Inventory Analysis of *Milicia excelsa* (Welw C. C. Berg.) in Ibadan (Ibadan Metropolis and University of Ibadan), Nigeria

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Abstract

A total of 78 existing stands of *Milicia excelsa* (Welw C. C. Berg.) in Ibadan Metropolis (IM) and University of Ibadan (UI) were evaluated in this study. All the accessible stands were evaluated for their height, diameter and canopy properties, while the relationships among the tree growth parameters were investigated. Density (Basal area) and stem volume of these tree stands in the study area were also computed while the collected data were analysed with the use of t-test statistical means. Results show that majority of trees fall within the 20-30 m height class and 100-200 cm diameter class, most of which are concentrated in UI. Furthermore, the tree stands in UI study area produced more tree density and stem volume than those in IM study area however, the difference was not significant ($p>0.05$). All the models generated were adequate and are recommended for *M. excelsa* volume assessment in the study area. The stand volume equations, which incorporated various tree growth variables, will enhance future yield prediction of the trees in the study areas since they provide quantitative basis for estimating stand growth parameters. It is believed that these models and volume prediction equations will enhance sound and informed management decisions and conservation measures for the remaining *M. excelsa* stands.

Keywords: *Milicia excelsa*, Ibadan Metropolis, University of Ibadan, tree volume equations, inventory analysis

1. Introduction

Traditionally, forests have formed an integral part of the household economy, providing an array of valuable products that, in many cases, the family would otherwise be forced to do without (Hines & Ekman, 1993). The relevance and significance of trees in urban areas has also been recognised (Babalola, 2008). However, the process of urbanisation has led to destruction and removal of vast area of forests (Ouinsavi & Sokpon, 2010); with serious impacts on the indigenous tree species. Complete removal of indigenous tree species is further complicated by replacement with exotic tree counterpart. Scattered indigenous tree species could still be found in some urban areas of the developing countries. Among the efforts pertinent to developing management and conservation strategies of these remaining indigenous tree species in urban setting start with collation of baseline information through forest inventory.

Milicia excelsa Welw C. C. Berg. (syn: *Chlorophora excelsa* Wel. Benth and Hook) commonly known as Iroko, belongs to the family Meliaceae, though previously placed in Moraceae family. It is a large deciduous tree that grows up to 50 m height, with a diameter of 4m, with high crown, umbrella-like and growing from a few thick branches (Bizoux et al., 2009; Ouinsavi & Sokpon, 2010). *M. excelsa* is one of the most important timber trees in Nigeria. The heartwood is durable, workable and resistant to termites and marine borers. The gravity is about 0.55 g/cm^3 (Dorthe, 2005). It is mainly used for outdoor construction work, furniture, boats, cabinet-work, panelling, frames and floors. The bark, its ashes, leaves and latex are used in local medicine and the trees play a major role in many local cultures where they are considered sacred, or parts of the tree serve ceremonial purposes (Putheti & Okigbo, 2008). It is widespread in tropical Africa from Guinea-Bissau to Mozambique where it is found in lowland rain forests and wetter savannah woodland areas (Ofori, 2007). There has not been any successful plantation establishment of this species in Nigeria due to the problem of gall fly, *Phytolyma fusca*

that affect it in early growing stage (Cobbinah et al., 2000; Alebiosu & Oyeleye, 2007). In addition, International Union for Conservation of Nature (IUCN, 2006) Red Data List of threatened species listed Iroko as one of the "near threatened" valuable timber species.

