Valuing Urban Forests: The Application of Contingent Valuation Methods

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Abstract

An economic valuation of the environmental service functions of forest trees in University of Agriculture, Abeokuta (UNAAB) permanent campus was performed using the contingent valuation method (CVM).This was to elicit willingness to pay (WTP) values from the respondents as a measure of value for the conservation of forest trees on the campus. The respondents were private individuals purposively selected from among the academic and non-academic staff members. A total of 68 respondents (45%) were willing to pay amounts of money ranging from #5 to#1000 monthly. The modal value was #100 having recorded the highest percentage of response (41%).The mean monthly WTP values ranged from #70 to #154 with corresponding aggregate values of #23450 and #51724 (1USD=#129). These amounts represented the estimated monthly monetary values of the environmental service functions of forest trees at the study site. Some socioeconomic variables such as age, monthly income, and length of service significantly influenced the WTP for urban environmental service functions as indicated by the linear equation.

Key words*: contingent valuation, forest service functions, trees,.*

1USD=#129; (#: naira i.e. Nigerian currency)

Introduction

Forests are renewable natural resources which provide essential goods and services that are both timber and non-timber based. These products include wood for home and industries, food, cover for wild and domestic animals, protection of soil and water values, and recreational resources. The forest also performs some important environmental service functions especially in the urban settlements. Prominent among them are mitigating air pollution, reducing emission of green-house gases and contribution to human health conditions. Cultural and spiritual values, biodiversity conservation, nutrient recycling, carbon dioxide sequestration are among other service functions of the forest (Ajewole and Popoola, 2001). Meanwhile the rapid urbanization experienced in the developing countries in recent times as a result of trans-migration to urban centres is exacerbating serious environmental problems especially on urban vegetations in the affected urban areas. It is estimated that by the year 2030 the urban population globally would be twice that of the rural if the present trend of growth is not arrested (Kuchelmeister, 1998).This require an urgent attention if the urban forests are to continue their environmental service roles especially in urban settings. Adequate and up-to-date information especially on the monetary values of forests, green spaces and their environmental services in urban settings are essential for future urban plannings.These information are presently lacking and unavailable and where available they are usually very scanty and un accessible especially in developing countries.

This information gap often predisposed urban forests and green spaces to wanton destructions to give room for other infrastructures such as buildings and roads. In the light of the above the ability of urban trees to be able to perform their environmental roles is doubtful in the near future. Hence the relevance of this present study whose main objective is to carry out an economic valuation of the environmental service functions of campus forest trees in Abeokuta, Nigeria. This information will assist the decision-makers and planners make plausible trade-offs with respect to the service functions of forest trees in urban settings.

Material and methods.

The field study was conducted in the University of Agriculture, Abeokuta (UNAAB) campus established on the 1st January 1988 over an area of 10,000ha stratified into six zones. UNAAB lies within the humid lowland tropical rain forest with two distinct seasons: the wet season (March to October) and the dry season: (November to February). Mean annual rainfall is about

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1113mm with peaks in July and September (Aiboni 2001) while the mean monthly temperatures ranges from 23°C in August to about 36°C in March. The area overlies the Precambrian metamorphic rocks of the basement complex (Jones and Hockey, 1964) with bedrocks predominantly of granite, hornblendes, gneiss, quartzites, and quartzeschists.

This study was carried out where the core academic and non- academic activities were concentrated i.e. colleges of animal production and heath (COLANIM),agricultural management and rural development (COLAMRUCS), environmental resources management (COLERM), the natural sciences (COLNAS),and plant sciences (COPLANT) besides other academic and administrative structures. The UNAAB community is about 7854 in population made up of academic staff, 315; non-academic staff, 852 and students 5677; as at year 2005.

Data Collection

The contingent valuation survey (CVS) was conducted with the aid of structured and pretested questionnaire. The number of respondent were 150 purposively selected from among the academic and non-academic staffs at the rate of 30 per college. The questionnaires were in two parts. Part "A" was concerned with the bio-data of the respondents while part "B" addressed the contingent valuation procedures. The payment card system (CVM) was adopted to elicit willingness to pay (WTP) values from the respondents.

