

SITE QUALITY ASSESSMENT AND YIELD MODELS FOR *TECTONA GRANDIS* (LINN. F.) STANDS IN IBADAN METROPOLIS



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ABSTRACT

The study involved site quality assessment and development of yield models for *Tectona grandis* in Ibadan metropolis. Five stands of *Tectona grandis* selected for this study were located at University of Ibadan Second Gate (UISG), International School Ibadan (ISI), Agodi garden (AG), Oke Baba-agba (OKBA) and Obegimo (OBGM). Twenty seven temporary sample plots of size 25m×25m were proportionally allocated to the five stands with respect to their land areas; and the sample plots were randomly located within each stand. Ten plots in UISG, 2 plots in ISI, 5 plots each, in AG, OKBA and OBGM respectively. Measurement of tree growth variables (diameters at breast height, base, middle and top, crown diameter and length, total height, merchantable height and stem quality) of all the trees in each of the plots in the study area were taken. Ages of the five stands were noted. For the purpose of site quality estimation, seven largest trees were chosen from each of the plots as the dominant trees per plots. The measured variables were processed and used to compute basal areas and stem volume of trees at individual tree and whole-stand levels. The dominant height-age data set were used to construct site index equation. This was used to estimate site index values for each of the plots. In addition, volume computed from all the trees within each sample plot was used to construct yield models at individual tree and whole-stand levels. The site index equation obtained for site quality assessment in this study was:

$$SI = \text{Exp} [\ln H_d + 7.48 (A^{-1} - (.04))]$$

The most suitable individual tree yield model found was $\ln SV = 1.59 + 0.02A + 1.05 \ln BA$ while the most suitable whole-stand yield model was $\ln SV = 1.83 - 11.89A^{-1} + 0.73 \ln BA + 0.07SI$.

INTRODUCTION

Site quality assessment is the evaluation of the productive potential of an environment in terms of its capacity to support a particular land use type (Pandey, 1998). In forestry, it is expressed as an estimation of the productive capacity of an area of forestland, usually for a given species, or a combination of species (FORMECU, 1991).

The chief problem facing forestry sector in Nigeria is land scarcity (Enabor, 1981). This sector has to compete with other land uses such as agriculture, infrastructure development, tourism and recreation. In view of this, it is most unlikely that the area of land available to forestry sector would increase in the near future (Omiyale and Joyce 1982). It is therefore becoming imperative to maximize productivity of the forest land through the allocation of appropriate tree species to suitable planting sites. This, of course, would require an in-depth knowledge of the suitability of various sites for different tree species.

According to FAO (2005a), the geometrical growth of Nigerian population, which has consequently led to an increasing trend in consumption of wood and wood products, poses a big challenge to the forestry sector. Although, several hectares of plantations are being established yearly, yet the plantation establishment efforts are thought to be inadequate to replace the high forest. This is partly due to poor crop performance in

some locations on one hand, and inappropriate management practices on the other hand (FAO, 2005b). There is a widespread concern for regeneration and conservation of the natural forests, with a view to meeting the ever-growing demand for wood and wood products. Experiences in Nigeria have, however shown that natural regeneration alone is inadequate for restocking the nation's forests. A continuous reliance on natural regeneration alone will not provide sufficient wood for the national needs. Consequently, there has been a shift in emphasis from natural regeneration to artificial regeneration of forest grown exotic and indigenous species, through plantation establishment (Akinsanmi and Akindele, 2002).

For example, Akinsanmi and Akindele (2002) noted that the estimated planted forest area of 375,000 hectares in 2000 comprised at least 110,000 hectares of *Gmelina arborea* and an area of about 160,000 hectares of different hardwood species, including 74,000 hectares of *T. grandis* in forest reserves and in privately-owned plantations. These plantations have been proven to be generally more productive than the natural forests. For instance, results from permanent sample plots within plantations have shown that annual increments of timber volume above 40cm diameter at breast height (or diameter above buttress) range between 1.14m³/ha/year and 8.34m³/ha/year, compared to annual increments of 2 to 3m³/ha/year for the natural stands (Abayomi, 1986).

