Willingness-to-pay for environmental services provided by trees in core and fringe areas of Benin City, Nigeria

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ABSTRACT

Economic valuation of environmental services has emerged as a new and more direct argument and incentive for protection of trees and sustenance of environmental quality. This study aim was to estimate the monetary value for conservation of urban trees and environmental services in Benin City, Nigeria. Contingent Valuation Method involving a survey of 350 residents, was adopted for the study. Flooding and erosion control, scenic beauty, provision of shade and regulation of local temperature received positive rankings and high scores. Thus, an average of US$1.20/month which yielded an aggregate value of US$1 200 000 to US$1 860 00 was the amount Benin City residents were willing to contribute towards the conservation of trees. This study identified profession, years of residency and indigenous knowledge of ES as significant predictors that can influence willingness-to-pay. The findings provided quantitative data to demonstrate the importance of conserving trees to town planners, forest managers, policy makers and the urban community.

Keywords: Contingent valuation method, payment card, perception, residents, monetary valuation

INTRODUCTION

Urban trees are an important component of the environment that make them part of the green infrastructure in cities (Baur *et al*. 2016). Mature trees provide numerous benefits that can help to ameliorate health and social problems occurring in urban areas. For instance, trees are reported to enhance speedy recovery of patients, provide a sense of mental well-being, reduce levels of psychological stress and support social interactions by connecting people with one

another in metropolitan areas (Miller 2007, Sandifer *et al*. 2015, Wolch *et al*. 2014). Most importantly, trees provide a diverse range of non-market environmental services (ES). Payment systems i.e. credits for carbon sequestration and ecotourism, exist as a monetary instrument to control market failures associated with the numerous environmental services provided by trees (Obeng *et al.* 2018). In addition, mature trees provide other ES services such as flooding and erosion control, reduced heat island effect generated by concrete or steel, improved air and water quality, scenic beauty, reduced noise pollution, amongst others (Arabomen *et al.* 2016, Bolund and Hunhammar 2009, Zhang *et al.* 2007). Thus, ES emphasize the value of urban trees and the unique role they play to make cities more liveable.

However, due to rapid and unplanned urban sprawl, development of social amenities, infrastructure, population pressure and the poor design and implementation of forest policies, Nigerian cities are characterized by a critical loss of urban trees and by extension environmental services (Ezeabasili *et al.* 2015, Wendell *et al*. 2012, Wolch *et al*. 2014). Large urban green areas are rapidly being lost, leaving cities with fewer trees but fast becoming a concrete jungle (Dumenu 2013). For instance, Dirisu *et al*. (2015) on a study on Land Use Land Cover Change in Benin City, Nigeria reported a significant decrease in green areas from 53.45% (646.44Km^2) of the total land area in 1987 to 24.03% (280.55Km^2) in 2013, representing an annual decrease of 2.12%. Another reason is that town planners, government and policy makers are not giving adequate attention to trees and its inclusion in infrastructure and other land allocation priorities (Ezeabasili *et al.* 2015, Mell *et al*. 2013). This is because more attention is given to the tangible market products, primarily timber and fuel wood, discounting its non-commercial environmental service values (Dumenu 2013). Chan *et al.* (2012) reiterates that monetary valuation of urban forest and trees are broadly reported in the literature while the non-market ES benefits remain mostly unexplored. Failure to quantify non-market ES in appropriate terms often results in an implicit value of zero being placed on them (Loomis *et al*. 2000). This condition contributes to insufficient incentives for the protection of trees and ES in metropolitan areas (Sengupta and Osgood 2003). It is essential to communicate the functional values of trees in response to the pressure of urbanization and development issues in cities. It is particularly urgent and important to do so considering the Sustainable Development Goal 11 which entails to make cities and human settlements safe, resilient and sustainable (FAO 2018).

Urbanization in Benin City is characterized by compact and high-density development. There is an outward expansion from the core towards the urban fringe. This results in extreme pressure on tree resource and green areas in Benin metropolis (Balogun

and Onokerhoraye 2017). About 60% of global ES are either lost, degraded or exploited unsustainably. The degradation of the quantity and quality of these services is likely to further accelerate over the next few decades (MEA 2015). The tree resource in Benin City is not left out from this overall assessment. The loss of trees contributes to decreased resilience and exposure of the City dwellings to excessive flooding, erosion and heat problems, among others. Thus, management and preservation of urban tree areas is increasingly important in Benin City for their environmental services.

Nowak and Walton (2005) informed that urban sprawl intensifies the extent and importance of tree resource to provide critical ecosystem services to sustain societal well-being and environmental quality in and around cities. Investing in conservation of urban trees in Benin City and including them in future planning activities is vital. This can be accomplished if adequate and current information on the environmental services of the urban trees are properly assessed. The information will assist policy makers and city planners who are challenged with decision on whether to conserve areas occupied by trees or convert them for other urban needs such as shopping centers, market stalls, housing-estates and other land uses (Dumenu 2013, Resende *et al.* 2017).

Conversely, public participation and economic valuation of ES has emerged as a new and more direct approach to enhance the conservation of trees in urban areas (Garekae *et al.* 2016, Ives *et al*. 2017). The perceptions of the public on environmental services (ES) are needed to inform planning within rapidly changing landscapes (Ives *et al*. 2017). This is significant where people are often directly affected by the decline in these ES (Landell-Mills and Porras 2002).

