Bashar (2018) affirm, with students being the majority of the visitors, it is assumed that in their leisure time they find themselves in non-monetary moments or jobs and that other people also visit the area during the afternoons or on vacation. Other authors who include the value of time, such as Shammin (1999), Freeman, Herriges and Kling (2014), use the value of one third of the regular wage, or one third of the hourly wage (PARSONS, 2013). Thus, it is possible to state that the inclusion of the time value involves the consumer's own judgment (SIMÕES, BARATA; CRUZ, 2013).

Phase 4: Obtaining the visit demand curve for recreational activities in the Park according to each region, using the average total cost of travel to verify the visit rate variation when the average expenditure increases.

Phase 5: The Park's Recreational Use Value (RUV) was estimated, shown by the area under the curve that represents the Consumer Surplus (CS) and reflects the recreational use value based on the analysis of the travel cost method from of the formula:

$$RUV_{ANNUAL\ ESTIMATED} = CS_{PER/VISITOR} * N$$

$$CS_{PER/VISITOR} = \frac{CS_{TOTAL}}{n}$$

$$CS_{TOTAL} = \int_{TC_{i_{min}}}^{TC_{i_{max}}} f(x)\,dx - (TC_{i_{max}} - TC_{i_{min}}) * VR_{i_{min}}$$

Where:

- TCi_{min}: Minimum travel cost between observed zones;
- TCi_{max}: Maximum travel cost between observed zones;
- *f(x)*: Demand function of visits to the Park;
- VRi_{min}: Minimum visit rate from i zones observed to the Park.

Consumer Surplus (CS) is the difference between the total amount that consumers are willing to pay for a good or service and the total amount they actually pay, understood as a measure of the net benefit of visitors (TAHZEEDA, KHAN; BASHAR, 2018; TORRES-ORTEGA et al, 2018).

In addition to the Estimated Annual Recreational Use Value, it was interesting to estimate the Annual Potential Recreational Use Value as follows:

$$RUV_{ANNUAL\ POTENTIAL} = CS_{PER/VISITOR} * \sum_{i=1}^{z_i} \frac{P_i}{g_i}$$

Where:

- P_i: Population from zone i who visited the Park;
- g_i: Family groups or the average number of residents in permanent private homes in zone i who visited the Park;
- z_i: Zone i from where visits to the Park were registered.

Data and sampling

The research was conducted using a simple random sampling to obtain the optimum sample size as the expression of Parga and Alonso (2018), with a confidence level of 95%, p = 0.5, and an error of 10%. Ninety-eight responses were obtained, of which 81 were valid and 17 were considered pilots to test the platform and evaluate the questions.

$$n = \frac{z^2 * N * p * p}{N * E + z^2 * p * p}$$

Where:

- N is the population number;
- z^2 is the critical value for 1-α (confidence level);
- p = q = 0,5 is the maximum variability of the proportion;
- E is the maximum allowable error

According to the data provided by the Park, a total of 20,000 visitors are registered per year, representing an average of 384 visitors per week. Thus, an optimal sample size of 77 respondents is obtained, and 81 questionnaires were considered valid. It is interesting to mention that the 10% error may be justified by reasons of time, availability of resources, logistics, travel to the location, as in Barros et al, (2018), Tyskowski et al, (2018) and Lima et al. (2019).

The instrument was developed with 31 questions that traced the visitor's sociodemographic profile, as well as described the travel costs, the level of satisfaction with the available attractions and the perception of the quality and access to the place. All respondents were volunteers in the survey and there was no personal identification of their responses. Subsequently, the questionnaire was randomly distributed during the month of June 2019 through an online platform, having been shared on several pages of tourism, universities and local radio stations, to get the largest possible sample and capture the perception of the local population. To reduce the risk of duplication, a restriction on sending an answer by IP was adopted.

To answer the questions, the environmental Travel Cost Method was applied, requiring visitors to have been in person at least once in the place, contextualizing it as a tourist destination. Brazilian tourists were interviewed, men and women, with varied ages and originated in fourteen different cities, from five federative units and from two countries, from twenty-five professional occupations, with different income levels and who used up to three types of transport to access the park.

