ESTIMATION OF HOUSEHOLDS' WILLINGNESS TO PAY FOR ECOSYSTEM SERVICES OF URBAN FOREST IN SELECTED NIGERIAN CITIES

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Abstract

This study examined households' willingness-to-pay for urban forest restoration and conservation in selected Nigerian cities. Data were collected using a semi-structured questionnaire and interview guide. Three hundred (300) copies of the questionnaire were administered to 100 respondents in each of the urban areas (Akure, Ado Ekiti and Osogbo metropolis). The results reveal that 259 respondents (86%) were willing to pay between ₦2,100.00 (1.5USD) to ₦3,360.00 (2.4USD) monthly for ecosystem services and conservation of urban forest resources. The total mean monthly willingness-to-pay for the 86.33% population for ecosystem services and conservation of urban forests in these three cities was estimated as Akure ₦1,524,157,250.00 (US$1,088,683.75); Ado Ekiti ₦836,106,054.00 (US$597,218.61) and Osogbo ₦1,602,629,602.00 (US$1,144,735.43). Respondents valued ecosystem services produced by the urban forests so highly that they are willing to contribute part of their income to ensure the continued ecosystem benefits from the urban forests. Research of this nature could form the basis for which information is generated and canvased for dialogue with the urban population in order to make urban forestry participatory and sustainable.

Keyword: Biodiversity conservation; ecosystem services; forest landscape; willingness-to-pay; urban forests; urban population dynamics.

Introduction

The benefits of natural ecosystems in urban areas to humans over the years cannot be overemphasized, as an essential part of man's life; it has increased the quality of life (De Sousa, 2003). Urban population growth in Nigeria has increased rapidly over the past five decades from 34 million in 1950 to 141.4 million in 2005, with a projected rise to 193.1 million in 2020 (Fuwape & Onyekwelu, 2011; UN, 2006). The United Nations predicted that the proportion of the urban population would exceed 67% of the world's population by 2030 (UN-Habitat 2014). Nigeria's demographic landscape presents a mix of high growth rate and intense rural–urban migrations in search of a better life within the urban settlement. Adekunle *et al.* (2008) indicated that half of the world's population is already living in cities, with no exception to Nigeria context.

Forests and forest products play vital roles in human life and they possess potential in improving the livelihood of the people (Agbelade *et al.*, 2022). Urban forests provide enormous ecosystem services that are beneficial to the urban populace

and improve their livelihoods. Urban forests have the potential and strategies for solving enormous problems associated with urbanization and people's livelihood. Fuwape and Onyekwelu (2011) in their study opined that people basically plant trees around their houses for various ecosystem services (fruits, nuts, leaves, fuel wood, fodder, building materials, shade and windbreaks). It is common practice in Nigerian communities for trees to be planted in village squares to provide shade during meetings, ceremonies, education, recreation, worship, and other social benefits. Thus, the planting and management of trees in Nigerian settlements was largely motivated by their nutritional, economic, social, cultural, medicinal and spiritual values (Adekunle & Agbaje, 2012; Agbelade & Onyekwelu, 2020; Fuwape & Onyekwelu, 2011). Although tree planting has been an integral and important part of settlements in Nigeria, the full value of the ecosystem services it provides was only recently being considered. The growing urban population in Nigeria is redefining urban forestry practices and has presented new challenges and opportunities. Ajewole (2001); Fuwape and Onyekwelu (2011) in their studies, stated that forests usages are basically and traditionally subsistence in nature in terms of income generation from ecosystem services and other benefits of forests as an entity. Urban forests are a special part of human life as they are valued for the necessities of life for food, shelter, and improvement of social and economic status (Agbelade *et al*., 2022).