Operational solutions such as payment for environmental services (ES) have been generated around the globe. The economic values of non-market ES are often assessed through valuation frameworks, which estimate the total economic value (TEV) of the tree resource and their numerous services (Obeng *et al.* 2018). For example, Templeton and Goldman (2006) corroborates that Californians spent about $1.08 billion to obtain the benefits of urban trees. The urban forestry sector recorded sales of at least US$1.24 billion per annum in the early 1990s. McPherson *et al* (2007) affirmed that urban trees of Chicago removed 5575 tons of air pollutants, estimated to be worth US$9.2 million as a cleaning cost. Monetary valuation of environmental services can help to provide the incentive needed for its conservation in developing countries, particularly in major cities of Nigeria. This is because the current economic situation mounts pressure on government budgets and on the funds allocated to maintain existing urban forest and tree resource. Popoola (2002) informs that this

system reveals in economic terms the level of peoples' concern for their environment as perceived from their willingness-to-pay for ES. If the values are sufficiently large enough, it offers supportive argument for the important roles trees play in sustaining environmental quality. This is obvious, since everyone involved in policy, including management and uses of tree resource are most likely conversant with gains and losses when expressed in monetary terms (Popoola 2002). Most importantly, economic value of ES can provide substantial evidence to assist the allocation of funds (i.e. environmental protection/ecological funds) for conservation of tree resource in Nigeria.

Despite this, there is lack of research on the monetary valuation of environmental services provided by urban trees in Benin City and most cities in Nigeria. This study adopted Contingent Valuation Method (CVM), a survey-based approach, to determine the economic value for conservation of trees and sustenance of environmental services in the City (Adekunle *et al.* 2008, Amigues *et al*. 2002, Dumenu 2013, Loomis *et al*. 2000). The basic concept of the CVM is that people have true and hidden preferences that can be discovered if appropriate questions are asked (Chen 2015, Frör 2008). The method uses a "hypothetical market" questionnaire instrument to obtain information about the perception of Benin City residents on environmental service values and willingness-to-pay to conserve the resource under evaluation, in this case, urban trees. The specific objectives were to (1) assess the perception of urbanites on environmental service functions associated with trees (2) determine peoples' willingness-to-pay for conservation program (3) investigate whether sociodemographic factors influence willingness-to-pay (4) estimate the economic worth for conservation of urban trees. It is expected that the findings from this seminal work will assist future planning and demonstrate to town planners and policy makers the need to invest in conservation of tree resource in the City.

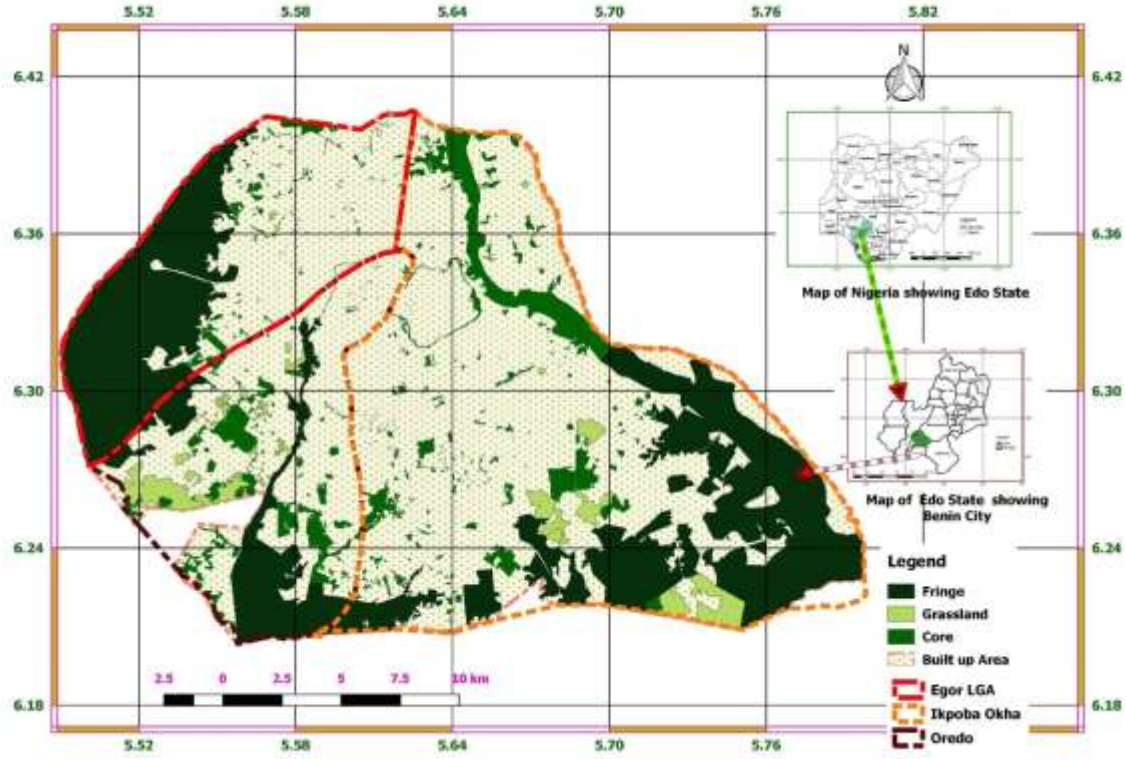
METHODS

Study area

Benin City, the 4th largest City in Nigeria, has an estimated 1 500 000 inhabitants and a land area of 1 204km² (NPC 2016). Administratively, the City has 3 Local Government Areas (LGAs) and 39 districts (Egor- 10, Ikpoba-Okha- 11, Oredo- 18). The geographical coordinates of the City lie within Latitudes 6°10' and 6°30'N and Longitude 5°30' and 5°45'E in the Southern region of Nigeria. The average daily temperature is about 25°C. There are two seasons, a rainy period from March to October and a dry (harmattan) season from November

