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Valuation of cultural ecosystem services in urban parks with different social contexts in the city of Recife (PE), Brazil

Valoração de serviços ecossistêmicos culturais em parques urbanos com diferentes contextos sociais na cidade do Recife (PE), Brasil

Beatriz Oliveira Gomes Florêncio[1], *Carlos Eduardo Menezes da Silva*[1], *Claudiano Carneiro da Cruz Neto*[2]

ABSTRACT

The accelerated process of urbanization of the planet and the significant accumulation of the human population make the existence of green areas in cities more and more necessary. Even so, in developing countries, measuring the cultural benefits generated by these areas is scarce. The insertion of ecosystem services into urban planning is also very infrequent. This work sought to estimate the monetary value of the benefits generated by urban parks in different social contexts in the city of Recife. For this, we used the Contingent Valuation Method (CVM), applying 421 questionnaires in three parks located in neighborhoods with different characteristics. We adopted the Bivariate Probit to analyze the dichotomous questions and calculate the willingness to pay (WTP) estimates. The estimated flow of annual benefits in cultural ecosystem services is calculated based on two scenarios of potential beneficiaries who live between 800 m and 4,800 m from the parks. The results showed that the annual WTP varied between R$ 34 and R$ 87. The user characteristics such as age and sex were significant for the model, while the education level was not. Users with higher income had a higher WTP in absolute terms, while in proportional terms, users with lower income had a higher WTP. In this way, the results seem to demonstrate that the cultural ecosystem services provided by urban parks are more important in less favored social contexts. This factor can support more equitable planning in providing these public spaces.

Keywords: urban green areas; willingness to pay; contingent valuation method; urban planning.

RESUMO

O acelerado processo de urbanização do planeta e a grande acumulação da população humana torna cada dia mais necessária a existência de áreas verdes nas cidades. Ainda assim, em países em desenvolvimento a mensuração dos benefícios culturais gerados por essas áreas é escassa. Também é muito pouco frequente a inserção dos serviços ecossistêmicos no contexto do planejamento urbano. Este trabalho buscou estimar o valor monetário dos benefícios gerados por parques urbanos em diferentes contextos sociais na cidade do Recife. Para isso, lançou-se mão do Método de Valoração Contingente (MVC), aplicando-se 421 questionários em três parques inseridos em bairros com características distintas. O modelo adotado para a análise foi o Probit Bivariado com perguntas dicotômicas, calculando-se duas estimativas para a disposição a pagar (DaP). E a estimativa do fluxo de benefícios anuais em serviços ecossistêmicos culturais foi calculada com base em dois cenários de potenciais beneficiários que moram nas distâncias de 800 e 4.800 m dos parques. Os resultados demonstraram que a DaP anual variou entre R$ 34 e R$ 87. Características dos usuários, como idade e sexo, foram significativas para o modelo, enquanto escolaridade não. Os usuários com maior renda apresentaram maior DaP em termos absolutos, ao passo que em termos proporcionais foram os usuários com menor renda que exibiram maior DaP. Dessa forma, os resultados parecem demonstrar que os serviços ecossistêmicos culturais providos por parques urbanos mostram maior importância em contextos sociais menos favorecidos, fator que pode embasar um planejamento mais equitativo na oferta desses espaços públicos.

Palavras-chave: áreas verdes urbanas; disposição a pagar; método de valoração contingente; planejamento urbano.

[1]Instituto Federal de Pernambuco – Recife (PE), Brazil.

[2]Universidade Federal do Recôncavo da Bahia – Cruz das Almas (BA), Brazil.

Correspondence address: Carlos Eduardo Menezes da Silva – Avenida Professor Luís Freire, 500 – Cidade Universitária – CEP: 50740-545 – Recife (PE), Brazil. E-mail: carlosmenezes@recife.ifpe.edu.br

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Introduction

Urban green spaces are fundamental elements of the landscape of cities and play critical roles in urban development, generating both environmental and economic benefits (Xu et al., 2020). Nevertheless, the urban green areas that support these benefits have been increasingly degraded by urbanization's direct and indirect impacts (World Economic Forum, 2022).

To alleviate the negative externalities of this urbanization, urban green areas play a fundamental role in improving the population's quality of life (Gaudereto et al., 2018), since they provide leisure spaces, encourage social encounters, and promote improvement in the physical and psychological well-being of individuals, in addition to fulfilling landscape, aesthetic and ecological functions in the urban environment (Muñoz and Freitas, 2017). Among the different types of green areas, urban parks are those that provide contact with nature and promote well-being and physical and psychological health for the population through climate regulation, which offers thermal comfort, noise reduction, and risk of extreme events such as floods, air purification, carbon sequestration, and other benefits (Gaudereto et al., 2018; Meneses, 2018; Mexia et al., 2018).