Forest Inventory is the procedure for obtaining information on the quantity and quality of the forest resources and characteristics of the forest landscape (Husch, Beers, & Kersaw, 2003). According to Phillips, Yasman, Brash and van Gardingen (2011), it does not only encompass resources classification and quantification but also includes development of suitable models for the sustainable management of such resources. Regardless of the forest management objectives, whether, timber, wildlife, recreation, water, or non-wood values, the forest overstorey must be quantified for informed decision-making. Forest cover is an important part of wildlife habitat, and the understorey component can often be related to overstorey characteristics (Avery & Burkhart, 1994). Sustainable tree and / or forest management require information on the growing stock. Such information guides the resource manager in valuation allocation of forest areas for exploitation. For timber production, estimates of the growing stock are often expressed in terms of timber volume, which can be estimated from easily measurable dimensions of the tree. The most common procedure for volume estimation is to use volume equations, which are based on the relationship between volume and variables such as diameter, height, *etc.* and other tree characteristics, which can be used in predicting tree volume. The assessment of stem volume is of high interest in forest management and is becoming of great global interest; for instance, in the context of Kyoto protocol rules, it is used in accounting for both absorbed and stored of CO_2 by trees (Lindner & Karjalainen, 2007).

Diameter at breast height (dbh) is the easiest tree measurement and is used in almost every forest inventory (Danquah et al., 2011). Dbh class distribution of trees in a stand may be used as crude estimator of the relative age structure and state of a forest when no growth data is available (Odum, 1971; Laurence et al., 2002); regeneration status of dominant tree species (Nwavu & Witkowski, 2009; Geldenhuys & Murray, 1992; Everard, 1982); and as an indicator of a natural induced disturbance history (Lorimer, 1980; De Souza et al., 2010). The number of individuals that falls within each tree dbh size class varies considerable in forests (Coomes et al., 2003). Tree size distribution often has been used to describe successional pathways and structural development (Zenner, 2005), and in predicting future forest stand structure (Feeley et al., 2007). Population size structure is also an important tool to understand plants strategies to survival according to light availability (Wright et al., 2003). However, there are limited studies carried out on estimating the tree volumes of tree species in Nigeria, therefore this study was conducted for inventory analysis of *Milicia excelsa* in Ibadan metropolis (IM) and University of Ibadan (UI), Oyo State, Nigeria, and at the same time determine the most appropriate method for estimating stem volume and the relationships among the studied growth parameters for Iroko tree.

2. Materials and Methods

2.1 Study Area

Historically, Ibadan is a city at the junction of the savannah and the forest, and it is the capital city of Oyo State (Figure 1) and the third largest metropolitan area in Nigeria, after Lagos and Kano, with a population of 2,550,593 according to the 2006 census (National Bureau of Statistics [NBS], 2007). It is located approximately on latitude 7º23′47″N and longitude 3º55′0″E in south-west Nigeria. Ibadan has a tropical climate of lengthy wet season and relatively constant temperatures throughout the course of the year. Ibadan's wet season runs from March through October (Olowogbon, 2011), while dry season extends from November to February, during which Ibadan experiences the typical West African harmattan. The city is endowed with myriads of indigenous forest tree species such as *Milicia excelsa, Azadirachta indica, Antiaris africana, Mangifera indica, Morinda lucida* among others. Majority of these tree species, used as avenue trees, scattered within the vast metropolitan area. However, as a result of population increase as well as human quest for development, most of these trees are continually felled.

Though *M. excelsa* is widely distributed across many states and cities in the Southwestern region of Nigeria, the scope of this study was limited to Ibadan metropolis due to a relatively large number of the tree stands sighted during reconnaissance survey and other constraints. It is expected that the findings of this study would stimulate similar studies on *M. excelsa* stands in other parts of the country.

Figure 1. Map of Nigeria showing Oyo State (inset is world map indicating Africa and location of Nigeria)

2.2 Data Collection

The data used for this study were forest inventory data collected from Ibadan metropolis (IM) and University of Ibadan (UI), Ibadan, Nigeria. The data collected were individual tree measurements for diameter (overbark) at base, breast height, middle and top positions along the stem, and tree total height, merchantable height, stem quality, crown length and crown diameter of *Milicia excelsa*. The tree total height, merchantable height and stem quality were measured using the relascope, while diameter at base, diameter at height, crown diameter and crown length were measured with measuring tape. t-Test was used to compare the basal area (BA) and Stem volume (SV) obtained from IM and UI. However, correlation analysis was used to determine the relationship among the growth variables from the study area. Other parameters obtained from the data were calculated using their standard formulae:

2.2.1 Basal Area

$$BA = \frac{\pi D^2}{4} \tag{1}$$

Where BA = Basal area (m^2); D = Diameter at breast height (1.3 m above the ground level).