to February (Eseigbe and Ojeifo 2007). The predominant vegetation is the moist deciduous forest that is composed of indigenous and exotic trees. The City is recognized for its biological importance, diversity and richness of its flora (Eseigbe and Ojeifo 2007). There are diverse tree species in areas such as botanical gardens, streets or avenues, public open spaces, roadsides, institutions and residences. The boundary for this study was extracted from satellite imagery of Benin City for 2016 (Figure 1). This was digitized on the Quantum Geographic Information System (QGIS 2.18) to produce the shapefiles and composite image of built-up areas in the core and fringe of the LGAs (Agbelade *et al*. 2017, Balogun and Onokerhoraye 2017, Nowak *et al.* 2014).

FIGURE 1 *Schematic of the Local Government, core and fringe areas of Benin City*



Contingent Valuation Method

Administratively, Benin City has three Local Government Areas (LGAs), namely, Egor, Ikpoba-Okha and Oredo and 39 districts with 10, 11 and 18 districts respectively in each LGA. Twenty-seven districts (70% of the total number of districts) representing nine (9) in each Local Government Area (LGA) were selected for the survey. The core and fringe areas were represented in 16 and 11 districts, respectively (Table 1). The sample included 350 residents

TABLE 1 *Information defining the distribution of respondents and number of questionnaire*

LGAs	Districts	Location	No of respondents	Total	Weighted %
EGOR	Uwasota	Core	12	108	31
	Uniben	Core	12		
	Upper Erhunse	Core	12		
	Owie, Textile Mill	Core	12		
	Siluko	Core	12		
	Akpata	Fringe	12		
	Ekhator district	Fringe	12		
	Okhokhugbo	Fringe	12		
	Evporo	Fringe	12		
IKPOBA-OKHA	Esosa district	Core	13	116	33
	Mission road	Core	13		
	Eirwele	Core	13		
	Obanosa	Core	13		
	Evbuabogun	Core	13		
	Edo-Osagie road	Core	13		
	Upper Sakpoba	Fringe	12		
	Benin-Sapele bypass	Fringe	13		
	Uhkiri	Fringe	13		
OREDO	Stadium road	Core	14	126	36
	Airport road	Core	14		
	Sunshine street	Core	14		
	Obanor	Core	14		
	Ugbor	Core	14		
	Amangba south	Fringe	14		
	Upper Ekehuan	Fringe	14		
	Ogba	Fringe	14		
	Evbotubu	Fringe	14		
Total				**350**	**100**

Field survey, 2017

who completed the self-administered questionnaires. The respondents were to complete the questionnaires and return immediately. The participants were randomly selected without considering any specific characteristic. The initial part focused on the bio-data- marital status, gender, income, years of residency, education, profession- of the respondents. From a series of opinion statements or predetermined list, the second part investigated the perception of residents on urban trees including (i) dichotomous choice question on awareness of environmental service functions provided by urban trees (ii) perceived ES values respondents assign to trees. The ES values were rated on a three-point scale from 1 (disagree) to 3 (agree). This 3-point scale was necessary owing to the relatively low frequencies for certain ES values (Lohr *et al.* 2004). In addition, a dichotomous choice question was used to determine whether the respondents were willing to pay to conserve trees. The final part employed the payment card (PC) mechanism to elicit the amount respondents were willing to pay towards the conservation program. The hypothetical market introduced a scenario of conversion of trees

for urban needs such as shopping mall, estate, road projects and additional social infrastructures. It was assumed that each person who showed a positive willingness-to-pay (WTP) should do so monthly to an institution involved with the conservation and maintenance of urban forest and trees, if the conversion is to be averted/controlled. The institution is expected to manage the funds collected for the protection program. To ensure realistic WTP, the payment card was presented to the respondents with ₦[1] offers (₦100, ₦200, ₦300, ₦500, ₦1 000, ₦2 000, ₦3 000, ₦5 000). Respondents were to select an offer representing the most they were willing to contribute towards the conservation program. They were also reminded to reflect on their financial plan i.e. their monthly income and expenses. Thus, a threshold of 5% was used to determine if the amount respondents were willing to pay was too high in relation to their income; such that questionnaires with respondents WTP higher than 5% of their income were discarded. Respondents' who did not present any WTP were given the option of indicating "₦0" and asked for their rationales. This aspect of the questionnaire was modified from previous studies **(**Ajewole and Popoola 2001, Chen *et al.* 2014, Dumenu 2013, Resende *et al*. 2017).

Analytical procedure

The overall rate of response was 93% (i.e. 325 valid forms returned), which is high for contingent valuation studies and qualifies to derive some general information (Groves and Couper 2008, Nowak *et al.* 2011). All variables (i.e. categorical, numeric and discrete) were summarized considering the frequencies and individual responses. Data analysis involved conducting descriptive and Pearson chi-square statistics to explain the perception of respondents on environmental service values and willingness-to-pay for conservation program. A mean rating was calculated for the environmental service functions of urban trees. The means of the environmental services were separated at 95% confidence interval on a 3-point ranking scale from 1 (disagree) to 3 (agree). The means of the environmental services were arranged by magnitude to determine the rankings; no further statistics were computed on the rankings. The binary logit model, which is a regression based on the cumulative logistic function was used to determine whether socio-demographic (gender, income, academic status, marital status, years of residency) and attitude (knowledge of ES) variables would influence the willingness of an individual to pay towards the conservation program. Firstly, a pooled logit analysis was

[1] ₦ denotes the Nigerian currency *Naira* at USD$1 = ₦360

done across the LGAs. Additionally, further analysis was done by conducting a separate logit analysis for each of the LGAs.