There are numerous ecosystem services and other important services that are generated from urban forests viz: improvement in air quality, water shed protection and purification, regulation of environmental temperature, biodiversity conservation and improved landscape structure for environmental beautification (Adekunle *et al*., 2012, Agbelade *et al*., 2017; MEA, 2005). Urban forestry is an art, science and technology of managing forest resources in and around urban community ecosystems for the physiological, sociological, economic, and aesthetic benefits. (Konijnendijk *et al*., 2006; McPherson *et al.*, 2005). Urban forests deliver a range of tangible and intangible goods and services, which justifiably include them as part of basic urban infrastructure (Akbari, 2002; Konijnendijk *et al*., 2004; Agbelade *et al.*, 2022). Urban forestry could be a means of catalysing community development, especially in developing countries. This study was set out to investigate the urban dwellers' attitudes and preferences of forest ecosystem services provided by urban forests in southwest, Nigeria. Various studies have indicated that preferences for urban forest ecosystem services are based on the social status of the urban populace (Adekunle & Sanni, 2009; Adekunle and Agbaje, 2012; Faleyimu & Akinyemi, 2014). However, in these three cities, there has been a lack of research on the urban dwellers' attitude, preferences and willingness-to-pay for

forest ecosystem services provided by urban forest users to provide decision-makers with key information for the development and management of urban forests. This research aims to provide information on urban dwellers' attitudes and preferences for forest ecosystem services and based on this information, make recommendations for efficient urban forest management. In addition, it is important to undertake an inventory of existing urban forest ecosystem services, as well as other key issues on urban forest tree resources. Currently, inventories of urban forest resources in Nigerian cities are scanty and there is little or no documented information on the important ecosystem services that could be derived from urban forests. This study was proposed to bridge these knowledge gaps.

Methodology

Study Area

The study was conducted in three selected cities (Akure, Ado Ekiti, and Osogbo), in the Southwest of Nigeria (Figure 1). The cities selected are the capital cities of these States with the highest population density and improved infrastructural development. Akure, the capital of Ondo State, is situated within the humid forest zone of Nigeria with rainfall for eight months (April to November), and a dry season for four months (December to March). The annual rainfall ranged from 1,500 mm to 2,000 mm. The Average relative humidity of Akure is 80 - 85% daily during raining season, while the average annual temperature is 30°C, with the lowest and highest temperatures in August and February, respectively. The city had a population of about 1,145,000 according to NPC 2026 data. Ado-Ekiti is the capital city of Ekiti State and is one of the developing states in Nigeria with a relatively low population of about 824,000 according to 2026 NPC data. The State is mainly an upland zone, rising over 250 meters above sea level. It lies in an area underlain by metamorphic rock.