These benefits are services provided by ecosystems to human society. Ecosystem services are the conditions and processes through which natural ecosystems and the species that compose them sustain human life (Daily, 1997). More specifically, cultural ecosystem services are intangible benefits obtained from ecosystems that influence the quality of life and human well-being (MEA, 2005). Examples of cultural ecosystem services are recreation, aesthetic pleasure, and tourism, which are characterized primarily as environments, places, or situations that promote changes in people's physical or mental states (Fish et al., 2016; Haines-Young and Potschin, 2018).

Valuing these ecosystem services consists of an approach that aims to measure the market values of goods and services provided by nature to help in the perception of the socio-ecological importance played by these functions (Sannigrahi et al., 2020). From that, there were several developments in the methods present in the literature to more adequately carry out the economic valuation of ecosystem services. Among these developments is the Contingent Valuation Method (CVM) that aims to question people interviewed about their socioeconomic factors and environmental and ecological perceptions about the environmental goods studied, as well as defines the willingness to pay (WTP) for these goods and services, creating hypothetical markets and seeking to make up for the lack of markets and prices for public goods (Travassos et al., 2018).

Studies involving ecosystem services have grown in the past 20 years but are primarily concentrated in the Southeast region (Parron et al., 2019). Research addressing the relevance of ecosystem services in urban areas is also increasing. It can be said that this is an improvement in understanding the importance and contribution of green areas to the environmental quality of cities (Muñoz and Freitas, 2017). However, studies are still needed to improve estimates of the benefits of urban parks (Barboza et al., 2021) and the impacts of their uneven distribution in space (Zuniga-Teran et al., 2021). It is even more necessary to assist in decision-making studies with economic value attribution focused on the urban environment, which is still not widespread today (Brandli et al., 2015; Latinopoulos et al., 2016; Neckel et al., 2020; Sabyrbekov et al., 2020; Silva et al., 2022). Most scientific articles published in the area address valuation only in quantitative terms but not in monetary terms, preventing the information from becoming more useful for public planning (Muñoz and Freitas, 2017).

It appears that the conceptual evolution of public parks follows a direction toward the formation of continuous and/or interconnected parks, in which, based on the valorization of these areas, resources are sought for the articulation of different typologies of urban green spaces, something that can recreate nature within cities, signaling a way to prevent the continuous expansion of buildings through more specific guidelines that regulate land use and occupation (Mota et al., 2016).

Therefore, the main objective of this work is to evaluate the importance of cultural ecosystem services provided by urban parks in different social contexts in the city of Recife. In addition, answer the following questions: Does the profile of the visitors of the analyzed urban parks influence their Willingness to Pay? What are the determining factors of this disposition? Are there differences between willingness to pay for cultural ecosystem services in different social contexts in the urban area?

Methodology

Characterization of the study area

The municipality of Recife, the capital city of the State of Pernambuco, is located on the coast of Northeast Brazil and has an estimated population of 1,653,461 inhabitants and a territory of approximately 219 km² (IBGE, 2021). Recife has 12 urban parks that correspond to approximately 0.27% of the city's territory, equivalent to 0.36 m² of urban park per inhabitant (Meneses et al., 2021). Three urban parks were studied, namely, Jaqueira, Macaxeira, and Santana (Figure 1). The choice of parks was based on the socioeconomic differences of the surrounding population and the heterogeneity of the vegetation cover distribution. The parks are named after their respective neighborhoods. These are part of the same Administrative Political Region 3 (RPA 3), which is also composed of 26 other neighborhoods. The city's most extensive region reaches approximately 35% of the territory (Recife, 2021).

The Jaqueira neighborhood has an area of 24 hectares and a resident population of 1,591 inhabitants. Its population density is 66.31 inhabitants/ha; the neighborhood has the second largest public park in the city, Parque da Jaqueira, with 70,000 m² (Recife, 2021). This