In addition, *T. grandis* plantations in South-west Nigeria are being managed on a 50-year rotation. Due to this long gestation period, any mistake made at the time of site selection may be difficult and costly to rectify, if detected later in the rotation (Akinsanmi and Akindele, 2002). Now that there is a wide-spread campaign for plantation establishment, including private establishments, it is therefore very pertinent to formulate a means through which site quality and potential would be determined before any commitment to planting is made. This could only be achieved by assessing the current productivity of the *T. grandis* plantation sites already established with a view to determining which sites are proving most productive for the species in the study area. This would then provide a guide for a suitable site selection in further plantation establishment programmes.

T. grandis has been selected for this study because of its unique importance when compared to other exotic species in the study area. It is a very high quality timber species having several uses, even more than some highly valued indigenous timber species such as *Melicia excelsa* (Akindele, 1991; Akinsanmi and Akindele, 2002). As a result of its highly favoured properties, several hectares of the species are established annually, both by private individuals and governments. It therefore became necessary to carry out further studies on the species, as various growth patterns have been observed over the years, even between plantations that were established the same year in the study area (e.g. Akindele, 1991). According to Akindele (1991), average stand volume per hectare for a nine year old plantation in Oniganbari forest reserve was 439m³ while that of a similar plantation in Olokemeji forest reserve was 58m³. He furthermore observed that even within Oniganbari forest reserve, the stand volume/ha for fifteen year old teak plantations ranged from 432m³ to 927m³. This necessitates the need to pay attention to site quality assessment within smaller geographic range. Moreover, a sustainable management for forest containing this species requires information on the growing stock. Such information guides the forest manager in timber valuation and allocation of forest areas for exploitation (Akindele, 2005). In this study, quantitative assessments of the productivity of some sites in Ibadan were carried out with a view to determining their qualities. Models were also developed for *T. grandis* in the area. It is envisaged that this study will provide a valuable tool in enhancing decisions on plantation establishment of *T. grandis*.

METHODOLOGY

The study area

Ibadan is located approximately on longitude 3° 54'E and latitude 7° 26' N at a distance of about 145km North East of Lagos, in the south-west geopolitical zone of the country (Fig. 1). It has a total land area of 130km² and is 750m above sea level (Oguntinyinbo, 1994). The northern edge of Ibadan corresponds with the southern edge of the derived guinea savanna while the southern boundary corresponds with the northern boundary of the

swampy area. The three major landform units-hills, plains and river valleys dominate the heart of the Ibadan region. The hills are the most striking features around Ibadan city, although they constitute less than 5% of the total area (Faniran, 1994). The plains form the most extensive landform with a general elevation of 180m and 210m above sea level. This landform makes up about 80% of the total surface area and essentially covers hill bases and entrenched valley bottom (Aweto, 1994). The river valleys are the narrowest, though not necessarily the least extensive landforms in the area.

Ibadan consists mainly of the basement complex rocks of metamorphic types of pre-Cambrian age, but with a few intrusions of granites and porphyries of Jurassic age. The rock can be grouped into major and minor rock types. The major rock types are quartzites complex comprising banded gneisses, augen gneisses and migmatites; and the minor types include pegmatites, quartz, aplite, diorites, amphibolites and xenoliths, occurring as intrusions in some of the major rock types. In most places, rocks are covered by weathered regoliths, but outcrop only in few places.

The soils of Ibadan were formed from rocks of the pre-cambrian basement complex formation, especially, granites, gneisses, quartz-schist, biotite gneisses and schist's. They were formed under moist semi-deciduous forest cover and belong to the major soil called ferruginous tropical soils (Aweto, 1994). It has the characteristic West Africa monsoonal climate, marked by distinct seasonal shift in the wind pattern because of its latitudinal location (Latitude 07°26'N). Between March and October, the city is under the influence of the moist maritime south west monsoon winds, which blow inland from the Atlantic Ocean (Oguntinyinbo, 1994). The rainy season falls in this period. The dry season occurs from November to February when the dust-laden winds blow from the Sahara desert. It has a mean annual temperature of 27.33°C with a mean relative humidity of 87.9% and the mean annual rainfall is 1373.5 mm.