Specification of the logit model

This model provides a suitable fit for binary choice situations in which the dependent variable can assume only two values (Hill *et al*. 2006, Loomis *et al*. 2000, Resende *et al.* 2017). In this study, the dependent variable i.e. the willingness of a respondent to pay (WTP), assumes a value of "1" if "yes" and "0" if the respondent is not willing to pay. This was evaluated as a function of several socioeconomic (gender, marital status, education, income, profession, years of residency) and attitude (Awareness of ES) variables (see Table 2). If $p \leq 0.05$ value was observed, it was concluded that the explanatory variable had a significant effect on the dependent variable (WTP).

TABLE 2 Descriptive measures in the logit model

Socioeconomic and attitude measure	**Definition**
Gender	1 = female, 2 = male
Marital status	1= married, 2 = unmarried
Profession	1 = resident has a paid job, 2 = resident is a trader, 3 = resident owns a business, 4 = resident is unemployed
Education	1 = resident has attended a postgraduate school, 2 = resident has an undergraduate degree, 3 = resident has a college degree, 4 = resident is an illiterate
Length of residency	1 = < 10 years, 2 = 10-20 years, 3 = 21-30 years, 4 = 31-40 years
Monthly income level	1 = < ₦50 000, 2 = ₦50 000 - ₦100 000, 3= > ₦100 000
Are you aware of the environmental benefits provided by trees?	1 = yes, 0 = no

In addition, *the Magnitude of beta-coefficient* was computed to establish the degree of influence of the socioeconomic variables on the dependent variables. It is a standardized regression coefficient which measures a change in the dependent variable, arising from a typical change in the independent variable. The variable with the highest *Beta* coefficient is said to have the greatest influence on the dependent variable. *Beta* coefficient is expressed as:

$$\beta_k = b_k \frac{S_{xk}}{S_w} \qquad 1$$

Where: β_k= beta coefficient; b_k= regression coefficient; S_{Xk}= standard deviation of X_k independent variables; S_w= standard deviation of the dependent variable

(2) The monetary value for the conservation of urban trees was estimated as a product of the mean willingness-to-pay (WTP) of the respondents and the total number of consumers or users. The total number of users in this case is the total population in Benin City (Ajewole 2001, Alhassan 2012 and Popoola 2002). The monthly mean values were calculated by a mathematical expectation formula and Pearson correlation was used to evaluate the association between the amounts respondents were willing to pay across different information groups, including: (a) respondents' LGAs, location, gender, marital status, education, length of residency; (b) characteristics of the household livelihood like income and profession. Additionally, where there was a significant association, ANOVA was carried out to evaluate the stated significant differences between the specific demographic groups, followed by Duncan Multiple Range Test to separate significant mean values. Furthermore, the aggregate value for environmental protection was extrapolated using the equation:

$$AMV = WP_x \qquad 2$$

Where: AMV = aggregate monetary value; W = mean WTP; P_x = population of the City

RESULTS AND DISCUSSION

Demographic profile of the respondents

The results of the demographic profile show that except in Oredo, men (56% - 70%) were the majority in the core areas, whereas women (53% -58%) dominated the fringe across all the LGAs (Table 3). There were mostly married people who have spent a minimum of 21 and maximum of 40 years in core and fringe respectively of the municipalities. Only few (4%-16%) of the respondents in the core and fringe of Oredo, Egor and Ikpoba-Okha had no formal education. In addition, most of those surveyed had a profession, with over 50% earning between US$100 to US$300 per month[2].

[2] This group of people were in the middle-income class

TABLE 3 *Demographic description of respondents*

Demographic or socioeconomic measure[††]	Proportion of respondents (%) in					
	Egor		Ikpoba-Okha		Oredo	
	Core (n = 56)	Fringe (n = 46)	Core (n = 73)	Fringe (n = 33)	Core (n = 66)	Fringe (n = 51)
Gender						
Female	30	57	44	58	55	53
Male	70	44	56	42	46	47
Marital Status						
Married	59	63	69	67	70	67
Unmarried	41	37	32	33	30	33
Highest level of Education						
Postgrad	29	26	32	9	24	21
Undergrad	21	44	18	30	37	38
College	34	26	40	49	24	31
None	16	4	11	12	16	11
Type of Profession						
Paid jobs	50	32	34	30	21	47
Trading	13	46	52	30	55	28
Business owners	35	21	12	39	24	23
Unemployed	2	0	1	0	0	2
Years of residency						
< 10	18	11	2	3	3	0
10-20	21	26	26	30	24	14
21-30	36	30	27	49	29	43
31-40	25	33	44	18	44	43
Monthly income level						
Low - < ₦50 000	20	26	14	21	23	25
Middle - ₦50 - 100 000	58	52	57	55	54	55
High - > ₦100 000	22	22	30	24	23	20

[††]Rounding may result in numbers not adding to 100%

Perception of respondents on trees and environmental services

Urban trees provide numerous environmental services (ES) that enhance the life of residents in cities. The study found that most people in the core and fringe of the LGAs (77% - 97%) were aware of the positive values (ES) that trees provide in urban areas by their agreement to the statement "Are you aware of the benefits provided by trees". Although, there was no significant difference in awareness of ES in the core (χ^2 = 2.41, p = 0.300) and fringe (χ^2 = 1.72, p = 0.422) areas across all the LGAs, when Ikpoba-Okha LGA was excluded, awareness of ES was significantly different in Egor (χ^2 = 13.78, p = 0.003) and Oredo (χ^2 = 10.69, p = 0.001) LGAs. Ranking the ES functions that trees provide showed that people allotted the highest importance to mitigating flooding and erosion (mean = 2.83) and to provision of shade (mean = 2.74) (Table 4). In addition, the standard error for these two highest ranked ES benefits was not statistically different, suggesting that the importance of these services is widespread across all the LGAs. Other regulating services such as control of local temperature and scenic beauty appeared to be of moderate importance, while the

abilities of trees to reduce noise (mean = 1.18) and improve air quality (mean = 1.25) were considered least important, as evidenced in the low scores (0%-33%).