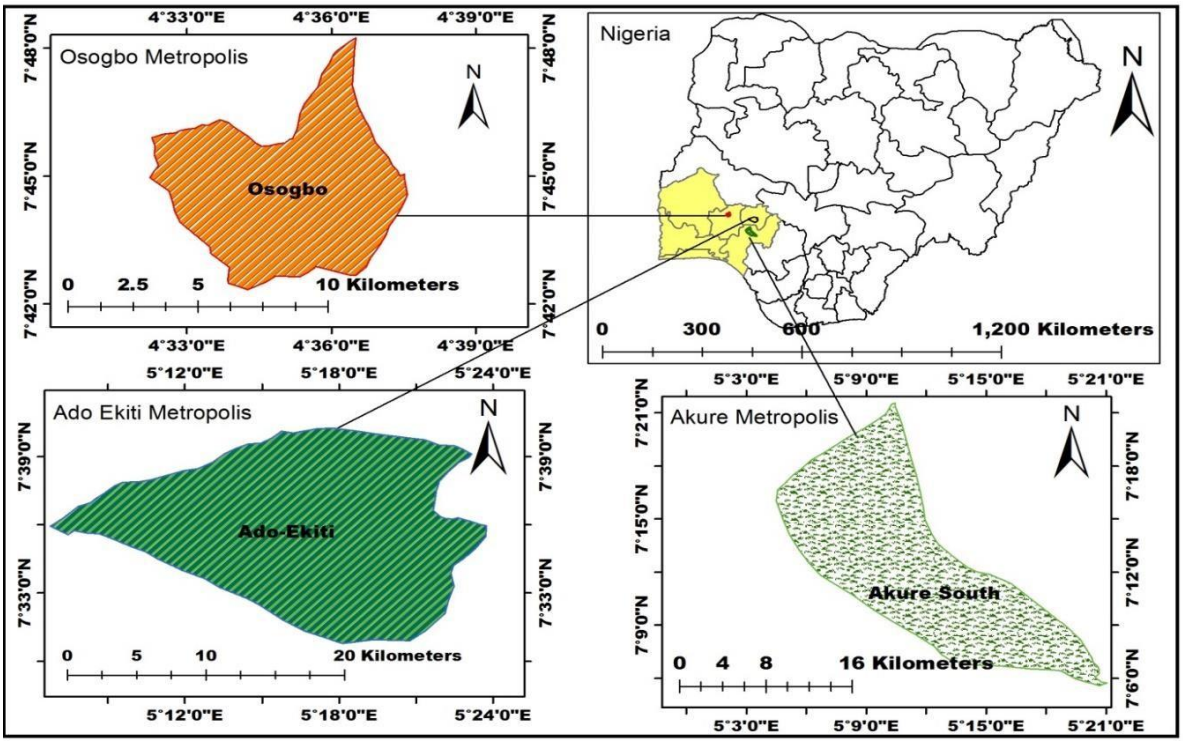

Figure1 Nigeria, Southwest and Study Locations Map (Akure, Ado Ekiti and Osogbo).

The topography is generally undulating with a characteristic landscape consists of old plains broken by steep-sided outcrops that occur singularly or in groups of ridges. The State is dotted with rugged hills, notable ones being Ikere Ekiti Hills in the south, Efon Alaaye Hills on the western boundary and Ado Ekiti Hills in the centre. Ado Ekiti enjoys a tropical climate with two distinct seasons. These are the rainy season (April–October) and the dry season (November–March). The temperature ranges between 21° and 28 °C with high humidity. The state is dominated by the Ekitis, a sub-ethnic group of the Yoruba tribe. Osogbo is the capital city of Osun State with the largest population and infrastructural development. Osogbo is the capital of Osun State. The city had a population of about 1,163,000 people and an approximate land area of 2875 km^2 according to NPC 2026 data.

Method of Data Collection

A Semi-structured questionnaire and interview guide were developed and administered for the data collection for this study. Data collection was done through the Payment Card System (PCS) of Contingent Valuation Method (CVM) as adopted by Adekunle and Agbeja (2012); Ajewole (2001) to el]icit the amount respondents are willing to pay for ecosystem services in their study. CVM is a valuation method of determining the economic value of ecosystem services whereby respondents indicates the maximum amount they are WTP per month for urban forest ecosystem services (Agbelade *et al.*, 2022). Three hundred (300) questionnaires were administered to 100 respondents in each of the urban cities (Akure, Ado Ekiti and Osogbo metropolis). The

questionnaire was in three parts (section A, B and C), section A was used to determine demographic information of the respondents, economic importance of ecosystem services to the respondents. Section B was used to determine the ecosystem services available in these urban cities. Section C addressed the attitude and preference of these respondents on ecosystem services within the urban forest estate. The questionnaire was pre-tested before final administration to the head of each household in these urban cities.