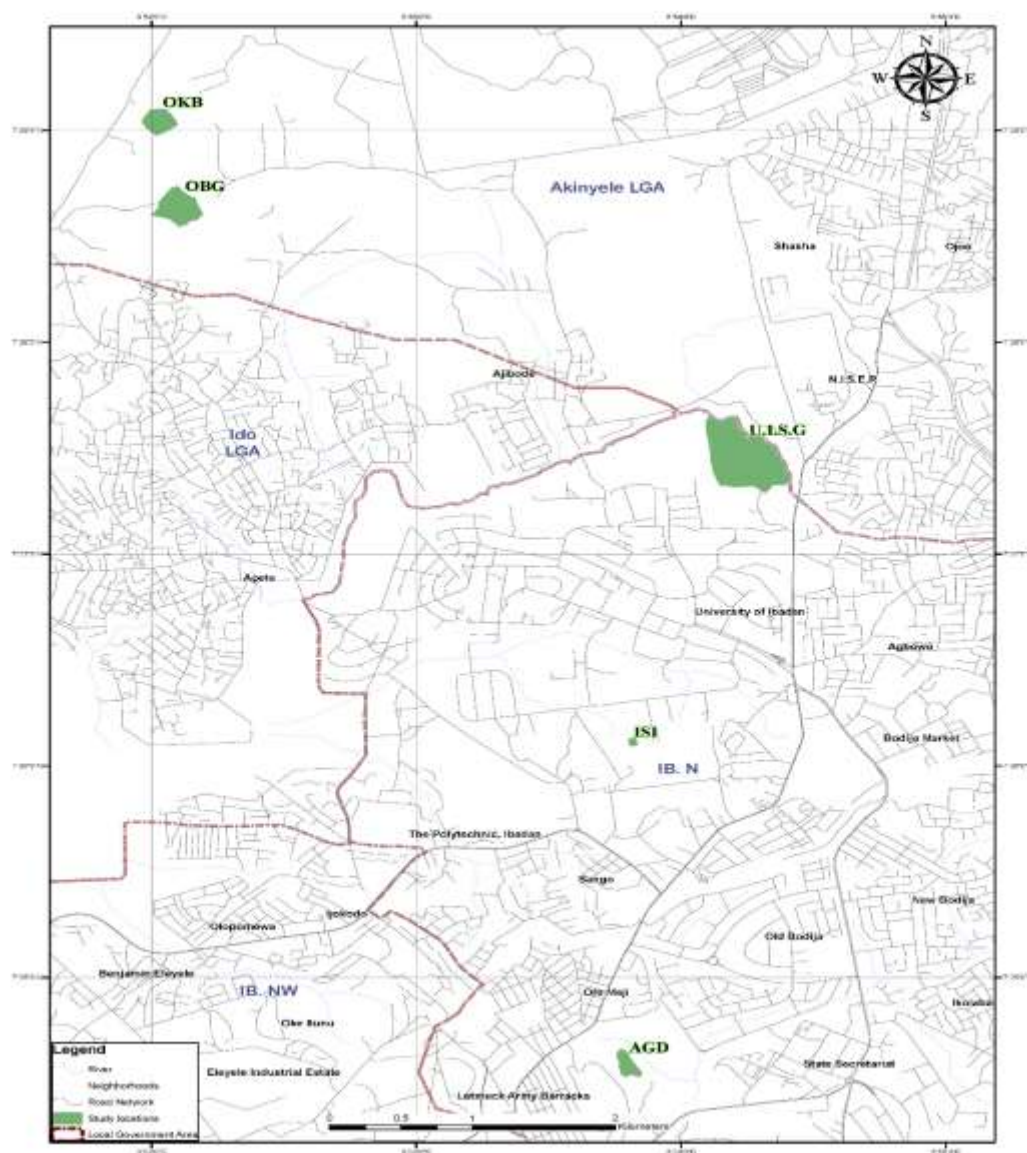


Fig.1: Map of study area showing study locations

Data Collection

Sampling Procedure

In site quality assessment and yield studies involving the use of temporary sample plots, as it was the case in this study, the usual procedure is to ensure that sample plots are distributed over the geographical study area to cover the range in age and site condition (Greaves, 1973 and Clutter *et al.*, 1983). This was achieved by purposively allocating sample plots to the various *T. grandis* plantations that were considered suitable for the study, but randomly locating them within each plantation. The random selection of sample plots within each of the stands was to ensure the validity of the usual test of significance of the final site index equations (Akindele, 1991). Each sample plot was 25m x 25m in size. Twenty-seven sample plots were used for the study (Table 1).

Table 1: The stands and their respective numbers of plots selected

Stand	Age (Years)	No. of plots/stand
UISG	54	10
ISI	43	2
AG	30	5
OKBA	10	5
OBGM	8	5
Total		27

Tree Data

The following tree growth data were collected on all the trees within each sample plot: Diameter at breast height (cm); Diameters at the base, middle and top of all of the trees (cm); Crown diameters of trees (m); Total and Merchantable heights of the trees (m); Stem quality (m); Crown length (m); Dominant height (m); average height of the stems, representing 100 largest trees per hectare (or 7 largest trees/0.0625 ha plot), for site quality assessment. In addition to these, age of each of the five stands was noted.

Data Analysis

Development of Site Index Equation

The development of site index equations, in this study involved two steps as done by Akindele (1991) and adopted by Adesoye (1997). They were:

- The development of site index equation for estimating the site indices of the sample plots. This was based on dominant height-age relationship.
- The computation of site index values for the sample plots and fitting linear regression model for predicting site index from tree variables.