TABLE 4 *Ranking of environmental services provided by trees, based on respondents' agreement with each statement*

		% of total responses in		
Environmental service values	**Ranking[y]**	**Egor (n = 102)**	**Okha (n = 106)**	**Oredo (n = 117)**
Trees can mitigate flooding and erosion	1 (2.83 ± 0.04)	92.2	74.5	90.6
Trees cast shade and cools the environment	2 (2.74 ± 0.05)	88.2	88.7	88.9
Trees can add beauty to our surroundings	3 (2.42 ± 0.04)	81.4	95.3	72.6
Trees help to regulate temperature	4 (2.33 ± 0.05)	52.9	56.6	50.2
Trees improve air quality	5 (1.25 ± 0.04)	33.3	12.3	6.2
Trees can reduce noise in cities	6 (1.18 ± 0.03)	0	0	31.6

[y]Ranking based on the order of the means (n = 325)
Figure in parenthesis ( ) is the mean ± margin of error, at 95% confidence interval. Means are based on a scale from 1 (disagree) to 3 (agree).

Willingness of respondents to pay for conservation of urban trees

Most respondents (70%, n = 227), irrespective of their socioeconomic profiles, were willing to make financial contribution to conserve trees as opposed to the 30% (n = 98) who were unwilling. In table 5, people who were not willing to pay were in decreasing order more in Egor (34%) followed by Ikpoba-Okha (32%) and Oredo (24%). However, there was no significant (χ^2 = 3.402, p = 0.183) difference in willingness to pay across the three LGAs. Most of these were also living in core areas (32%). Additionally, with respect to gender and marital status, these were men (33%) and the unmarried (33%) people. Those who did not agree to pay were unemployed (67%). A significant (χ^2 = 6.62, p = 0.051) difference in willingness to pay was observed across the different employment categories of the respondents. Moreover, those who did not agree to pay would have lived in the city for 10 years or less (47%).

TABLE 5 *Demographics of residents who are willing to pay compared to those who are unwilling*

Demographic or socioeconomic measure††	Willingness to pay Number (n = 227)	%	Not willing to pay Number (n = 98)	%	Pearson Chi-square	p-value
LGAs						
Egor	67	66	35	34		
Ikpoba-Okha	71	67	35	32	3.402	0.183
Oredo	89	76	28	24		
Location						
Core	133	68	62	32	0.623	0.430
Fringe	94	72	36	28		
Gender						
Female	105	72	41	28	0.540	0.462
Male	122	68	57	33		
Marital Status						
Married	151	71	63	29	0.152	0.967
Unmarried	76	69	35	33		
Type of Profession**						
Paid jobs	84	74	30	26		
Trading	89	69	41	32	3.739	0.042
Business owners	53	68	25	32		
Unemployed	1	33	2	67		
Years of residency*						
< 10	11	55	9	45		
10-20	59	78	17	22	6.620	0.051
21-30	71	64	40	36		
31-40	86	73	32	27		
Monthly income level (₦)						
Low - < 50 000	71	71	29	29		
Middle – 50 000 – 100 000	91	68	43	32	0.802	0.489
High - > 100 000	65	71	26	29		

*, $p \leq 0.05$, based on Pearson chi square statistics
††Rounding may result in numbers not adding to 100%

Factors explaining willingness-to-pay for conservation of urban trees

Many socio-economic variables have been reported to have effect on willingness-to-pay for conservation of urban green spaces (Adekunle *et al*. 2008, Dumenu 2013). Owing to this, a binary logit statistic was conducted to determine the relationship between the willingness of a respondent to pay for conservation of urban trees and different socio-economic (income, education, marital status, years of residency, profession and gender) and attitude ("I am aware of the ES function of trees") variables. Only the statistics value with variables significant at the 0.05 or 0.01 level are shown in Table 6. In general, the coefficient of determination (R^2) of 0.26, indicated that the socioeconomic variables accounted for 26% of the variation in willingness-to-pay (WTP) across the LGAs. The result demonstrated that individual profession was a significant socioeconomic factor in the willingness-to-pay (WTP) function across the three LGAs. However, years of residency and knowledge of ES made significant contributions to the model in Egor and Oredo LGAs.

TABLE 6 *Factors explaining willingness-to-pay based on demographic and attitude variables*

Demographic or socioeconomic measure	EXP (B)	Wald	S.E.
Constant	0.448	0.471	1.169
Profession		2.368	
Paid jobs	3.064**	1.564	0.33
Trading	1.582**	1.201	0.42
Business owners	1.483*	0.563	0.49
Unemployed	0.221	0.000	0.05
Years in city			
31 - 40*Egor	1.273**	4.421	0.52
Knowledge of ES			
I am aware of ES provided by trees*Egor	1.333*	2.286	1.153
I am aware of ES provided by trees*Oredo	1.029*	1.291	1.242

*, **, $p \leq 0.05$ or 0.01 respectively, based on logistic function

In addition, since other variables such as education, marital status, income and gender were consistently insignificant in the core and fringe of the LGAs, the variables were thus arranged in order of magnitude of their *beta* coefficients to show/determine their level of contribution to the model (Table 7). The result indicated that income and education (though not statistically significant) somehow were the leading variables that contributed to the willingness-to-pay function.