Data Analysis

Descriptive statistical tools such as frequencies, means, modes and percentages were used to analyze the variables of interest such as age, education, income, length of service and WTP values. Also inferential statistical tools especially the multiple regression was also employed to find out the relationship between WTP and some selected socioeconomic factors (independent variables).The linear regression model is as follows:

$WTP= f(x_1 + x_2 \ldots x_n + e)$ ……..(1)

x_1 – Age; x_2-income; x_3-education; x_4-sex; x_5-length of service;

x_6-employment status, e-error term.

Three functional forms were tried in order to choose the one with the best performance viz: linear, semi-log and double-log.

Results and Discussion

Monthly WTP for urban forest tree environmental services.

The respondents WTP across different socio-economic strata are summarized in Table 1. This table has established the differences in WTP between strata and within each stratum. The highest mean WTP was recorded among the male respondents i.e. (#72.). This could be because men in most cases earn more than their female counterparts. Also men have more authority over the family income and hence can make budgetary decisions on behalf of their wives. Theses results are consistent with previous reports of World Bank (1993), Ajewole (2001), and Adekunle (2005). Likewise the older respondents in age brackets of 45 to 55^+ had higher mean WTP than youths, (<35 years) presumably because the older people have additional income. Regarding educational status, respondents with post graduate qualifications generally had higher mean WTP (#75), This could be because most of the postgraduate respondents are in the senior staff cadre of the university who earn more money. Also this category of staff could be more concerned with the service functions of the trees on campus.

Respondents in the high income bracket had the highest mean WTP of #278 implying a direct relationship between an individual's income and his ability to contribute for the conservation projects. In the same vain, respondents with longer number of years at UNAAB (6 to10 years) indicated the largest mean WTP of #97 and those with 1 to 5 years elicited a mean WTP of #36. .This shows that the length of service in UNAAB could have a positive influence on the value of forest service functions probably due to increment in income overtime.

When the status of employment of the respondents was considered, the largest mean WTP was elicited from the non-academic staff. Table 1 further reveals a higher mean WTP of #372 from single respondents than their married counterparts.

Perception of environmental services of forest trees.

Provision of shade was the most important service function with the highest frequency of interest 131 (43.67%) (Table 2). Climatic amelioration had the least frequency and aesthetic values having intermediate values. This is because shade provision and ornamental values of trees and flowers are more directly felt and enjoyed than microclimatic modifications by the members of the community. This might inform the high level of commercial activities on campus such as photography, sales of agricultural products and operatives of mobile phone calls located under tree shades. These findings were found to be consistent with the reports of Adekunle and Sanni (2007).They found out that 55% of the small scale business enterprises in the campus cited provision of shade as the most important service of forest trees.

Sixty eight respondents (45.33%) gave an affirmative response concerning WTP for forest tree service functions (Table 3). The relatively lower proportion of positive responses could be because people are not used to paying for forest services as 'free riding' on social and natural resources is common in developing countries like Nigeria. The characteristic nature of forest resources such as open access, non-rivalry and non-excludability may make people averse to pay for forest resources. But with the present trends in budgetary constraints in the Universities and other governmental institutions, some of the services might be made to pay for themselves wholly or partially as observed by Jenkins et al. (2002).

Distribution of responses on WTP values for environmental service functions.

Respondents were willing to pay various sums of money ranging from #5 to #1000 with #100 being the modal value 41.18% (Table 4). The sum of #50 was also elicited from all respondents across the colleges which represented a sub-modal value. The most preferred instrument of payment was 'Direct payment' into the university revenue office while the least number of respondents suggested 'direct taxation' as the most feasible payment instrument.

Aggregation of WTP values for urban environmental service functions.