Data analysis procedure

The entire questionnaire administered was retrieved and subjected to analysis. The data collected were subjected to descriptive statistics in the form of frequency, percentage distribution and tables to present the demographic characteristics of the respondents and willingness-to-pay for the ecosystem services. The means of the environmental services were separated at 95% confidence interval on a 3-point ranking scale from 1 (disagree) to 3 (agree) as adopted by (Arabomen *et al*., 2019; Obeng *et al*., 2018). In this study, the dependent variable, positive willingness of a respondent to pay (WTP), assumes the value of 1 while the negative willingness of a respondent to pay (WTP), assumes the value 0. This was adopted for analytical procedure for the socio-economic characteristics of respondents such as: age (≤ 20 = 0; 21-40 = 1; 41-60 = 2; 61-80 = 3; ≥ 81 = 4), sex (male = 0; female = 1), marital status (0 = single; 1 = married), level of education (none = 0; primary = 1; secondary = 2; Tertiary = 3), employment status (salary earners = 0; trading = 1; business owners = 2; unemployed = 3), income generation (low ≤ ₦50 000 = 0; medium- ₦51 000 - ₦100 000 = 1; high ≥ ₦101 000 = 2); years of residence (≤ 10 = 0; 11-20 = 1; 21-30 = 2; 31-40 = 3), awareness on the benefits of ecosystem services (adequately aware = 0; not aware = 1). When the level of significant at ($p \leq 0.05$) values was observed, the conclusion was the significant effect on the dependent variable for respondents that are willing-to-pay (WTP). Further analysis was conducted using (Magnitude of beta-coefficient), this was used to compute the degree of influence of the socio-economic variables on the dependent variables as adopted by (Arabomen *et al*., 2019; Dumenu, 2013; Khuc *et al.*, 2016). Beta coefficient 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 has greater influence on the dependent variable. Beta coefficient is expressed as:

$$\beta_{\kappa} = b_{\kappa} \frac{S_{x\kappa}}{S_w} \quad (1)$$

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.

The willingness-to-pay (monetary value) for urban forest ecosystem services were estimated as a product of the mean of the respondents and the total number of consumers of ecosystem services. The total number of users in this case is the total population in these cities (Akure, Ado Ekiti and Osogbo) as it was done by Ajewole (2001); Khuc *et al.* (2016); Popoola and Ajewole (2002), adopted by (Arabomen *et al*., 2019). Multiple linear regressions were used to determine the socio-economic factors by which WTP for ecosystem services can be measured and predicted. The model specifications are as follows:

$W_d = f(X_1 + X_2 + ... + X_n + e)$ (2)

Where: W_d = individuals willingness-to-pay (WTP) for ecosystem services
X_1 = age; X_2 = sex; X_3 = Individual income; X_4 = level of education; X_5 = employment status; X_6 = year of residence; X_7 = marital status; e = experimental error.

The monthly mean values were calculated by a mathematical expectation formula and Pearson correlation was used to evaluate the relationship between the amounts respondents were willing-to-pay across different information groups, including: (a) respondents' city, sex, marital status, level of education, length of residence; (b) characteristics of the household livelihood such as income and profession. Furthermore, the aggregate value for environmental protection was extrapolated using the equation:

$AMV = WP_x$ (3)

Where: AMV = aggregate monetary value; W = mean Willingness-To-Pay (WTP); P_x = population of the City. Percentage ecosystem system distribution of socio-economic and environmental benefits of urban forests was determined by this equation. This is in form of frequency and percentage distribution, tables, graphs and Bar charts to prioritize the socio-economic and environmental benefits that respondents derived from ecosystem services.

Results and Discussions

Demographic characteristics of respondents in the study areas

The research covered a total of 3 cities in the southwestern states of Nigeria. The result of this study indicated that 82% of the respondents are male in Akure, 79% are male in Ado Ekiti and 86% are male in Osogbo. Respondents with formal education dominated these three cities (Table 1). Those who were without formal education are very few (5% in Akure; 3% in Ado Ekiti and 7% in Osogbo). The majority of the respondents across the cities was married and had been residing in these cities for a

minimum of 21 and a maximum of 40 years (Table 1).

Perception of respondents on urban forest ecosystem services

Urban forests are essential components of the urban environment with numerous benefits to the urban residence. Largest numbers of people in these three cities (95% – 99%) are aware of the values and benefits of urban forests to the urban environment. There was no significant difference in awareness of ecosystem services Akure ($X^2 = 13.41$, $p = 0.003$), Ado Ekiti ($X^2 = 13.72$, $p = 0.003$) and Osogbo ($X^2 = 13.78$, $p = 0.003$) across all the cities. Prioritizing the ecosystem services of these three cities, the result indicated that beautification purposes (mean = 3.92), edible fruits and vegetables (mean = 3.82), garden as recreation centres (mean = 3.64), religious centers (mean = 3.42) and relaxation parks (mean = 2.64) are the most important ecosystem services derived from urban trees (Table 2). Ecosystem services such as (wind break, erosion control, temperature regulation, purification of air, herbs and medicines), are other importance services that urban forest generate for the urban populace.