TABLE 7 *Magnitude of socio-economic variable contribution to willingness-to-pay*

Socioeconomic measure	Beta coefficients
Income*middle*₦50 000 - ₦100 000	1.698
Education*college	1.573
Gender*female	1.301
Marital status*married	1.159

Monetary valuation of environmental services

On average, the residents were willing to pay ₦420 or US$1.20 (US$1 = ₦360) per month for conservation of urban trees and sustenance of environmental services. Thus, multiplying ₦420 by 70% (representing 1.09 million people[3]) of the total number of respondents who expressed willingness-to-pay gives an aggregate sum of ₦440 000 000 (US$1 200 000) being the lower limit that Benin City could realize from monthly payment by all residents for the conservation program. In addition, this value would increase to ₦672 000 000 (US$1 860 000), being the upper limit for monthly payment when the population for Benin Metropolis is projected to 1. 6 million in 2018[4]. Moreover, ₦430 to ₦440 was the mean amount people were willing to pay in the core and fringe areas. With respect to gender, women (₦370) were

[3] i.e. 70% of the total number of people in Benin City which was approximately 1 500 000 in 2016 (National Population Commission 2016)

[4] The total population for 2016 is projected at 4% annual growth rate to 1 600 000 in 2018 (National Bureau of Statistics, Nigeria, 2016)

willing to pay more than their male counterpart (Table 8). However, there was no significant ($p = 0.078$) difference in the mean amount between gender. There was a significant ($r = 0.156$, $p = 0.005$) positive correlation between the profession and mean WTP. Respondents who are employed were willing to pay between ₦200 and ₦300. There was a significant ($p = 0.029$) difference in the mean amount across the different employment categories.

In addition, people with disposable income were willing to pay ₦200 to ₦400. The result further showed a significant ($r = 0.142$, $p = 0.022$) association between the average amount and years of residency. In table 8, people who have been in an area for between 31-40 years were willing to pay more (₦200) than those (₦100) who have spent less than 10 years. On the contrary, people with a higher education i.e. a bachelor and/or postgraduate degree were willing to pay an average ranging from ₦140 to ₦160, which was relatively lower than the ₦200 that people with a college education were willing to pay. There was however, no significant ($p = 0.795$) difference in the mean amount across the different educational status.

TABLE 8 *Reported* m*onthly mean monetary values across respondents' demographic profiles*

Demographic measure	Number (n)	Total WTP (₦)	Monthly mean WTP[ɬ] (₦)
Gender			
Female	105	38 800	370[a]
Male	122	33 000	270[a]
Highest Level of Education			
Postgrad	59	8 500	140[a]
Undergrad	65	10 800	160[a]
College	80	16 000	200[a]
None	23	2400	100[a]
Type of Profession**			
Paid jobs	84	20 100	300[b]
Trading	89	19 700	200[a]
Business owners	53	12 400	230[a]
Unemployed	1	100	100[a]
Years of residency*			
< 10	11	1 200	100[a]
10-20	59	10 100	170[a]
21-30	71	13 300	190[b]
31-40	86	17 600	200[c]
Monthly income level (₦)			
Low - < 50 000	71	12 400	200[a]
Medium – 50 000 – 100 000	91	25 500	280[a]
High - > 100 000	65	24 800	400[a]

[ɬ]Rounding monthly mean WTP to the nearest whole number

*, **, $r \leq 0.05$ or 0.01 respectively, based on a Pearson correlation

Means with superscript letters are not significantly different, based on Duncan Multiple Range Test

DISCUSSION

Perception of respondents on trees and environmental services

Urban trees are a valuable resource that primarily provides important environmental services (ES) in urban areas (Baur *et al*. 2016, MEA 2015). This study showed that peoples' perception of trees in general are positive. Other studies have documented that positive perception is widespread among the general public (Barro *et al*. 2007, Lohr *et al.* 2004, Sommer *et al*. 1994, Wendel *et al.* 2012). Although ES, classified as public goods, are often underestimated or overlooked in cities (Wolf and Kruger 2010), most of the citizens in this study recognized the ES functions of trees across the three LGAs. Schroeder *et al* (2006) in a study on public attitudes toward trees in the United Kingdom and United States observed that trees in the urban environment were highly valued elements and that their benefits far outweigh their annoyances.

In the study, respondents considered the function of trees to mitigate flooding and erosion as the most important reason for having them in cities. Bolund and Hunhammar (2009) contended that ES functions vary according to the explicit environmental and socioeconomic condition of an area. For instance, the importance of trees in cushioning extreme events of flooding and erosion can be especially relevant in Benin City, owing to the high rainfall patterns and urban development (Balogun and Onokhoraye 2017, Eseigbe and Ojeifo 2007). Another important ES value of trees was provision of shade and cooling of the urban environment. This corroborates the findings of Lohr *et al.* (2004) who revealed that residents of the largest cities in the United States considered trees important because they provide shade and cool their surroundings. In this study, other ES functions such as regulation of local temperature and scenic beauty received positive rankings. Many studies have shown that people generally attribute great significance to the provision of several intangible benefits that trees provide in urban areas (Barro *et al*. 2007, Dwyer *et al*. 2002, Lohr *et al*. 2004, Sinclair *et al* 2014, Sommer *et al*. 2004).