Index age of 25 years was used for developing equation for site index estimation for each plot, as done by Greaves (1973) and FORMECU (1991) and adopted by Akindele (1991) and Adesoye (1997).

A linearized regression model was used due to its age-long suitability. The model is of the form:

$$H_d = e^{(\beta_0 + \beta_1 A^{-1})} \dots\dots\dots (1)$$

as originally suggested by Schumacher (1939).

Where, H_d = Average height of dominant trees per plot, A = stand age (year), β_0 = intercept value uniquely associated with each particular site index. β_1 = slope with the same value for all site indices.

This can only produce anamorphic site index equations. The site index generated was a family of parallel lines with constant slope and varying intercepts. Equation for a particular site index line was obtained bearing in mind that such a line has the form:

$$\ln H_d = b_0 + b_1 A^{-1} \dots\dots\dots (2)$$

Where, H_d and A are as earlier defined b_0 and b_1 are sample estimates of β_0 and β_1 respectively, $\ln$ is the natural logarithm. This equation was fitted to dominant height-age data to obtain estimates of the regression parameters. When $A = A_i$ (i.e. index or base age), which is 25 years for this study, H_d would be equal to site index. Hence,

$$b_0 = \ln(SI) - b_1(0.04) \dots\dots\dots (3)$$

Substituting Equation 3 for b_0 in Equation 2, it became;

$$\ln(H_d) = \ln(SI) - b_0(0.04) + b_1 A^{-1} \dots\dots\dots (4)$$

$$\ln(H_d) = \ln(SI) - b_1(A^{-1} - 0.04) \dots\dots\dots (5)$$

When SI was made the subject of formula in the equation 5, site index equation obtained was:

$$\ln(SI) = \ln(H_d) - b_1(A^{-1} - 0.04) + b_1 A^{-1} \dots\dots\dots (6)$$

$$SI = e^{[\ln H_d - b_1(A^{-1} - 0.04)]} \dots\dots\dots (7)$$

With known values of age and dominant height, this equation was used to estimate site index for each plot. The average site index for the plots in each stand was then computed. Furthermore, anamorphic site index curves were drawn for the teak stands assessed in this study.