RESULTS AND DISCUSSIONS

Visitor profiles

Of the total of ninety-eight respondents, eighty-one people claimed to have visited the Serra da Capivara National Park, with approximately 45.7% indicating having visited at least once in the year, 21.0% having visited more than three times, 23.5% visited twice and 9.9%, three times. Regarding sexual differentiation, female visitors aged 18 to 35 (both 60.5%) and complete higher education (81.4%) were predominant, with 14.8% indicating incomplete graduation, and 2.5% incomplete high school. The level of monthly income of tourists pointed out that 50.6% receive more than five minimum wages and 21% receive one to three minimum wages monthly, reinforcing the hypothesis that the cost of travel influences the demand for visitors, prevailing the profile socioeconomic status belonging to higher income groups. It is worth remembering that, in the period in which the interviews were applied, the value of the Brazilian minimum wage was R$ 998.00 (BACEN, 2019). The sociodemographic classifications used were based on the social indicators of the IBGE (2019). Table 1 summarizes the sociodemographic results collected.

Regarding the declared occupations, it is noteworthy that 29.6% is composed of teachers and students, 12.3% by doctors, 3.7% by archaeologists and 2.5% by retirees. After setting up a socioeconomic profile of the respondents, the questions continued the search for information regarding the trip itself. Interviews with tourists from five Brazilian states (Distrito Federal, Maranhão, Minas Gerais, Piauí and São Paulo) were considered, 71.6% from Teresina and 7.4% from São Raimundo Nonato, both in Piauí, traveling in average 632.93 kilometers.

Table 1. Sociodemographic data

Variable		n	%
Gender	Feminine	49	60,5
	Masculine	32	39,5
Age group	Below 18 years old	2	2,5
	18 to 35 years old	49	60,5
	36 to 59 years old	19	23,5
	Above 60 years old	10	12,3
Education level	Incomplete high school	2	2,5
	Completed graduation	15	18,5
	Incomplete graduation	12	14,8
	Incomplete specialization	7	8,6
	Complete specialization	23	28,4
	Incomplete Master's degree	3	3,7
	Complete Master's degree	9	11,1
	Incomplete doctorate degree	1	1,2
	Complete doctorate degree	8	9,9
Per capita income level	Up to 1 minimum wage	5	6,2
	1 to 3 minimum wages	17	21,0
	3 to 5 minimum wages	18	22,2
	More than 5 minimum wages	41	50,6

Source: Elaborated by the authors (2020).

Table 2. Respondents' home cities

Origin	N	%
Belo Horizonte-MG	1	1,2
Bonfim do Piauí-PI	2	2,5
Brasília-DF	2	2,5
Buriti dos Lopes-PI	1	1,2
Canto do Buriti-PI	1	1,2
Floriano-PI	1	1,2
Cayenne/Guiana Francesa	1	1,2
Parnaíba-PI	2	2,5
Santos-SP	1	1,2
São Paulo-SP	1	1,2
São Raimundo Nonato-PI	6	7,4
Teresina-PI	58	71,6
Timon-MA	1	1,2
Varginha-MG	1	1,2
Várzea Branca-PI	2	2,5

Source: Elaborated by the authors (2020).

Regarding the type of transport used to get to the Park the trip was made using private vehicles and buses. 59.3% of people indicated the use of a private car, 34.6% indicated the bus as a means of transportation and 3.7% used an airplane to access the tourist site. In order to estimate the costs of traveling by car and to create a parameter for comparison with the values declared in the responses, the type of car used by forty-eight people was indicated, the model was also recorded and the estimate of the cost of average travel per kilometer per km was calculated, based on information from INMETRO (2019).

Table 3. Type of vehicle used to access the Park

Type of cars	N	%
1.0	8	16,7
1.6	18	37,5
2.0	14	29,2
More than 2.0	8	16,7

Source: Elaborated by the authors (2020).