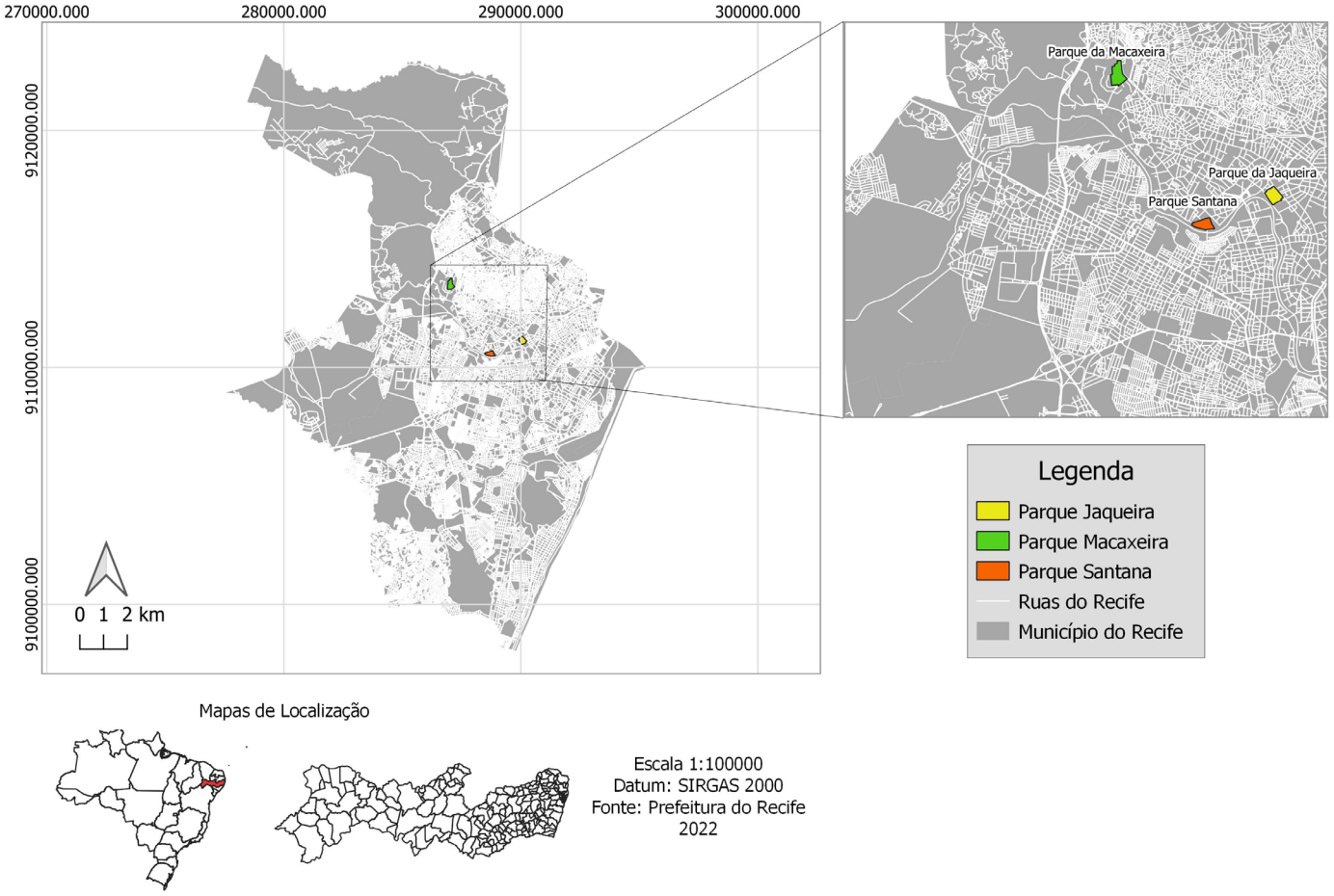

Figure 1 – Location of urban parks Jaqueira, Macaxeira, and Santana, Recife.
Source: prepared by the authors.

park has the third highest density of tree cover in Recife's parks — 7.21%. In addition, it stands out in terms of the diversity of fruit trees, having approximately 16 species, corresponding to 23% of the park's total tree cover. The largest urban park in the city of Recife is Parque da Macaxeira, with approximately 98,725.34 m² (Meneses, 2018). It is located in the Macaxeira neighborhood, with a territorial area of 125 hectares and 20,313 inhabitants, which corresponds to a population density of 162.25 inhabitants/ha (Recife, 2021). The Santana neighborhood has a territorial area of 47 hectares, housing a population of 3,054, with a population density of 64.65 inhabitants/ha (Recife, 2021). It is the Santana Urban Park, which has 54,912.32 m² (Meneses, 2018), located on the banks of the Capibaribe River, with a low density of tree cover compared to other parks in the city (Souza, 2011). These three urban parks have areas for the practice of sports, recreation, and socialization.

Methodological procedures

The Contingent Valuation Method (CVM) was used to estimate the value of ecosystem services. It was a widely used method to measure the benefits provided by public goods (Haab and McConnell, 2002), especially the ecosystem services provided by urban parks. The purpose of this method was to measure willingness to pay (WTP) for an improvement in environmental quality or willingness to accept (WTA) in compensation for environmental degradation. In this work, it is not proposed to work with WTA but with WTP. The WTP serves to demonstrate the economic value assigned by society to an environmental resource. The composition of the WTP is influenced by the income and other factors inherent to the interviewees (Castro and Nogueira, 2019).