The total monthly estimated amounts ranged from #835 for COLANIM to #3, 525 for COLAMRUCS. The total mean individual WTP ranged from #70 to #154 lower and upper limits respectively. This resulted into aggregate values of #23, 450 and #51, 724 lower and upper limits respectively (Table 6). These findings are in line with Maher and Chapman's (1995) submissions that the objective of valuation is not the environment per se, but rather the peoples' preference for changes in the environment and their preference for changes in the level of risk to their lives. Hence importance is measured by the summation of many individual WTP. In this case economic valuation measures the preference of people for environmental good or against environmental bad. Similar results were reported by Cooksey and Howard (1995) who recorded a mean WTP of $31.23 per annum and an aggregate WTP of all Coos county residents of $228,416 to$1,000,000 annually to protect forest benefits.

Determinants of the levels of willingness to pay for forest tree service functions.

This study went further to statistically identify factors that potentially influences the levels of willingness to pay for forest service functions and by implication the monetary values of forest services especially in an urban campus environment (Table 6). The 3 equations estimated shows the following R^2 values: 0.46, 0.35, and 0.32 for linear, semi-log and double log functions respectively. A low R^2 has been found to be consistent with a socioeconomic study of this nature probably as a result of some biases. The likely sources of biases in a CVM study of this nature has been by summarized in Maxwell (1994).This include strategic, information and instrument biases. However the R^2 values obtained in the present study were higher than the 0.20 (20%) standard variability (Maxwell, 1994) set for a good CVM result. At least 3 of the tested

variables were found to be significant in each of the equations at the percentages indicated in the table. However respondents ages, and length of service were significant in all the equations. The likely reason for this is that the older an individual is the more responsible he or she in preserving and care for environmental resources especially forest trees. In the same vain the longer the length of service in the campus the more the likelihood of the interest to sustain the service functions of forest trees. This can be substantiated by the number of cars usually parked under tree shade. This finding agrees with Popoola and Ajewole (2002) who opined that the willingness of an individual to pay for forest service functions is an indication of positive concern for the quality of the environment. Income and education levels of respondents were found to be significant in the linear and double log equations .According to the results the higher the income and educational level of an individual the more the willingness to pay for forest service function especially in a campus environment. This is evident by the high WTP values elicited by this categories of respondents within their individual stratum (Table 1).The sex of the respondents were found to be significant in the semi and double log equations only. As observed in Table 1, the male respondents elicited the highest WTP when compared with their female counterparts. This shows that the higher the numbers of male staff in a campus the more the likelihood of high WTP values for forest services. The statuses of employment were not significant in any of the equations. This is an indication that the status of employment either as academic or nonacademic staff is not a strong indication of willingness to pay for forest services.

Conclusion

It can be concluded from the study that the university community valued the presence of trees highly that they are prepared to contribute parts of their income to maintain and enhance the continual existence of trees on campus. This is because providing funds for their upkeep and maintenance is usually a problem in academic campuses probably due to budgetary constraints. Finally, age, annual income, education gender and length of service were found to be the major factors through which payments for the environmental service functions of forest trees can be explained and predicted especially in an urban campus environment.

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Table 1: Month WTP across different socioeconomic strata in the study area.

Socioe-economic variables	Total frequency	Total WTP #	Mean WTP #	Mode
Gender				
Male	94	6785	72.18	Male
Female	56	3715	66.33	
Age (Years)				
<35	8	650	81.25	
36-45	79	3255	41.20	
46-55	63	6585	104.52	45.55
Educational Levels				
Secondary School	11	305	27.3	
Tertiary School	28	184	65.71	
Postgraduate	11	8355	75.21	Postgraduate
Annual Income				
<250,000	44	2315	52.16	
260-500,000	29	1130	38.96	
510-750,000	32	665	20.78	
760-1,000,000	36	3670	101.94	
1,000,000+	9	2510	278.88	1,000,000+
Length of service (years)				
1-5	67	2425	36.19	
6-10	83	8075	97.29	6-10 years
Employment Status				
Academic	47	2240	47.66	
Non-academic	103	8260	80.19	non-academic
Marital Status				
Married	136	9490	69.77	
Single	14	1010	72.14	Single
Divorced				

Table 2: Respondents perception of environmental service functions of forest trees on campus

Tree Service Functions	Frequency	Percentage of Total
Provision of shade	131	43.67
Climatic amelioration	44	14.67
Air pollution reduction	53	17.67
Ornamental services	72	24.00
Total	300	100.00

Table 3: Distribution of respondents WTP for urban forest trees environmental services on campus.