Table 1 Demographic characteristic of respondents in three urban cities

	Proportion of Respondents (%) in the selected cities		
DEMOGRAPHIC CHARACTERISTICS	**AKURE (n=100)**	**ADO EKITI (n=100)**	**OSOGBO (n=100)**
Sex			
Male	82	79	86
Female	18	21	14
Marital Status			
Single	31	27	21
Married	69	73	79
EDUCATIONAL LEVEL			
No formal education	5	3	7
Primary School	17	13	18
Secondary School	22	20	26
Tertiary Education	56	67	49
EMPLOYMENT STATUS			
Salary Earners	32	27	26
Trading	29	30	36
Business owners	25	19	31
Unemployed	12	16	17
YEARS OF RESIDENCE			
≤ 10	10	14	11
11-20	31	23	29
21-30	28	29	28
31-40	31	34	32
MONTHLY INCOME			
≤ ₦50,000	31	34	29
₦51,000 – 100,000	35	33	36
≥ ₦101,000	31	38	33

Table 2 Prioritizing of ecosystem services provided by trees in the three urban cites

		% of total responses		
Ecosystem services	**Prioritizing**	**Akure (n = 100)**	**Ado Ekiti (n = 100)**	**Osogbo (n = 100)**
Trees for beautification	1 (3.92 ± 0.09)	86.6	90.8	89.9
Edible fruits and vegetables	2 (3.82 ± 0.07)	79.2	76.7	72.7
Trees as garden	3 (3.64 ± 0.08)	68.9	69.5	66.7
Trees as religion centres	4 (3.42 ± 0.07)	59.2	52.8	55.9
Relaxation parks	5 (2.64 ± 0.05)	41.6	43.9	46.8
Wind break	6 (2.48 ± 0.04)	36.7	32.9	33.2
Erosion control	7 (1.64 ± 0.03)	28.9	21.7	25.6
Temperature regulation	8 (1.37 ± 0.04)	20.1	19.6	20.9
Purification of air	9 (1.24 ± 0.04)	12.8	10.8	12.4
Herbs and medicines	10 (1.16 ± 0.04)	8.7	6.8	8.8

Prioritizing based on the order of the means (n = 300). Figure in parenthesis ( ) is the mean ± margin of error, at 95% confidence interval. Means are based on multiple answers by respondents.

Respondents' willingness-to-pay (WTP) for urban forest ecosystem services

Majority of the respondents (86%) affirmed their willingness-to-pay for ecosystem services of the urban forests (Table 3). Few respondents (14%) are unwilling-to-pay for ecosystem services as they are of the view that it is a gift of nature. The distribution of the respondents' willingness-to-pay according to the selected cities is Akure (89), Ado Ekiti (86) and Osogbo (84) while respondents who are unwilling to pay are Akure (11), Ado Ekiti (14) and Osogbo (16). Further analysis was used to determine the relationship between respondents who are willing-to-pay and those who are not willing-to-pay using logit binary statistic with selected socio-economic variables. These socio-economic variables are (income, education, marital status, years of residency, profession and gender) and attitude variable (awareness of ecosystem services). Statistical values with variables significant at the 0.05 probability level are shown in Table 4. The coefficient of determination (R^2) of 0.31 indicated that the socio-economic variables accounted for 31% of the variation in willingness-to-pay (WTP) across the cities. The result demonstrated that individual profession, year of residency and education were the contributing factors to the level of significant on socio-economic characteristics of the respondents' willingness-to-pay (WTP) for ecosystem services across the three cities. The result on willingness-to-pay indicated that residents were willing to pay between ₦2401.06 and ₦3139.84 (US$1.72 – US$2.24) per month with the level of income being a major determinant. The average total amount residents in Akure are willing-to-pay per month was ₦1,740,221,781.76 (US$1,243,015.56), Ado Ekiti was ₦926,557,048.70 (US$661,826.46) and Osogbo was ₦1,776,003,302.92 (US$1,268,573.79). These were the average amounts that could be realized from