The extremely skewed responses toward these regulating services are a reminder of urban living setting. In most cities and the fringes, urban dwellers' basic needs and livelihood activities are not directly dependent on "forest and trees" as one may find in the rural areas (Dumenu 2013). However, the major benefits that urbanites often connect with are the regulating/environmental services provided by urban trees. Thus, conserving urban trees may serve the dual role of enhancing the environment while at the same time qualifying for payment for environmental services (PES) and trade in carbon credit projects (Dumenu

2013). Such proceeds can be invested into the conservation of urban trees, as well as support urban development programs in cities.

Willingness of respondents to pay for conservation of urban trees

Public participation and economic valuation of environmental services (ES) has emerged as a new and more direct approach to enhance the conservation of tree resource in urban areas (Garekae *et al.* 2016, Ives *et al*. 2017). It is a useful instrument for decision making that can encourage the efficient use of limited funds for conservation and restoration of forest and trees in urban areas (de Groot *et al*. 2012, Smith and Pattanayak 2002). Since Benin City residents are aware of the ES provided by trees, there was a proportionate level in willingness-to-pay (WTP), irrespective of their demographic characteristics. The positive response (70%) was an indication that the residents have affinity for the existence of urban trees and the ES they provide. Dixon *et al*. (1994) using Contingent Valuation Method recorded that 92% of park users were willing to pay for the conservation of Bonaire Marine Park in The Hague, Netherlands. Ajewole and Popoola (2001) recorded 77% of residents who were willing to pay towards conservation of urban trees in Ibadan metropolis in Nigeria. Adekunle and Sanni (2009) reported a 75% response on willingness-to-pay for environmental service functions of urban trees in Abeokuta, Nigeria. In this study, few respondents (30%) expressed non-willingness to pay. This rate of "protest" response is not uncommon in previous contingent valuation studies (Bateman *et al*. 2006, Chen 2015). The key reasons provided for non-willingness to pay were: (1) It is the duty of the government (2) What is paid to the relevant authorities may be diverted for other uses. Adekunle *et al.* (2008) reiterates that some people do not pay for forest services that are considered as 'free rider' resources in metropolitan areas. In addition, Obeng *et al.* (2018) corroborates that since many non-market ES- (i.e. provision of shade, aesthetics, improving air quality, flooding and erosion control)- are classified as "public goods", they are exposed to "free-rider" problems. The "free-rider" problem occurs when "non-participants" do not have to pay for the provision of these non-excludable and non-rival services. Thus, monetary valuation of ES is designed as an incentive to control market imperfections by including public values associated with ES (Obeng *et al.* 2018, Roesch-McNally and Rebotyagov 2016).

Factors explaining willingness-to-pay for conservation of urban trees

Individual profession was a significant factor that influenced willingness-to-pay (WTP) across the three LGAs. The positive sign indicated that people who are employed will be willing to contribute towards the conservation program compared to those who were unemployed. In the study, traders and business owners may have expressed WTP owing to the direct benefit they derive from proximity to areas with trees. In addition, during business hours people prefer to protect their cars from direct sunlight under tree canopies. This indicates how employment could enhance willingness-to-pay for the sustenance of environmental benefits such as shade.

Conversely, the results from previous studies (Amponin *et al*. 2007, Chaudhry and Tewari 2006, Chen 2015) and findings from this study, confirm that the length of residency and awareness of the environmental service values of urban trees could have a significant positive influence on WTP. On the other hand, income and education, though not significant, could be strong predictors that could influence peoples' decision 'to pay' or not to pay.

Although these characteristics may not be used to make inferences for the entire Benin City, the results suggest some specific ways in which peoples' demographic profiles may contribute to variation in perception of and attitude toward trees. Thus, concerted efforts to improve the sustainable development of the tree resource would be more effective if communication on management is designed to suit relevant demographic status of residents in the City. Simultaneously, this would assist to motivate people to actively participate in urban tree conservation and management programs.

Monetary valuation of environmental services

Economic valuation of environmental services (ES) recognizes how the perception and attitudes of residents towards urban trees can influence payment for environmental services (ES). This is for these ES benefits to be expressed in units that allow incorporation in planning and policy for the conservation of forest and tree resource in urban areas (Sengupta and Osgood 2003). In this study, the monthly willingness-to-pay (WTP) for conservation program cuts across the LGAs and between the core and fringe areas, as observed from the mean amounts. Contrary to previous studies (Dumenu 2013, Loomis *et al* 2000), years of residency had a significant influence on mean WTP for environmental protection. It is most likely that having experienced environmental crises that are common in the areas (i.e. flooding, erosion, heat), people who have spent most of their years in the City would be

willing to pay towards protecting the environment from further degradation. Chen (2015) in a study on public willingness to pay towards conserving trees in South China corroborates that people who have lived an average of 20 years or more were willing to pay for a better environment. This could change the traditional ideas of environmental "unworthiness" and guarantee the sufficient supply of environmental services in urban areas (Zheng and Tu 2009). In addition, people who are employed and earned income were willing to contribute towards the conservation program. Adekunle *et al.* (2008) and Dumenu 2013 also observed that an individual's income and employment status can influence their ability to contribute towards conservation programs in cities. Conversely, a higher level of education did not necessarily lead to higher WTP values. Except in few cases in Nigeria, the income of people with postgraduate or tertiary education is not necessarily commensurate with their qualification. However, the odds ratio indicated that as educational status increased from no formal education to college level, an individual was 15 times more willing to pay. This shows that literate people can increase their ability to access information on benefits of trees from the media sources in their area. In addition, the more learned a person is the more they are expected to be conscious of and willing to give back to their environment.