The main objectives when taking the tour, as explained by the respondents, indicate that 35.8% of the people went to the Park because they were on vacation and the same percentage went to spend the weekend, 14.8% were on work and took advantage of the opportunity to see the Park, and 3.7% was just passing through the city and decided to visit the site. It was also observed that that 77.8% of the visitors stayed at least two days in the city and that 45.7% of them were in groups of four or more people. In addition, the number of hours that people stayed at the Park was also consulted, of which 44.4% of the responses indicated that they spent three to six hours on site.

Table 4. Tour Duration

Time spent in the park	n	%
Up to 3 hours	10	12,3
Between 3 and 6 hours	36	44,4
Between 6 and 8 hours	17	21,0
Between 8 and 12 hours	6	7,4
More than 12 hours	12	14,8

Source: Elaborated by the authors (2020).

Subsequently, the questionnaire assessed the perception of visitors about the attractions offered, based on qualifications on scales from 1 to 7 for each one. The tourists' satisfaction was mainly related to the natural beauty, whose best evaluation was to observe the landscape in the viewpoints with an average of 6.46, followed by visiting the Nature Museum with 6.33 and visiting the archaeological sites with 6.25. It is noteworthy that not everyone answered all the items, demonstrating that they had not known such activity, such as cycling tourism (response rate of only 51.9%) and admiring the night lighting (65.4% response rate).

Application of the Zonal Travel Cost Method (ZTCM)

From the application of the method, the information about the number of visitors, the rate of visits to the Park, and the total travel cost are presented in table 5.

Table 5. Estimation of visit rates and total travel cost

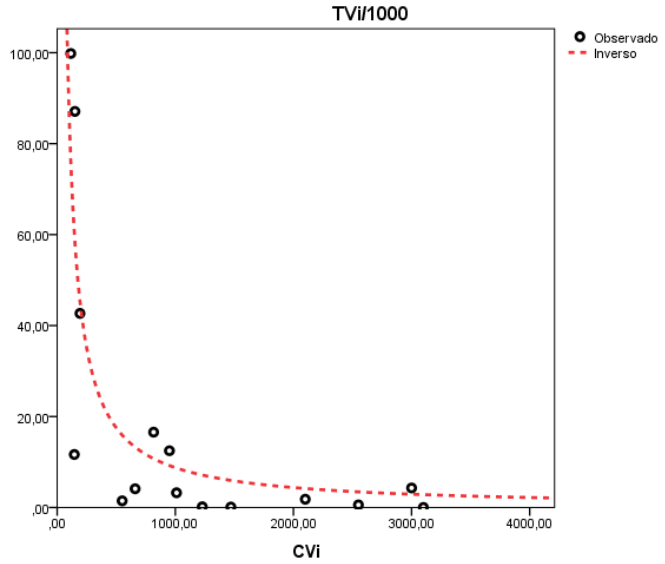
City of origin	Distance* (round trip)	Population	Visitors (Obs.)	VRi**	TCi***
Bonfim do Piauí-PI	126,2	5670	2	87,09	150
Canto do Buriti-PI	152,6	21187	1	11,65	145
Floriano-PI	438	59935	1	4,12	660
São Raimundo Nonato-PI	73,8	34710	6	42,68	192,8
Teresina-PI	812	864845	58	16,56	816,04
Timon-MA	800	169107	1	1,46	550
Várzea Branca-PI	146,6	4947	2	99,82	115
Buriti dos Lopes-PI	1236	19781	1	12,48	950
Parnaíba-PI	1300	153078	2	3,23	1010
Belo Horizonte-MG	2510	2512070	1	0,10	1470
Brasília-DF	1962	3015268	2	0,16	1228,5
Santos-SP	3482	433311	1	0,57	2550
São Paulo-SP	3412	12252023	1	0,02	3100
Varginha-MG	2922	135558	1	1,82	2100
Cayenne/Guiana Francesa	3716	57615	1	4,29	3000
			81		

Source: Elaborated by the authors (2020). * Estimated distance (km) of a round trip to the destination.** Visit rate for each area or city of origin per 1000 people. ******* The trip's cost is estimated at R$ and represents the total travel and stay costs for visitors from each zone or city of origin.