monthly payments by 86.33% of the population for the sustainability of the urban forest in providing ecosystem services. In addition, as the population increases the amount also increases because there is an average projection of 3.72% population increase for Akure, 3.60% for Ado- Ekiti while 2.14% was projected for Osogbo.

Table 3 Respondents' willingness-to-pay for urban forest ecosystem services

DEMOGRAPHIC CHARACTERISTICS	Willing to pay for ecosystem services		Not willing to pay for ecosystem services	
	Number (n = 259)	%	Number (n = 41)	%
CITIES				
Akure	89	34.4	11	27
Ado Ekiti	86	33.2	14	34
Osogbo	84	32.4	16	39
SEX				
Female	38	15	15	37
Male	221	85	26	63
MARITAL STATUS				
Married	233	90	12	29
Singled	26	10	29	71
EMPLOYMENT STATUS				
Salary earners	78	30	7	17
Trading	92	36	3	7
Business owners	71	27	4	10
Unemployed	18	7	27	66
YEARS OF RESIDENCE				
≤ 10	21	8	14	34
11-20	67	26	16	39
21-30	78	30	7	17
31-40	93	36	4	10
MONTHLY INCOME				
≤ ₦ 50,000	75	29	19	46
₦ 51,000 – 100,000	91	35	13	32
≥ ₦ 101,000	93	36	9	22

Table 4 Factors responsible for rrespondents willingness-to-pay for ecosystem services

Socio-economic variables	B.	S.E.
Employment (yes)	2.064*	0.47
Trading (yes)	1.765*	0.38
Business owners (yes)	1.552*	0.53
Unemployed (yes)	-0.364	0.08
Years in residence*21-40*Akure (yes)	1.356*	0.45
Awareness of ES provided by trees*Ado (yes)	1.246*	1.28
Awareness of ES provided by trees*Osogbo (yes)	1.083*	1.19
Constant	-0.059	1.27

B=beta coefficient; S.E.=standard error; *Probability level at 0.05, based on logistic function

Table 5 Average amount respondents are WTP for urban forest ecosystem services

Location	No. of Respondents	Mean WTP (₦)	(86.33%) Population	Total Amount (₦)	Total Amount (US$)
Akure	89	3,139.84	554,239	1,740,221,781.76	1,243,015.56
Ado -Ekiti	86	2,401.06	385,895	926,557,048.70	661,826.46
Osogbo	84	2,881.27	616,396	1,776,003,302.92	1,268,573.79

Exchange rate: #1400.00 = $1

Discussions

Urban vegetation covers are part of the environmental resources that provides basically ecosystem services for the benefit of the urban populaces. This study indicated that the general population are aware of the resources provided by urban forests and their perceptions on the benefits of ecosystem services are generally positive. The urban population in these three cities are well informed on the functions and ecosystem services which outweighed the challenges of urban forests. Despite high level of underestimation of the urban forests resource, trees in urban environment are important components of the urban ecosystems. In this study, respondents considered the ability of urban forests in beautification purposes, food (nuts, fruits and vegetables), gardens (event centres, joints and bars), religion centres and relation parks as the most important reason for conservation and planting of trees in urban cities. The result revealed that urban population are knowledgeable on the ecosystem services (tangible and intangible) that urban forests can provide. Researches indicated that people are adequately aware of ecosystem services and they recognized the environmental functions that urban forests provide in the urban cities (Adekunle & Agbeja 2012; Ajewole 2001; Arabomen *et al.* 2019; Agbelade *et al.* 2022). The functions of urban forests vary considerably based on the demographic characteristics of the people and the cultural belief of the area. Provision of quality air, serves as windbreak, erosion control, and temperature control is other components of ecosystems services urban forests render to the urban environment. The result of this research is in agreement with the findings of Arabomen *et al.* (2019) that residents of Benin City considered erosion control as important ecosystem services due to high relative humidity and rainfall. This corroborates the findings that urban population attribute high importance to the provision of intangible services by the urban forests in urban centres (Adekunle & Agbaje, 2012; Arabomen *et al.*, 2019; Agbelade *et al.*, 2022). Urban ecosystem services are essentials aspect of the urban population due to its ability to enhance the livelihoods of the urban population and mitigate climate change (Agbelade *et al.,* 2017; Fuwape & Onyekwelu, 2011; Obeng *et al.*, 2018). Urban populaces appreciate provision of regulating services, beautification purposes and addition of nutritional component by