2.2.2 Stem Volume

Stem Volume was estimated using the Newton's formula (FAO, 1980) expressed as -

$$V = h/6 (A_b + 4A_m + A_t) \tag{2}$$

A_b, A_m and A_t = tree cross-sectional area at the base, middle and top of merchantable height, respectively (in m^2) and h = total height (in meter).

Following the computation of tree basal area and volumes, the data were summarized by computing simple descriptive statistics for each growth variable. The statistics included number of observations, range, mean and standard error of estimate. Graphs were also plotted to examine the relationship among the variables

2.2.3 Volume Equation

Volume model developed by Schumacher and Hall (1933) was used for modelling process in this study. However, several forms of this model, using height with the introduction of other variable was considered and tried for this species. This is because height is the major determinant variable if stem volume of tree is considered (Schumacher & Hall, 1933). Consequently, the generalised logarithmic model consisting of height and diameter at the middle as the independent variable was the most appropriate for the species in the study area. The model was therefore selected for the modelling of the species from the two locations. In its original form, the model is expressed as:

$$LogV = b_o + b_1 LogH + b_2 LogD \qquad (3)$$

where, V = tree volume (m^3);

D = diameter at breast height (cm);

H = merchantable height (m);

b_0, b_1 and b_2 are the regression parameters.

3. Results and Discussions

A total of 78 trees were measured within the study area-33 in IM and 45 in UI. The summary of the statistics for all the data collected on the tree growth variables in the study area is presented in the Table 1. As indicated in the table, the average value of tree growth variables such as DB, DBH, DM, THT, MHT, SQ, SV, SC and CPA from UI were significantly ($p<0.05$) more than those from IM. However, there was no significant difference ($p>0.05$) between the locations as regards to DT, CL and BA.

Table 1. Summary of the data collected for the tree growth variables

Variables	Range of data IM	Mean	Std. D	Range of data UI	Mean	Std. D	p-value
DB (cm)	21.64 – 429.66	149.75	84.35	55.38 – 381.92	185.69	66.36	0.039*
DBH (cm)	17.50 – 381.92	118.45	70.11	47.74 – 254.61	147.224	39	0.024*
DM (cm)	18.4 – 180.76	91.21	38.79	37.90 – 180.00	116.69	30.65	0.002*
DT (cm)	15.00 – 120.00	70.75	27.51	30.00 – 125.00	80.71	25.32	0.102ns
THT (m)	7.50– 35.00	23.01	7.53	9.50– 41.00	27.96	5.78	0.002*
MHT (m)	2.00 – 12.00	5.88	2.55	3.00 – 17.50	9.11	3.52	0.000*
SQ (m)	2.00 – 12.00	5.28	2.1	2.00 – 15.00	8.46	3.26	0.000*
CL(m)	3.60 – 27.00	16.88	6.5	4.50 – 31.00	18.84	5.48	0.153ns
BA (m^2)	0.02 – 11.46	1.47	2.06	0.18 – 5.09	1.81	0.98	0.335ns
SV (m^3)	0.08 – 39.30	6.47	8.7	0.76 – 34.78	12.33	8.13	0.003*
SC	8.51 – 56.81	23.39	9.89	9.33 – 32.43	19.75	4.75	0.034*
CPA (m^2)	30.19 – 594.03	282.31	166.33	56.75 – 1040.76	405.49	218.2	0.008*

DBH = Diameter at breast height, DB = Diameter at base, DM = Diameter at middle, DT = Diameter at top, THT = Total height, MHT = Merchantable height, SQ = Stem quality, CL = Crown length, BA = Basal area, SV = Stem volume, SC = Slenderness coefficient, CPA = Crown projection area.

ns = not significant ($p>0.05$).