These values are obtained through field research, where respondents are asked about the WTP given improvements in the availability

of natural resources through the scenarios presented (Motta, 1997). To estimate the number of questionnaires needed, a sample was calculated considering the sum of the population of the neighborhoods in which the parks are located, based on the following Equation 1, presented by Gil (2008):

$$n = \sigma^2.\text{p.q.N} / e^2(N-1) + \sigma^2 p.\ q \quad (1)$$

Where:
n = the sample size;
σ^2 = the chosen confidence level expressed in a number of standard deviations;
p = the percentage with which the phenomenon occurs, in this case, a maximum value of 65% was chosen;
q = the complementary percentage, that is, 35% (Silva et al., 2012);
N = the population size of the three studied neighborhoods, which corresponds to a total value of 24,958 inhabitants;
e^2 = the maximum allowable error of 6% (Gil, 2008).

From this, a total estimate of at least 254 questionnaires necessary for the feasibility of the research was obtained. However, in the three parks studied, a total of 421 questionnaires were applied in person during the months of September 2018 to October 2019. The questionnaires contained a total of 17 questions in order to trace the socioeconomic profile of the interviewees and different aspects of their relationship with the parks. The form used and the dataset are available in a Github repository, available at https://github.com/cccneto/valuation_urbanParks/blob/master/Question%C3%A1rio%20Jaqueira.pdf. The questionnaire is part of a larger project. Here, only the data were used for the valuation study of the three parks. A pilot study was previously carried out in only one city park (Cruz Neto et al., 2021).

In the valuation part of the questionnaire, the scenarios presented were used to estimate the users' WTP because of the proposed environmental improvements (Motta, 1997). Thus, scenario 1 addressed the positive and negative points present in the current condition of the park; in scenario 2, a hypothetical situation was presented, highlighting the possible improvements in the environmental quality of the park if there was densification in the tree cover. These scenarios were created focusing on leisure-related cultural ecosystem services. Thus, respondents were asked about their willingness to pay for these improvements with values previously assigned in the questionnaires randomly, answering YES or NO to the initial value. If the answer was negative, a lower value than the previous one was presented in the second bid — an offer that is used to set a price that each individual is willing or unwilling to pay for the ecosystem service being analyzed.

In situations where the second answer is negative, the WTP is considered equal to 0. For this reason, the econometric model of dichotomous choice is used in contingent valuation research (Groothuis and Whitehead, 2002). The econometric dichotomous choice model has been used in contingent valuation research (Groothuis and Whitehead, 2002). Assume that going to the park represents an attitude aimed at enjoying the amenities of the place; thus, the act already represents an element of pleasure for the user, and therefore he enjoys some of the cultural services provided by the park.

If the second answer was negative, then the WTP is considered equal to 0, thus using the econometric model of dichotomous choice widely used in contingent valuation research (Groothuis and Whitehead, 2002). The study assumes that going to the park represents an attitude aimed at enjoying the amenities of the place. Therefore, the act already represents an element of pleasure for the user, who enjoys some of the cultural services provided by the park.

After the application of the questionnaires, the data were tabulated and organized in an Excel spreadsheet. Only questionnaires from people over 18 years of age who declared some levels of income were considered valid for research. To estimate the value of WTP, the model proposed by Alberini (1995), the Bivariate Dichotomous Model, was followed, running using the R Studio 4.0 software. The data and scripts used are available in the GITHUB repository. The questionnaires were applied according to the norms of resolution 510/1617 of the National Health Council (Brasil, 2016).

When approaching the interviewees in the park, users were presented with a free and informed consent form (TCLE) and asked if they agreed to answer the research questions. This work is part of a research project approved by the Research Ethics Committee through the Brazil platform. CAAE: 44427920.7.0000.0130.

Data analysis

Using the recommendations of the Bivariate Dichotomous Model (Alberini, 1995), if the correlation coefficient, $\rho \neq 1$, it follows that, in general, the second WTP does not perfectly coincide with the first and can be interpreted as a revised version of the amount of the first WTP. If the values of s are independently determined then $\rho = 0$. For all other values of the correlation coefficient, the range $0 < \rho < 1$ is valid, which implies that the correlation between the two values of the WTP is less than perfect. In this work, the correlation coefficient of the dependent variables was $\rho \neq 1$, which guided the choice of the bivariate model. The possibility of imperfect correlation between the error terms of both WTP equations makes the Bivariate Dichotomous Model (MDB) the correct specification (Alberini, 1995), since the normal bivariate distribution allows the existence of a distinct zero correlation between the error terms, while the logistic distribution does not allow.