Monetary evaluation denotes a strong financial commitment towards the conservation of trees and sustenance of environmental services (ES). Cooksey and Howard (1995) in a study of WTP to protect forest benefits with conservation easement in New Hampshire, USA, recorded an aggregate of US$220 000 - US$1 000 000 each year. Kramer and Mercer (2007) in WTP to protect tropical rainforest in the United States, estimated a total of US$2.2 billion and US$2.8 billion per annum using the combination of both referendum and payment card format, Popoola (2002) in monthly willingness to pay for rehabilitation of the urban environment in Ibadan, Nigeria through reforestation projects recorded US$1 800 000 to US$2 400 000. Dumenu (2013) recorded a value of US$695 000 per annum, as the economic value to restore the urban forest in Kumasi, Ghana. Urban tree functions include providing an extensive range of environmental services such as: cooler air temperatures, flooding and erosion control, aesthetics and casting of shade. The monetary estimate can serve as a strong argument against the conversion of areas with trees to other land uses, especially without the consideration for replacement. The information represents a focal point to aid/support management programs, improve forest policies towards enhancing environmental quality in Benin City. Thus, decision makers, town planners, forest managers and government (at federal, state and local level) can access this information as an additional input to integrate public values and support for protection of trees in Benin City, and other major cities of

Nigeria. Moreover, the result highlights that failure to place monetary value on environmental services may lead to excessive removal of trees, loss of economic value and environmental damage.

Furthermore, ₦420 (US$1.20) was the average monthly amount for people who were inclined to make financial commitments for conservation of urban trees. Converting the US$1.20 monthly payment to an annual payment, the US$14 is certainly a substantial sum. This reflects a good support for urban greening program in Benin City. However, this is not out of line with other willingness-to-pay (WTP) studies such as Hanemann *et al.* (1991) contingent valuation study to conserve water quality in California, USA (US$35), Loomis *et al.* (2000) study to protect the ecosystem services provided by the South Platte river in the United States (US$43) and Popoola and Ajewole (2010) study on reforestation of the urban forests in Ibadan, Nigeria (US$18). Consequently, the aggregate amount to protect urban trees in Benin City was estimated as ₦440 000 000 (US$1 200 000) to ₦672 000 000 (US$1 860 000). This further represents the potential financial resource the residents were willing to contribute in support and to improve green areas in the City.

CONCLUSIONS AND RECOMMENDATION

This study demonstrates that peoples' perceptions of urban trees in general are positive in relation to their awareness of environmental services in Benin City. Urban trees were rated important for the environmental service values such as flooding and erosion control, scenic beauty, temperature regulation and provision of shade in urban areas. It is important that awareness programs lay emphasis on the numerous intangible services and values associated with urban trees to increase peoples' willingness to support the conservation of trees and biodiversity (Dearborn and Kark 2010, Dwyer *et al*. 2002, Lorenzo *et al*. 2000). Nevertheless, the result from the study indicated out that most residents were willing to make financial contribution towards the continued existence and management of urban trees in Benin City. Individual profession was a significant socioeconomic variable that influenced willingness-to-pay (WTP) across the three LGAs in Benin City, indicating that individual decision on "whether to pay" was largely based on their source of livelihood. In addition, years of residency and prior knowledge of ES were generally good predictors of WTP in the City. Thus, it is stressed that concerted efforts to improve protection programs for urban trees would be more effective if communication on management is designed to suit the demographic and socioeconomic profile of the residents in the City. This would encourage

meaningful dialogue with urban residents to understand their perception and attitude towards urban trees. In addition, it can encourage participatory management by members of the community in the planning, establishment and maintenance of trees in the City.

Furthermore, the study has reinforced the negative implications of urban sprawl on the provision of environmental services using the payment card mechanism to estimate the amount the residents are willing to pay. An average of ₦420 (US$1.20) which yielded an aggregate of US$1 200 000 to US$1 860 000 was the amount people were willing to contribute towards the conservation program. This has the potential to reduce the effect of budgetary constraints for the preservation of urban trees in the City. When properly organized and collected, such funds should be integrated into development plans and properly accounted for in policy and town planning processes. At present, for instance, the environmental impact assessment (EIA) required in establishing industrial and/or commercial projects does not include economic valuation of urban tree resource as is the case in Europe (see Bliem and Getzner 2012).

As a matter of concern, many authors for over two decades have stressed that public valuation about user's preferences and needs is important to urban management (Burgess *et al*. 1988, Costa 1993). This study provides a basic way to conceptualize and understand public willingness-to-pay for the conservation of urban tree resource in rapidly developing countries, using Benin City, Nigeria as a case. The findings from this study offer insights on connecting management decisions for urban trees with the environmental service (ES) values that people rate as important and establishing a linkage between the perception of urbanites on ES provided by trees and willingness-to-pay behaviour in contingent valuation studies. In conclusion, it is envisaged that the results of this study will open-up public discourse with decision makers, town planners and other change agencies concerned with forest and tree resource management on the inclusion of total economic value of urban trees in policy, planning and future development projects in cities in developing countries. This recommendation is to ensure that this vital resource is not measured only by its timber/marketable components, but with the inclusion of its numerous intangible and/or non-market environmental services.

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AUTHOR CONTRIBUTIONS

Arabomen, O designed the study, conducted the research and wrote the manuscript. Chirwa, P.W. and Babalola, F.D. supervised the research and revised the manuscript. The authors declare no conflict of interests.

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