*= significant ($p<0.05$).

3.1 Tree density, Basal Area and Biovolume

Table 2 shows shows that the total basal area of Iroko in Ibadan was 120.63 m^2 out of which IM accounted for only 48.76 m^2 (40.4%) while that of the UI was 71.87 m^2 (59.5%). This result may be due to the fact that UI is an academic environment, where the conservation of the species is well guided as compared to the IM where sort of clandestine logging operation of tree species exists. There was no significant difference ($p>0.05$) between the basal area of the two locations, when analyzed with t-test as it is evident from the Table 2.

Table 2. Distribution of basal area and stem volume in the study area

Variable	Ibadan Metropolis	University of Ibadan	t-value	Df	p-level
BA(m^2)	1.47 (40.4%)	1.59(59.5%)	0.36	76	0.718[ns]
Total	48.76(m^2)	71.87(m^2)			
G-total	120.63(m^2)				
SV(m^3)	12.19(34.79%)	16.76(65.21%)	1.68	76	0.09[ns]
Total	402.54 (m^2)	754.63(m^2)			
G-total	1157.17(m^3)				

ns = not significant (p>0.05).

Table 2 explains the stem volume of the Iroko in Ibadan. Also, the details of the stem volume obtained in the study area are presented in the Table 1 above. The total stem volume of Iroko in Ibadan was calculated to be 1157.17 m^3. This result followed similar trend with the result of the tree density in view of the fact that IM had the smaller volume (402.54 m^3) compared to that of UI (754.63 m^3). The percentage of the stem volumes from these two locations are in parenthesis in Table 2. Similarly, the difference between the stem volume from the two locations was not significant (p>0.05)

3.2 Stem Diameter and Height Distribution

The distribution of the trees in the two locations of the study area into height classes is presented in the Table 3. About 51.5% of the measured 33 trees in IM fall into the third height class (20-30 m). This constitutes the largest percentage of the tree in the location. This was followed by the second height class (10-20 m), which had about 24.2%. The fourth height class captured 15.2% of the total trees in the location, while only 9.1% of the trees are in the height class of 0-10 m. However, there was no any tree in the IM that was found in the fifth height class. In the case of the UI, the third height class (20-30 m) equally had the highest trees of about 55.6%. Next to this is height class 30-40 m, which contained about 33.3%, second class (6.7%), and the least was the first and fifth class of 2.2% each (Table 3).

Table 3. Distribution of the trees into height classes

Height Classes	Ibadan Metropolis		University of Ibadan		Pooled data for the two locations	
	Freq	%	Freq	%	Freq	%
0-10 m	3	9.1	1	2.2	4	5.1
10-20 m	8	24.2	3	6.7	11	14.1
20-30 m	17	51.5	25	55.6	42	53.8
30-40 m	5	15.2	15	33.3	20	25.6
40-50 m	0	0	1	2.2	1	1.28
Total	33	100.0	45	100.0	78	100

The distribution of trees into DBH classes (Table 4) reveals that majority (51.5%) of the trees in IM belongs to the second diameter class (100-200 cm). About 42.4% of the trees are captured by 0-100 cm diameter class, which makes it the second largest in IM. In the same vein, the DBH class 100-200 cm contained the majority (88.8%) of the trees in UI. This was followed by 0-100 cm DBH class (28.9%), 200-300 cm DBH class and the lowest was 300-400 cm, in which none of the Iroko trees was found in UI.