Modeling the data generated by the questions in the dichotomous double-threshold choice format is achieved by the Equation 2:

$$Y_i(\text{yes}|\text{no}) = \beta_0 + \beta_1 \text{Age}_i + \beta_2 D_{1i} + \beta_3 D_{2i} + \beta_4 D_{3i} + \beta_5 D_4 i + \beta_6 \text{Bid}_i + \varepsilon_i \quad (2)$$

Where:

Y_i = the dependent variable and informs the respondent's response (yes = 1 or no = 0) to the bid;
Age_i = the age of the respondent;
D_{1i} = the dummy variable for the respondent's gender (male = 1, female = 0);
D_{2i} = a dummie for school (complete higher education = 1);
D_{3i} = a dummy to assess the respondent's perception of park temperature in tree-covered areas, (good/great=1);
D_{4i} = a dummy to assess the respondent's perception of the infrastructure available in the park to its users (good/great = 1);
$Income_i$ = the income of the respondent;
Bid_i = the variable for the values drawn as bids to respondents;
WTP_{ij} = the jth respondent's willingness to pay;
i = 1, 2 denotes the first and second questions, respectively (Equation 3).

$$WTP_{ij} = X_{ij}'\beta_i + \varepsilon_{ij} \quad (3)$$

The DaP depends on a systematic component given by the observed characteristics of the interviewee ($X_{ij}'\beta_i$), as well as a random component (ε_{ij}~(0,σ2)) (Equation 4).

$$\Pr(\text{yes},) = \Pr(WTP_{1j} \geq t_1, WTP_2 J < t_2)$$
$$= \Pr(X_1'\beta_1 + \varepsilon_{1j} \geq t_1, X_2'\beta_2 + \varepsilon_2 J < t_2) \quad (4)$$

Given that the other sequence of possible answers can be constructed in an analogous way, which allows the construction of the likelihood function (Equation 5):

$$Lj(\mu|t) = \Pr(X_1'\beta_1 + \varepsilon_{1j} \geq t_1, X_2'\beta_2 + \varepsilon_{2j} < t_2) YN \text{ x}$$
$$\Pr(X_1'\beta 1 + \varepsilon_{1j} < t_1, X_2'\beta_2 + \varepsilon_{2j} \geq t_2) NY \text{ x}$$
$$\Pr(X_1'\beta_1 + \varepsilon_{1j} > t_1, X_2'\beta_2 + \varepsilon_{2j} \geq t_2) YY \text{ x}$$
$$\Pr(X_1'\beta_1 + \varepsilon_{1j} < t_1, X_2'\beta_2 + \varepsilon_{2j} < t_2) NN \quad (5)$$

Given a sample of respondents, we have that the logarithmic probability function of the responses to the first and second moves of the double-bound dichotomous choice is as follows (Equation 6):

$$ln(\mu|t) = SY\ ln\Pr(X_1'\beta_1 + \varepsilon_{1j} \geq t_1, X_2'\beta_2 + \varepsilon_{2j} < t_2)\ x$$
$$NY \ln \Pr(X_1'\beta 1 + \varepsilon_{1j} < t_1, X_2'\beta_2 + \varepsilon_{2j} \geq t_2)\ x$$
$$YY \ln \Pr(X_1'\beta_1 + \varepsilon_{1j} > t_1, X_2'\beta_2 + \varepsilon_{2j} \geq t_2)\ x$$
$$NN\ ln \Pr(X_1'\beta_1 + \varepsilon_{1j} < t_1, X_2'\beta_2 + \varepsilon_{2j} < t_2) \quad (6)$$

Once the regression is estimated, the WTP is given as follows (Equation 7):

$$WTP\_LI = \frac{\hat{\alpha}\ \bar{X}_j}{\hat{\beta}} \quad (7)$$

Where:

WTP_*LI* = the WTP from the linear Income Model.

After finding the value of the WTP, the total benefits generated by these areas in terms of cultural ecosystem services are estimated. For this purpose, we used the aggregated individual WTP value for the estimated beneficiaries of the parks. To calculate the number of beneficiaries, the population around the parks was considered: in scenario 1, the population residing in the entire area within a perimeter of 800 m radius was considered; and in scenario 2, the population residing in the entire area within a perimeter with a radius of 4,800 m was considered (Mertes and Hall, 1996; Meneses et al., 2021).

Results

The results of the users' profile demonstrated, as expected, the differences in the surroundings in which the parks are located. Parque de Santana showed an intermediate level of average income (R$ 9,040.76) and more years of school (16.9 years). Parque da Jaqueira showed a higher level of average income (R$ 11,339.79) and an intermediate level of school (14.5). Macaxeira Park, on the contrary, had the lowest average levels of average income (R$ 1,387.01) and school (12.7 years). There was a predominance of girls in the parks of Santana (53.51%) and Jaqueira (52.56%) and boys in the Parque da Macaxeira (55.17%).