Response		COLPLANT	COLAMRUCS	COLERM	COLANIM	COLNAS	Total
Yes	freq.	18	16	13	10	11	68
	%	60	53.33	43.33	33.33	36.67	45.33
No	freq.	12	14	17	20	19	82
	%	40	46.67	56.67	66.67	63.33	54.67
Total	freq.	30	30	30	30	30	150
	%	100	100	100	100	100	100

COLPLANT: college of plant sciences
COLAMRUCS: college of agricultural management rural development and consumer studies.
COLERM: college of environmental resources management
COLANIM: college of animal production and health.
COLNAS: college natural sciences.

Table 4: Distribution of respondents' willingness to pay bid values (N) for tree services
Elicited Values (N =naira)

Colleges		N5	N10	N20	N50	N100	N200	N500	N1000	Total
COLPLANT	Freq.	-	1	2	6	7	-	2	-	18
	%	-	5.55	11.11	33.33	38.89	-	11.11	-	100
COLAMRUCS	Freq.	1	-	1	2	9	-	1	2	16
	%	6.25	-	6.26	12.50	56.25	-	6.25	12.50	100
COLERM	Freq.	-	1	4	1	5	-	1	1	13
	%	-	7.69	30.11	7.69	38.46	-	7.69	7.69	100
COLANIM	Freq.	1	1	1	4	2	2	-	-	11
	%	9.09	9.09	9.09	36.36	18.18	18.18	-	-	100
COLNAS	Freq.	-	-	-	3	4	2	-	1	10
	%	-	-	-	30	40	20	-	10	100
Total	Freq.	2	3	8	16	28	4	4	4	68
	%	2.49	4.41	11.76	23.53	41.18	5.88	5.88	5.88	100

Table 5: Monthly and aggregate estimate values (Naira N) of urban forest tree environmental service functions in UNAAB.

Colleges	A Monthly Estimate Value ₦	B Mean Monthly WTP Value ₦ (Lower Limit) n = 30	C Mean Monthly Value WTP (Upper Limit) n = x	D Population of Academic & Non-Academic Staff	E Monthly Aggregate Values (Lower Limit) n* D	F Monthly Aggregate Values (Upper Limit) X * D
COLPLANT	2050	68.3 n_{30}	113.9 (x = 18)	70	4781	7,973
COLAMRUCS	3525	117.5 $_{n-30}$	220.31 (x =16)	65	7637.5	14,320
COLERM	2140	71.3 $_{n-30}$	164.62 (x = 13)	65	4634.5	10,700
COLANIM	835	27.8 $_{n-30}$	75.9 (x = 11)	45	1251	3,415
COLNAS	1950	65.0 $_{n-30}$	195 (x = 18)	90	5850	17,550
Total	10,500	70.0 (n = 150)	154.4 (x = 68)	335	23,450	51,724

1US$ = N130; n-sample size; x-number of respondents who elicited willingness to pay naira values.

Table 6. Regression results for the estimation of factors that determine willingness to pay for forest trees service functions.

	b_o	X_1 age	X_2 income	X_3 education	X_4 sex	X_5 length of service	X_6 status of employmt	R^2	Adj.R^2	Sig.F
linear	-238.8 (-1.13)	4.9*** (3.52)	6.5*** (3.95)	4.8 (0.37)	-5.38 (-0.16	6.1*** (5.00)	-0.16 (-0.00)	0.46	0.44	16.14***
Semi-log	-573.5 (-0.87)	115.5* (2.80)	37.8 (0.95)	-95.5 (-0.38)	-8.3* (-3.30)	24.2*** (3.80)	-48.7 (0.73)	0.35	0.31	6.2*
Double log	-2.2 (-0.32)	1.26* (3.86)	0.21 (0.52)	0.63* (3.25)	-0.32*** (-4.91)	0.12* (3.39)	-0.59 (-0.86)	0.32	0.32	3.54

***Represents sig at1% ; ** sig at 5%; *sig at 10 % Figures in parenthesis are t-values.