Table 4. Distribution of the trees into DBH classes

DBH Classes	Ibadan Metropolis		University of Ibadan		Pooled data for the two locations	
	Freq	%	Freq	%	Freq	%
0-100cm	14	42.4	4	8.9	18	23.1
100-200cm	17	51.5	40	88.9	57	73.1
200-300cm	1	3.0	1	2.2	2	2.6
300-400cm	1	3.0	0	0	1	1.3
Total	33	100.0	45	100.0	78	100

3.3 Correlation and Relationship among Growth Variables

As expected, there was a significant linear association between MHT and SQ (Table 5). This may be due to the fact that close values were recorded for these two variables in most of the trees measured. Generally, there was significant correlation ($p<0.05$) between most of the tree growth variables. This implies that most of the variables rise and fall together. For instance, there was a very high correlation between the DBH and DT (0.84); SV and DB (0.87); SV and DM (0.83); and SV and DT (0.79). However, there were very weak correlations between SQ and DT (0.28); SV and CL (0.24). This implies that stem quality of Iroko is not positively correlated with canopy diameter, while stem volume development depends partially on the length of the crown. On the other hand, there was no significant correlation ($p>0.05$) between MHT and CL; SQ and CL; CD and CL; CPA and CL. The details of the correlations between tree growth variables are presented in the Table 5.

Also, the relationships between the predictor variables and stem volume are depicted graphically with scatter plot in Figures 1 – 11. Generally, there are outliers in the graphical relationships. This may be due to the fact that the trees were naturally grown and therefore some were older than the others. For the purpose of modelling, theses outliers were screened out in order to have better model. As could be observed from these figures, all the relationships were significantly positive ($p<0.05$), indicating that an increase in the value of predictor variables tends to be associated with an increase in the value of dependent variable (Stem volume). It is also evident from the graphs that the predictor variable DB, DBH, DM, DT and BA had linear relationship with stem volume (SV). This suggests that any of these variables can be substituted for one another as a predictor of stem volume. Similar results have been reported in tropical rain forest area of Nigeria for plantation-grown *Tectona grandis* (Osho, 1983) and *Gmelina arborea* (Akindele, 2003).

The linear relationships between THT, MHT, SQ, CL, CD, CPA and stem volume (SV) did not depict a reasonable pattern as indicated by the small r^2. This shows that linear regression equations for these variable as the predictors may not be appropriate for volume equations for the *Milicia excelsa* study area, unless with some transformations of the variables. The lack of any meaningful trend in the relationship between stem volume and total height from the simple equation could be attributed to the fact that the upper limit for the height measurement varies greatly between and within species. Total height is influenced by several factors such as age, site factors, growth patterns and species differences.

Table 5. Correlation Coefficients for tree growth variables in the study area

	THT	MHT	SQ	CL	DB	DBH	DM	DT	CD	BA	SV	CPA
THT	1											
MHT	0.78*	1										
SQ	0.50*	0.63*	1									
CL	0.71*	0.11[ns]	0.09[ns]	1								
DB	0.64*	0.53*	0.43*	0.43*	1							
DBH	0.61*	0.51*	0.38*	0.40*	0.96*	1						
DM	0.55*	0.48*	0.30*	0.32*	0.83*	0.84*	1					
DT	0.53*	0.46*	0.28*	0.33*	0.80*	0.79*	0.98*	1				
CD	0.42*	0.45*	0.32*	0.17[ns]	0.51*	0.53*	0.54*	0.53*	1			
BA	0.43*	0.34*	0.30*	0.30*	0.87*	0.92*	0.68*	0.62*	0.36*	1		
SV	0.60*	0.63*	0.43*	0.24*	0.87*	0.88*	0.83*	0.79*	0.45*	0.85*	1	
CPA	0.41*	0.44*	0.31*	0.15[ns]	0.49*	0.51*	0.53*	0.53*	0.98*	0.36*	0.47*	1

* = significant ($p<0.05$), ns = not significant ($p>0.05$).