Regarding the main aspects of use and access to the parks, a greater distance was traveled by the users of Jaqueira Park (average = 3,433 m) and a concentration of approximately 70% of users of the Santana and Macaxeira parks was noticed, among those who traveled less than 2,000 m to reach the parks (Table 1).

Table 1 – Socioeconomic use and access characteristics of park users.

Variables	Parks		
	Santana	Jaqueira	Macaxeira
Average age	41.79	37.27	32.9
Income*	R$ 9,040.76	R$ 11,339.79	R$ 1,387.01
School (years)	16.96	14.5	12.79
Gender			
Boy	46.49%	47.44%	55.17%
Girl	53.51%	52.56%	44.82%
Distance			
< 1,000 m	30.26%	8.97%	39.08%
1,000 and 2,000 m	36.40%	28.63%	35.06%
2,000 and 3,000 m	12.72%	11.97%	0.57%
> 3,000 m	20.61%	50.43%	25.29%
Average	2,139.47 m	3,433.19 m	2,136.58 m
Freqvis	3.09	3.5	2.24
Tempoestad (min)	112.36	113.2	105.25

*Average household income.
Source: Recife (2021).

The WTP estimated with the dichotomous choice method showed that approximately 72.44% of respondents said they were "willing to pay" for the cultural ecosystem services provided by the parks. Approximately 50% responded positively to both bids (YES/YES). The models rejected the null hypothesis, demonstrating that the set of variables influences the WTP of users and allows the calculation to estimate the WTP (Table 2).

The results for the first model showed that for the three parks, the value presented by the interviewer (bid1) is significant and negative, demonstrating that the higher the value presented, the lower the estimated WTP tends to be. The age variable proved to be significant and negative for the WTP of users of Parque da Jaqueira, showing that younger people tend to be more willing to pay for the improvement of that space. Gender was shown to be significant and positive for Macaxeira Park, in which male individuals are more likely to respond positively to WTP. Finally, it is noted that when respondents have a more positive perception of the park's infrastructure, there is a positive effect on the value attributed to their WTP, especially among users of Santana Park. For the second WTP value model, bid2 was significant and positive for Macaxeira Park and negative for Jaqueira Park, suggesting different behaviors between the two groups. The age was once again significant and negative for Santana Park. Gender was once again significant and positive for Macaxeira Park.

Considering the values of average household income in the neighborhoods, it is possible to observe that the WTP estimated by users of Parque Santana was R$ 39.90 referring to the value accepted in the first bid, which is equivalent to 0.44% of the average household income, while the second bid totaled R$ 138.62, which is equivalent to 1.53% of the average household income. The WTP of visitors to Parque da Jaqueira was R$ 87.15 referring to those who accepted the first bid, this data indicates that, on average, this portion of park users is willing to allocate 0.77% of their income for park conservation. The WTP found that the 23% of respondents who accepted the second bid corresponded to R$ 150.72, indicating that they are willing to pay what refers to 1.33% of the average income. In Macaxeira Park, a WTP of R$ 34.33 corresponds to 2.48% of the average household income. For those who accepted the second bid, the WTP was R$ 12.40, corresponding to 0.89% of the average household income.

It is possible to add the value of the WTP, considering the sum of the provisions to be paid. In other words, the value of the WTP is multiplied by the total number of beneficiaries of the cultural ecosystem services provided by the parks in 1 year. This allows estimating (partly) the size and importance of these areas in the city (Table 3). For Parque Santana, considering scenario 1 (800 m radius), we have a total of 13,100 potential beneficiaries. For scenario 2 (4,800 m radius), we have around 48,704 potential beneficiaries. Thus, the estimated amount (monetarily) of the annual flow of ecosystem services provided by the park is from R$ 522 thousand to R$ 6.7 million. For Jaqueira Park, in scenario 1, we have 16,841.98 beneficiaries, and in scenario 2, a total of 169,657.39 beneficiaries. Thus, the value of the flow of SEC benefits generated by the park ranges from R$1.46 to R$25.57 million. For Macaxeira Park, scenario 1 would have 4,334.55 and scenario 2 would have 126,724.48 potential beneficiaries. What would generate a benefits flow between R$ 53,000 and R$ 4.35 million?

Table 2 – Regression results for cultural ecosystem services in the urban parks studied.