Figure 1 resulted from the exercise to obtain the demand curve for visits, which relates recreational activities to the visitation rate per thousand people and the total travel cost from the following equation, with $R^2 = 0,788$, adjusted $R^2 = 0,773$, F-Fisher = 51,975 e p-value = 0,000.

$$VR_i = 8754,868 * TC_i^{-1}$$

Figure 1. Visit demand curve by city of origin



Source: Elaborated by the authors (2020).

therefore, travel costs influenced the visit rate per thousand people, which is why Teresina has more than seventy percent, while more distant cities have a lower visitation rate. And finally, on estimating the Park's Recreational Use Value, the following results were achieved:

$$CS_{TOTAL} = \int_{TC_{i_{min}}}^{TC_{i_{max}}} \left(8754,868 * TC_i^{-1}\right) dTC_i - \left(TC_{i_{max}} - TC_{i_{min}}\right) * VR_{i_{min}}$$

$$CS_{TOTAL} = 8754,868 * \left((lnTC_i)|_{115}^{3100}\right) - \left(TC_{i_{max}} - TC_{i_{min}}\right) * VR_{i_{min}}$$

$$CS_{TOTAL} = R\$\ 28\ 780,81$$

$$CS_{PER/VISITOR} = R\$\ 355,32$$

$$RUV_{ANNUAL\ ESTIMATED} = R\$\ 7\ 106\ 372,18$$

$$RUV_{ANNUAL\ POTENTIAL} = R\$\ 2\ 199\ 082\ 256,11$$

When analyzing the consumer surplus from each of the origins, that is, the estimated final benefit, which was calculated to obtain the economic value added by recreation to the Serra da Capivara National Park, a total of R$ 7.1 million per year was found, which represents the sum of the consumer surplus of the regions registered in the survey, multiplied by the total annual visitors. It is worth mentioning that possibly this value is underestimated, since it uses the minimum estimate of the number of tourists who visit the region annually (20,000) and disregards the cost of time opportunity. Considering this possibility, the value of potential recreational use was calculated, and a total of R$ 2.2 billion was obtained.

At the same time, it was decided to develop the analysis of the travel cost based on Fasciolo's (2002) demand models implementing the Zonal Travel Cost Method, considering the total of 81 valid respondents, in order to compare the results, using a simple regression model that proposes VRi as a dependent variable explained, in the general sense, by the Total Cost of Travel, which estimated models can be seen in the table 6. It remains the zonal trip's cost because the VRi are from the cities of origin of each respondent. The individuals' socioeconomic characteristics are not analyzed, being recognized in the literature as a form of ZTCM.

Table 6. Estimated models for the Zonal Travel Cost Method (VRi)

Variable	Linear	Logarithmic	Inverse	Potency	Exp	Logistic
Constant	31,889** (0,000)	124,777** (0,000)	5,403** (0,000)	6869,995** (0,000)	36,777** (0,000)	0,027** (0,000)
TCi	-0,014** (0,000)	-16,237** (0,000)	6552,749** (0,005)	-0,980 (0,345)	-0,001** (0,000)	1,001** (0,000)
R^2	0,214	0,464	**0,610**	0,317	0,344	0,344
R^2 adjusted	0,204	0,457	**0,605**	0,308	0,336	0,336
F-Fisher	21,558	68,258	123,427	36,606	41,397	41,397
df1	1	1	1	1	1	1
df2	79	79	79	79	79	79
p-value	0,000	0,000	0,000	0,000	0,000	0,000

Source: Elaborated by the authors (2020). * Significant p <0.05 (95% confidence) ** Significant p < 0,01 (99% de confidence)

Among the models tested, the one that demonstrated being the best fit was the reverse, explaining more than sixty percent of the Park's visitation rate. From the choice, the following equation was formed to determine VRi:

$$VR_i = 5{,}403 + 6252{,}749 * TC_i^{-1}$$

It was applied in the consumer surplus formula, and the following results were achieved:

$$CS_{TOTAL} = (5{,}403 * TC_i + 6252{,}749 * lnTC_i)|_{82}^{3100} - \left(TC_{i_{max}} - TC_{i_{min}}\right) * VR_{i_{min}}$$