THT:SV: y = -11.5211 + 1.0225*x;
r = 0.6039, p = 0.00000; r^2 = 0.3647

Figure 1. Relationship between stem volume and total height

MHT:SV: y = -6.7539 + 1.5337*x;
r = 0.6398, p = 0.0000
,r^2 = 0.3111

Figure 2. Relationship between stem volume and merchantable height

SQ:SV: y = 2.473 + 1.1899*x; r = 0.4390, p = 0.00006;
r^2 = 0.1927

Figure 3. Relationship between stem volume and stem quality

CL:SV: y = 7.2248 + 0.6506*x; r = 0.2416, p = 0.0331;
r² = 0.0584

Figure 4. Relationship between stem volume and crown length

DB:SV: y = -11.9921 + 16.6089*x;
r = 0.8752, p = 0.0000; r² = 0.7659

Figure 5. Relationship between stem volume and diameter at base

DBH:SV: y = -11.7957 + 20.4171*x;
r = 0.8846, p = 0.0000; r² = 0.7826

Figure 6. Relationship between stem volume and diameter at breast height

DM:SV: y = -14.1282 + 31.9182*x;
r = 0.8304, p = 0.0000; r^2 = 0.6896

Figure 7. Relationship between stem volume and diameter at middle

DT:SV: y = -8.8265 + 32.0981*x;
r = 0.7974, p = 0.0000; r^2 = 0.6359

Figure 8. Relationship between stem volume and diameter at top

CD:SV: y = -2.487 + 0.8509*x;
r = 0.4552, p = 0.00003; r^2 = 0.2072

Figure 9. Relationship between stem volume and crown diameter

BA:SV: y = 3.7367 + 7.1766*x; r = 0.8542, p = 0.0000;
r^2 = 0.7296

Figure 10. Relationship between stem volume and basal area

CPA:SV: y = 4.7989 + 0.0281*x;
r = 0.4749, p = 0.00001; r^2 = 0.2256

Figure 11. Relationship between stem volume and crown projection area

3.4 Tree Volume Models

The result of various volume models used for this study are shown in Table 6. All the assessment criteria revealed that they are all suitable for tree volume estimation of Iroko in Ibadan. The fit index, which is the coefficient of determination (R^2), for all the categories of models, was very high, with values ranging between 91.0% and 92.9% for the completely transformed models. For the partly linear models, it ranges between 70.3% and 81.6%. Furthermore, all the models were significant at p<0.05 level (Table 6).

Table 6. Models generated for tree volume estimation in the study area

S/N	Models	R^2 (%)	SEE	f-ratio	p-level
1	lnSV = -1.03+0.78lnMHT+1.98lnDB	91.0	0.38	377.66	0.00*
2	lnSV = -0.81+0.84lnMHT+2.02lnDBH	91.0	0.38	380.03	0.00*
3	lnSV = -1.94+1.41lnMHT+1.89lnDM	92.9	0.34	490.70	0.00*
4	lnSV = -1.77+1.43lnMHT+1.36lnDT	91.1	0.38	385.56	0.00*
5	lnSV = -0.56+0.84lnMHT+1.01lnBA	91.0	0.38	377.99	0.00*
6	lnSV = -4.81+1.65lnMHT+1.08DB	81.6	0.55	166.21	0.00*
7	lnSV = -5.10+1.78lnMHT+1.24DBH	81.0	0.56	159.53	0.00*
8	lnSV = -5.46+1.71lnMHT+1.42DM	89.4	0.41	317.29	0.00*
9	lnSV = -5.30+1.79lnMHT+2.42DT	87.5	0.45	262.70	0.00*
10	lnSV = -6.75+2.45lnMHT+0.05CD	71.0	0.69	92.00	0.00*
11	lnSV = -6.42+2.52lnMHT+0.002CPA	70.3	0.70	88.63	0.00*

R^2 = Coefficient of determination, SEE = Standard error of estimate, SV = stem volume, DBH = Diameter at breast height, DB = Diameter at base, DM = Diameter at middle, DT = Diameter at top, THT = Total height, MHT = Merchantable height, BA = Basal area, SV = Stem volume, SC = Slenderness coefficient, CPA = Crown projection area. ***= Significant (p<0.05).**