Equation 1	Macaxeira	Jaqueira	Santana
Parameter coefficient	**Estimates**	**Estimates**	**Estimates**
(Intercept)	3.00E + 02	1.20E + 03	-8.09E + 01
	(0.5482)	(0.0126**)	(0.845)
Bid 1	-1.60E + 01	-1.22E + 01	-1.44E + 01
	(0.0352**)	(0.0502*)	(0.020**)
Age	–5.24E + 00	–1.63E + 01	4.44E-01
	(0.5538)	(0.0291**)	(0.951)
Gender	5.66E + 02	1.04E + 02	1.37E + 02
	(0.0178**)	(0.6607)	(0.493)
School	5.67E + 03	6.63E + 03	4.84E + 02
	(0.9975)	(0.9994)	(0.236)
Temperature	-2.61E + 02	-2.74E + 05	-2.00E + 03
	(0.6406)	(0.9733)	(1.000)
Infrastructure	1.38E + 02	3.16E + 02	6.36E + 02
	(0.5769)	(0.3177)	(0.018**)
Equation 2	**Macaxeira**	**Jaqueira**	**Santana**
Parameter coefficient	**Estimates**	**Estimates**	**Estimates**
(Intercept)	-1.7748	1.20E + 03	1.29E + 03
	(0.00891**)	(0.0124**)	(0.00295***)
Bid 2	0.10260	-7.42E + 00	-6.48E + 00
	(6.8e-05***)	(0.0202**)	(0.41462)
Age	0.01840	-1.59E + 01	-2.12E + 01
	(0.12914)	(0.0302**)	(0.00472***)
Gender	6.22E + 02	2.35E + 02	-1.97E + 02
	(0.00947**)	(0.3409)	(0.32292)
School	4.5766	5.95E + 03	2.51E + 02
	(0.99801)	(0.9994)	(0.54410)
Temperature	-0.35192	3.99E + 04	4.77E-02
	(0.55441)	(0.9961)	(1,000)
Infrastructure	0.35676	3.16E + 02	1.98E + 02
	(0.26712)	(0.2944)	(0.44720)
	N = 168	*N* = 142	*N* = 111

Source: elaborated by the authors.

Table 3 – The individual and aggregated value of the WTP estimate is based on two scenarios.

	WTP individual	WTP/average household income	Aggregate WTP 1*	Aggregate WTP 2**
Santana Park				
Bid 1	R$ 39.90	0.44%	R$ 522,701.57	R$ 1,943,313.54
Bid 2	R$ 138.62	1.53%	R$ 1,815,962.20	R$ 6,751,431.65
Jaqueira Park				
Bid 1	R$ 87.15	0.77%	R$ 1,467,778.56	R$ 14,785,641.54
Bid 2	R$ 150.72	1.33%	R$ 2,538,423.23	R$ 25,570.761.82
Macaxeira Park				
Bid 1	R$ 34.33	2.48%	R$ 148,805.10	R$ 4,350,451.40
Bid 2	R$ 12.40	0.89%	R$ 53,748.42	R$ 1,571,383.55

*Scenario 1; **scenario 2.
Source: elaborated by the authors.

Discussion

The study's main result shows that people with higher incomes are more willing to pay for park conservation. This result corroborates what was found in similar studies in Brazil (Brandli et al., 2015; Neckel et al., 2020; Silva et al., 2022), as in other countries (Latinopoulos et al., 2016; Sabyrbekov et al., 2020). Even so, what is surprising when analyzing WTP in proportion to income is that users in the lower income region have a higher WTP in proportion to their average household income. This result is not commonly reported in recent works, although it is expected that in valuation studies, respondents are less likely to answer yes, in acceptance of the bids offered, as their income increases (Groothuis and Whitehead, 2002). The result indicates that urban parks play a role of significant importance for the population, especially those with fewer leisure options and when it comes to visitors with income restrictions. For this reason, the importance and need to offer this type of public good to lower-income populations should be highlighted.

Another important result is the characterization of the distances traveled by users to reach the parks. Considering the distances covered by the highest percentage of users, Macaxeira Park would be categorized as a neighborhood park (39.08% < 1,000 m), Santana Park as a District Park (36.40% between 1,000 and 2,000 m), and Parque da Jaqueira as a large urban park (50.43% > 3m000 m). This classification also considers the size (Mertes and Hall, 1996), and in this case, the largest of the three parks analyzed is Macaxeira Park (98,725.34 m^2), while Santana Park is smaller (54,912.32 m^2) and Jaqueira Park is intermediate (71,793.04 m^2). Which would put them all as district parks?

The distance of parks from their users' locations must be considered in the planning and supply of these areas; otherwise, this could result in a demand pressure on ecosystem services, especially those in more urbanized locations. Carbone et al. (2020) suggested urbanization as a factor directly associated with an increased demand for ecosystem services. Regarding the minimum distance of access to urban green areas, there are recommendations that at least 2 ha would be available within 300 m of all inhabitants (WHO, 2016). Compliance with the recommendation made by the WHO contributed to the reduction of about 42,000 deaths from natural causes per year across Europe (Barboza et al., 2021), in addition to the occurrence of other benefits also observed from the greater social integration provided for the existence of these public spaces and their adequate location in urban areas (Astell-Burt et al., 2021). This result adds to the effort to shed light on important aspects related to the unequal distribution of public green spaces in cities. The possibility of better connection of the most diverse open spaces and protected areas, with the possibility of reaching expansion goals in line with the parameters suggested for biodiversity conservation and promotion of the quality of urban life, is another relevant factor in this problem that must be observed (Mota et al., 2016).