$$CS_{TOTAL} = R\$\ 38\,958{,}62$$

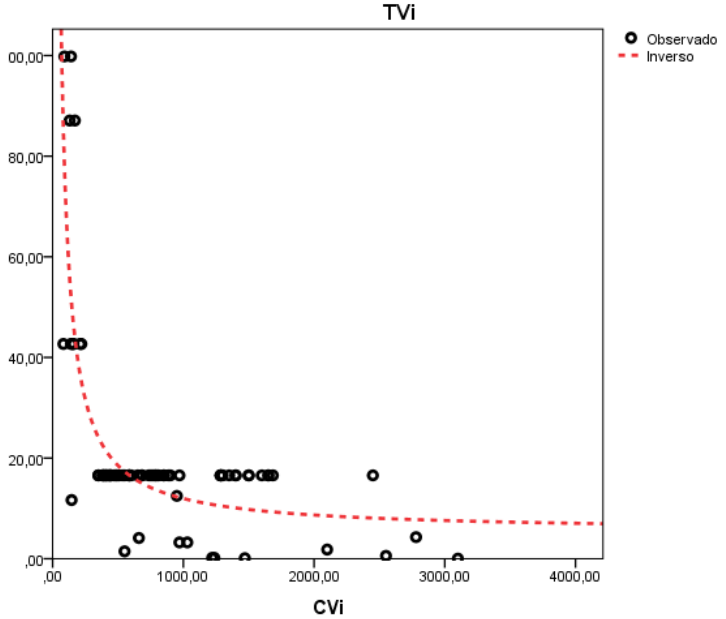
$$CS_{PER/\text{VISITOR}} = R\$\ 480{,}97$$

$$RUV_{ANNUAL\ ESTIMATED} = R\$\ 9\,619\,411{,}84$$

$$RUV_{ANNUAL\ POTENTIAL} = R\$\ 2\,976\,747\,820{,}40$$

Similarly, figure 2 shows the estimation of the respective visit demand curve according to the model defined by Fasciolo (2002).

Figure 2. Visit demand curve according to Fasciolo's model (2002)



Source: Elaborated by the authors (2020).

For this analysis, the estimated recreational use value for the Serra da Capivara National Park was R$ 9.6 million per year. And the potential recreational use value obtained was approximately R$ 3 billion.

CONCLUSIONS

Once the objective of this article was reached, which was designed to estimate the recreational

use value of the ecosystem goods and services of the Serra da Capivara National Park through a revealed preferences method, specifically the Travel Cost Method, it was confirmed the assumption that the frequency of visits is influenced by travel costs. Even with a probable underestimation due to the inaccuracy of records of the number of tourists who frequent the site, the value of the Park's recreational use is approximately R$ 7.1 million per year, corresponding to approximately 0.2% of the total GDP value of the State of Piauí in 2017 - last available amount of R$ 45.4 billion, depending on the model used to estimate the RUV and a potential to represent up to 6.6% of the state GDP, which indicates the importance of the natural heritage preservation.

In this sense, visitors' fundraising could be assessed based on their willingness to pay for ecosystem services as a way of contributing to the Park, without this representing, in any way, the privatization of the environmental asset or market price-fixing, but a perception of space appreciation. From an economic conception, this valuation would be represented by the total desire to pay by the users of the Park, thus being able to be reverted for strictly protection and conservation purposes of the natural space.

It is common sense for many authors that developing marketing strategies and scientific education and dissemination programs, as well as practical and efficient environmental education actions aimed at this type of ecosystem would be recommended to promote the knowledge of tourists and non-tourists about the place and assist in the perception of the value of the goods and services available and the importance of an individual attitude in maintaining these resources.

For future studies, it is suggested to deepen the analysis of the users' behavior, knowing that the city of São Raimundo Nonato has access to ecotourism practices - in process of intensification - that were not evidenced in this study, opening space for investigation of this sustainable dimension of tourist activities.

Thus, given the grandeur and attributes of the Serra da Capivara National Park, and taking into account that the present tourism is an activity based on both culture, history and nature, it is imperative that the place and its goods and services are the destination of environmental investments that ensure the maintenance of the quality of natural capital and the well-being provided to visitors, as well as the continuity of its use and the economic benefit that this environment generates.