urban forests as its support and sustain their livelihood.

Adekunle *et al.* (2008); Adekunle and Sanni (2009) in their studies stated that income of an individual and employment status can determine their level of willingness-to-pay for ecosystem services. This study has revealed that willingness-to-pay depends on the ability of each city. The average amount respondents in Akure ₦3,139.84 (2.24USD) can pay differs from the amount respondents in Ado Ekiti ₦2,401.06 (1.72USD) and the amount respondents in Osogbo ₦2,881.27 (2.06USD) have the capacity to pay. Economic valuation of ecosystem services uses the influence on perception and attitudes of the urban populace to determine the willingness-to-pay for ecosystem services towards urban forests conservation for the continuous provision of ecosystem benefits for livelihood sustainability (Adekunle and Sanni, 2007; Arabomen *et al*., 2019). T his amount is considerably higher compared with the other study. Arabomen *et al.* (2019) observed that residents of Benin City are willing to pay ₦420 for the conservation of urban forest for environmental services. This is an indication of monetary support for ecosystem services and conservation of urban forest resources. Ajewole and Popoola (2001); Popoola and Ajewole (2002) in their studies observed that respondents are willing to pay (US$18) per month and US$1,800,000 to US$2,400,000 per year for the rehabilitation and reforestation of the urban forests in Ibadan metropolis of Nigeria. Furthermore, the total amount respondents were willing to pay for ecosystem service and conservation of urban forests in these three cities was estimated as Akure ₦1,689,039,702.00 (US$1,206,456.93); Ado Ekiti ₦926,555,560.00 (US$661,825.40) and Osogbo ₦1,776,001,136.00 (US$1,268,572.24). These amounts respondents were willing to pay from these cities are an encouragement for the support of urban forest infrastructure in cities across the south-western, Nigeria. This is in agreement with the study of Dumenu (2013) that estimated US$695,000 per annum as the economic value of ecosystem services and restoration of urban forests in Kumasi metropolis of Ghana.

Conclusion and Recommendations

Ecosystem services availability enhanced sustainability of the livelihood of urban populations with adequate planning and management of urban forests. The urban dwellers that are willing to pay for ecosystem services are those with relatively high income and with a high level of educational status. Urban forest provides ecosystem services both tangible (fruits, nuts, herbs, vegetables) and intangible (purification of air, aesthetic purposes, windbreak, shade, erosion control, religious and event centres). The monetary estimation conducted in this study has indicated the capability of the urban

populaces to the level of their financial power in supporting urban forests and this can form the basis for policy maker and urban forests managers in dealing with urban forest degradation and deforestation. Therefore, policy makers, landscape developers, town planners, forest managers and government at different stages and levels can be sure of the ability of the urban populace to pay for ecosystem services and restoration of urban forests in these three cities and that can be replicated in other cities across southwest Nigeria. Research of this nature could form the basis for which information is generated and canvased for dialogue with the urban population in order to make urban forestry participatory and sustainable. These amounts that the urban populations were willing to pay could reduce the burden on the government and change the perception of urban forests as the responsibility of government in Nigeria.

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