Another result that calls attention is the predominance of male users, only in Macaxeira Park (55.17%), while they are a minority among users of Santana (46.49%) and Jaqueira (47.44%) parks. It is possible that this result is correlated with the nature of the equipment present in the parks (e.g., in Macaxeira Park, there are more spaces for sports practiced by men such as football and basketball, but this reality may also be related to the safety aspects of the park). Of the areas around the parks, the Macaxeira Park region has worse public safety indicators. Again, the need to consider equity in the planning of leisure spaces such as urban parks is highlighted, as well as including concerns regarding gender aspects (WHO, 2017).

With regard to the results of willingness to pay the values found, especially for the first bid, and their respective WTP, we have the following results: Santana (R$ 39.90), Jaqueira (R$ 87.15), and Cassava (R$ 34.33). Such values seem to correspond to what was observed in studies of the same genre in Brazil, between R$ 20.68 and R$ 300 (Brandli et al., 2015; Castro and Nogueira, 2019). Even so, we can point out a deficiency in the results of estimating users' WTP for the sec-

ond bid offered. The values obtained for the Santana (R$ 138.62) and Jaqueira (R$ 150.72) parks were higher than the values referring to the first bid. This contradicts what is most commonly observed in contingent valuation models using double bidding. The most common is that the second bid serves as a kind of review of the user's decision, with a tendency to accept a lower bid than the first (Aizaki et al., 2015). That is why we emphasize that the most reliable estimates of the economic benefits that are generated in these areas from the use of ecosystem services (by the user population) are those extracted from the values derived from the first bid offered to users. For Macaxeira Park, between R$ 148,000 and R$ 4.35 million; for Santana Park, between R$ 522.7 thousand and R$ 1.94 million; and for Jaqueira Park, between R$ 1.4 and R$ 14.7 million. The way in which valuation is a methodological tool to focus the attention of the public authorities and subsidize the creation and improvement of environmental policies is highlighted (Andrade et al., 2012). In monetary terms, the benefits generated by these areas are highlighted which assist in decision-making.

We also emphasize the necessary care with the use of the results presented here. Given that even with all the academic rigor applied, there are biases and flaws ranging from the collection instrument, sampling, and the willingness and interest of participants to respond. It is also noteworthy that valuation studies estimate temporally benefit flows rather than capital stock. It is necessary and recommendable to deepen and expand studies in these areas to support better decision-making.

Even so, it can be said from the results that the benefit generated by urban parks in terms of Cultural Ecosystem Services has more impact on socially more vulnerable areas. This leads to an essential consideration of this aspect in urban planning to provide green areas that promote leisure.

Conclusions

The city of Recife has 12 urban parks to serve more than 1.6 million inhabitants. In this research, we observed three urban parks in the second most populous region of the city. Due to the growing importance of the conservation of green areas, especially in urban and heavily populated areas, this study sought to analyze the benefit of urban parks in different socioeconomic contexts in the city. Our results showed that the benefits generated by urban parks, in terms of cultural ecosystem services, have a more significant impact on the low-income population. This highlights the importance of offering green areas in most peripheral cities.

Another significant result of the present work seems to demonstrate that the perception of park users about the type of infrastructure (and somehow, the equipment provided), as well as the perception of safety in these spaces, can influence the search for parks that are closer or more distant, especially for female users. Therefore, the necessary concern with the adequate planning of the parks to allow more democratic access is highlighted.

This work demonstrates the importance of the proper use of economic valuation methods for decision-making oriented toward the conservation of cultural ecosystem services, with a particular focus on the context of decision-making by local governments. However, it is recommended to deepen the data in future research, particularly to verify whether the population's view of the benefits of ecosystem services has changed after the period of social isolation.

We also emphasize that, even as the first results perceived in this work, they can contribute to the decision-making process by the public authorities, especially in improving the management of urban green areas with an emphasis on contributing to the achievement of the goals of the Sustainable Development Goals (SDGs) from the UN 2030 Agenda in the city.

Contribution of authors:

FLORENCIO, B. O. G. Writing — original draft; Writing — review & editing; Acquisition; Formal Analysis; Cruz Neto, C. C.: Writing — review & editing; Formal analysis; SILVA, C. E. M.: Writing – review & editing; Supervision.

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