REFERENCES

ANGELO, P. G., CARVALHO, A. R. Valor recreativo do rio Araguaia, região de Aruanã, estimado pelo método do custo de viagem. **Acta Sci. Biol. Sci Maringá**, v. 29, n. 4, p. 421-428, 2007. https://doi.org/10.4025/actascibiolsci.v29i4.886

AZQUETA, D., ALVIAR, M., DOMINGUÉZ, L., O'RYAN, R. *Introducción a la Economía Ambiental*. 2 ed., Madrid: **McGraw-Hill/Interamericana de España**, S.A.U, 2007.

BACEN. Banco Central do Brasil. **Sistema Gerenciador de Séries Temporais v2.1**. Brasília, 2019. Disponível em: <https://www3.bcb.gov.br/sgspub/consultarvalores/consultarValoresSeries.do?method=getPagina>. Acessado em 04/08/2019.

BARROS, D. CASTRO, R. V. O, CARNEIRO, A. de C. O., CARVALHO, A. M. M. L, VITAL, B. R., SANTOS, R. C. dos. *Sampling methods and number of roundwoods for determining the moisture content*. **Revista Árvore**, v. 42, n. 4: e420401, p.1-6, 2018. http://dx.doi.org/10.1590/1806-90882018000400001

FASCIOLO, G. *Método de Valoración Contingente (MVC)*. **Instituto Nacional del Agua.** Centro de Economía, Legislación y Administración del Agua, 2002.

FREEMAN, A. M., III, J. A. HERRIGES e C. L. KLING. *The Measurement of Environmental and Resource Values: Theory and Methods*. Routledge. 3rd Edition., New York: **Resource for the Future (RFF) Press**, 2014.

FUMDHAM. Fundação Museu do Homem Americano. **Parque Nacional da Serra da Capivara**. 2019. Disponível em: <http://fumdham.org.br/> Acessado em 27/07/2019.

IBGE. Instituto Brasileiro de Geografia e Estatística. **Síntese de Indicadores Sociais–SIS**. 2019. Disponível em: <https://www.ibge.gov.br/estatisticas/sociais/populacao/9221-sintese-de-indicadores-sociais.html?edicao=9222&t=sobre>. Acessado em 04/08/2019.

ICMBIO. Instituto Chico Mendes de Conservação da Biodiversidade. **Parque Nacional da Serra da Capivara**. 2019. Disponível em: <http://www.icmbio.gov.br/portal/visitacao1/unidades-abertas-a-visitacao/199-parque-nacional-da-serra-da-capivara>. Acessado em 27/07/2019.

INMETRO. Instituto Nacional de Metrologia, Qualidade e Tecnologia. **Tabelas de Consumo/Eficiência Energética: Veículos Automotores Leves**. 2019. Disponível em:

<http://www.inmetro.gov.br/consumidor/pbe/veiculos_leves_2019.pdf>. Acessado em 26/07/2019.

JUAREZ, A. S.; CAÑETE, R. B. *Valuation of the recreational use of the Calares del Mundo and Sima Natural Park through the travel cost method*. Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA), **Forest Systems**, v.22, n. 2, p.189-201, 2013. https://doi.org/10.5424/fs/2013222-02534

LIMA, M. MIRANDA, L da S. BARROS, W dos S., COSTA, B. C., OLIVEIRA, E. S. de, RADDATZ, D. D., OLIVEIRA, F. de A. Comparação entre processos de amostragem para estimar o volume em uma florestal no município de Barcarena-PA. **Meio Ambiente: Inovação com Sustentabilidade**. Ponta Grossa: Editora Antena, v.1, p. 158-167, 2019. https://doi.org/10.22533/at.ed.454190110

MESQUITA, R. F. de, SOUSA, L. R. M., MATOS, F. R. N., MONTE, A. L. A. do. Comportamento turístico dos visitantes do Parque Nacional da Serra da Capivara. ***Tourism & Management Studies***, v.11, n. 2, 2015. p. 78-85, 2015. https://doi.org/10.18089/tms.2015.11210

MTUR. Ministério do Turismo. **Ministro do Turismo interino faz visita técnica à Serra da Capivara (PI)**. 2019. Disponível em: <http://www.turismo.gov.br/%C3%BAltimas-not%C3%ADcias/12819-ministro-do-turismo-interino-faz-visita-t%C3%A9cnica-%C3%A0-serra-da-capivara-pi.html>. Acessado em 27/07/2019.