In this study, all of the models generated have negative intercepts (Table 6). This is as a result of the logarithmic transformation of the variables utilized in the models, thereby leading to value reduction vis-à-vis tilting of the variable values towards negativity (Schumacher & Hall, 1933). This is also in line with the report by Avery and Burkhart (2002) that tree volume prediction usually gives negative intercept. The standard error of estimate (SEE), which measures the overall predictive value of regression models (Adekunle, Akindele, & Fuwape, 2004), and which is a common measure of goodness of fit in nonlinear regression models (Glantz & Slinker, 2001), with low value indicates better fit. In this study, the SEE of the models ranged between 0.34 and 0.70. These results suggest that all the models have good fit within the context of the field data. Evidently, the transformed models give better fit going by their coefficient of determination and standard errors of estimates.

Comparing all the models tried in this study using the fit statistics, model 3, which is with diameter at the middle and height as the independent variable is the most appropriate (R^2 = 92.9, SEE = 0.34 and f-ratio = 490.70). In other words, diameter at the middle is the best predictor of Iroko stem volume among all the tested predictors. This may be due to the Newton's formula used in the estimation of the volume. Hence, more preference is given to diameter at the middle than those from base and top by having coefficient of 4 (Equation 2).

Comparing the models from the two parts of the study areas (Table 7), UI model was more statistically fitted (R^2 = 99.1%, SEE = 0.13, f-ratio = 1621.17) than IM model (R^2 = 95.7%, SEE = 0.15, f-ratio = 468.87). This may be attributed to the better tree growth variables obtained from the UI as indicated in Table 1, which may also be related to site factors. This is in conformity with Brandel, (1990), who discovered that site determines the fitability of tree volume functions. However, the two models can be applied in determining the volume of Iroko trees in these locations based on the statistical significance and closeness of the fit statistics of the two location models.

Table 7. The best fitted Model for the sites

Sites	Models	R^2 (%)	SEE	f-ratio	p-level
IM	lnSV = -9.33+1.08lnMHT+1.97lnDM	95.7	0.15	468.87	0.00*
UI	lnSV = -9.79+0.96lnMHT+2.13lnDM	99.1	0.13	1621.17	0.00*

4. Conclusion

This study has clearly reflected the status of the *Milicia excelsa* in Ibadan metropolis and University of Ibadan in terms of its distribution and yield. It was revealed that University of Ibadan houses majority of Iroko in Ibadan despite its smaller area coverage compared to the Ibadan metropolis. Therefore, it could serve as good gene bank from which multiplication of Iroko in the country as a whole could be obtained. Most of the trees which are in 20-30 m height class and 100-200 cm diameter class were concentrated in the University of Ibadan. This is

because the act of illegal logging of this species is outlawed in the institution. Consequently, the conservation of this species as a result of its status is owed at high esteem. Conversely, the residual number of this species still standing in Ibadan metropolis is relatively low compared to that of UI, based on the fact the population of this species is highly threatened by the illegal fellers and lack of tree management. Majority of the remaining stands in Ibadan Metropolis are however located on a difficult terrain, where they could not be assessed or very close to the residents, where their felling can cause severe damage, thus contributing to their existence.

The stand volume equations, which incorporated various tree growth variables, will enhance future yield prediction of the study area since they provide quantitative basis for estimating stand growth parameters. For instance, those growth variables that have very strong relationships, depicted by their high coefficient of determinations (R^2) and low standard error of estimate (SEE) with tree stem volume could be regarded as important determinants to be considered in stand volume assessment in Ibadan. All the models generated are adequate and are recommended for stand volume assessment in the study area.

The volume prediction equations provide the means through which the production potential of the existing stands can be estimated in the study area. It is believed that the equations obtained in this study will enhance sound and informed management decisions and conservation measures for the remaining stands.

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