OLIVEIRA FILHO, R. C. de, MONTEIRO, M. do S. L. Ecoturismo no Parque Nacional Serra da Capivara: trata-se de uma prática sustentável? **Turismo em Análise**, v. 20, n. 2, Teresina, 2009.

OSMAN, A., ASANO, L. Trecho turístico do Parque Nacional da Serra da Capivara: entraves, análise e propostas de melhoria. Fundação Getúlio Vargas, São Paulo, 2017.

PARGA, E.; ALONSO, P. *The Altamira controversy: Assessing the economic impact of a world heritage site for planning and tourism management*. **Journal of Cultural Heritage**, v. 30, p. 180–189, 2018. https://doi.org/10.1016/j.culher.2017.09.007

PARSONS, G. R. *The Travel Cost Model. In A Primer on Nonmarket Valuation. The Economics of Non-Market Goods and Resources*. Dordrecht: ***Kluwer Academic Publishers***, 2013. p. 269– 329.

ROBERT, I. *Application of Travel Cost Method to Valuation of Historic Building: Old Residence in Calabar, Nigeria*: **Middle-East Journal of Scientific Research**, v. 25, n. 10, 2017. p. 1925-933. https://doi.org/10.5829/idosi.mejsr.2017.1925.1933

SETUR-PI. Secretaria de Estado de Turismo do Piauí. **Governo do Estado do Piauí. Parque Nacional da Serra da Capivara**. 2019. Disponível em: <http://www.turismo.pi.gov.br/serracapivara/>. Acessado em 27/07/2019.

SHAMMIN. *Application of the travel cost method (TCM): A case Study of Environmental valuation of Dhaka Zoological Garden*. **IUCN**: Switzerland, 1999.

SIMÕES, P., BARATA E. e CRUZ, L. *Joint Estimation Using Revealed and Stated Preference Data: An Application Using a National Forest*. **Journal of Forest Economics**, n. 19, p. 249 – 266, 2013. https://doi.org/10.1016/j.jfe.2013.03.001

SOUSA, G. B. de; MOTA, J. A. Valoração econômica de áreas de recreação: o caso do Parque Metropolitano de Pituaçu, Salvador: **Revista de Economia**, Editora UFPR, v. 32, n. 1, ano 30, p. 37-55, 2006.

TAHZEEDA, J., KHAN, M.R., BASHAR, R. *Valuation approaches to ecosystem goods and services for the National Botanical Garden*. Bangladesh: **Environmental & Socio-economic Studies**, n. 6(1), p. 1-9, 2018. https://doi.org/10.2478/environ-2018-0001

TORRES-ORTEGA, S., PÉREZ-ÁLVAREZ, R., DÍAZ-SIMAL, P., LUIS-RUIZ, J. M. de, PIÑA-GARCÍA, F. *Economic Valuation of Cultural Heritage: Application of Travel Cost Method to the National Museum and Research Center of Altamira*. **Sustainability**, n. 10, p. 2550-2562, 2018. https://doi.org/10.3390/su10072550

TYSKOWSKI, K.C., AMARAL, J. A. da S., SOUSA, K. A., SANTOYO, A. H, PIACENTI, C. A. *Estimación del valor de uso recreativo del Parque Ambiental "Horto Florestal" en Rio Branco, Acre*. **Revista Brasileira Planejamento e Desenvolvimento**, v. 7, n. 5, Edição Especial Desenvolvimento Sustentável Brasil/Cuba, 2018. https://doi.org/10.3895/rbpd.v7n5.9059

VOLTAIRE, L. LÉVI, L., ALBAN, F., BONCOEUR, J. *Valuing cultural world heritage sites: an application of the travel cost method to Mont-Saint-Michel*. **Applied Economics**, v. 49 (16), p. 1593–1605, 2017. https://doi.org/10.1080/00036846.2016.1221046