Basal area estimation

The basal area for each tree in each plot was estimated using the formula by Husch *et al.* (2003):

$$BA = \frac{\pi D^2}{4} \dots\dots\dots (8)$$

Where, BA - Basal area (m^2), D - Diameter at breast height.

The basal area for each plot was then obtained by adding individual tree basal areas within each plot.

Volume estimation

The volume of trees per plot was calculated using Newton's formula by Husch, *et al.* (2003) and adopted by Adekunle *et al.* (2004) and Adekunle (2007) among others.

$$V = \frac{h}{6} (A_b + 4A_m + A_t) \dots\dots\dots (9)$$

Where V = Volume (m^3), h = Total height of the tree (m); A_b , A_m and A_t are cross sectional areas at the base, middle and top of the trees respectively.

$$\text{Since } A = \frac{\pi D^2}{4}$$

The volume equation was re-written as:

$$V = \frac{h}{24} (\pi D_b^2 + 4\pi D_m^2 + \pi D_t^2) \dots\dots\dots (10)$$

Construction of yield equations

The whole-stand yield models were formulated, which express volume per hectare as a function of age, site index and basal area/ ha. The yield model used in this study for estimating current yield was the one suggested by Schumacher (1939) and adopted by Akindele (1990) and Adesoye (1997). The model is given as:

$$\ln SV = \beta_0 + \beta_1 SI^{-1} + \beta_2 A^{-1} + \beta_3 \ln BA \dots\dots\dots$$

Where, SV =Stem volume per hectare (m^3/ha); SI = site index; A =Age (years); BA = Basal area (m^2/ha); $\ln$ = Natural logarithm; $\beta_0, \beta_1, \beta_2$ and β_3 , are regression parameters.

Prediction equation for future yield was also formulated for estimation of the volume that is expected from each stand at different points in time in the future. Such prediction equation requires stand density projection (Clutter *et al.*, 1983). The model for basal areas projection in this study was:

$$\ln BA = a + b \ln A \dots\dots\dots(12)$$

Where, BA = basal area/ha (m^2/ha); A = Age (years); a and b are regression parameters. Basal area projection model was then substituted into the yield model to obtain prediction equation for the future yield. Thus we have:

$$\ln SV = \beta_0 + \beta_1 SI^{-1} + \beta_2 A^{-1} + \beta_3 (a + b \ln A) \dots\dots\dots(13)$$

Where, A = projection age; $\beta_0, \beta_1, \beta_2$, and β_3 and SI are as earlier defined.

Other Prediction equations also formulated in this study, which take into consideration, other growth parameters are as follows:

$$\ln SV = \beta_0 + \beta_1 CD + \beta_2 (A) \dots\dots\dots(14)$$

V = volume of the trees per ha (M^3/ha); CD = crown diameter of the tree (m)

A = Age (year). This expressed volume/ha as a

function of crown diameter and Age.

Another equation was the one that expressed the volume per hectare as a function of crown projection areas (CPA) and diameter at breast height (dbh). It is given as;

$$\ln SV = \beta_0 + \beta_1 \ln CPA - \beta_2 \ln Dbh \dots\dots\dots(15)$$

Where, SV is as defined earlier; CPA = Crown projection area (m^2/ha); dbh = diameter at breast height (cm).

The fitness of these equations was determined using the coefficient of determination (R^2) and standard error of estimates (SEE).

RESULTS AND DISCUSSION

Results

Site Index Equation

The site indices computed for this study ranged from 20.39m to 24.74m. The site index equation obtained for the study was:

$$SI = e^{\left[\ln H_d + 7.48(A^{-1} - 0.04) \right]} \dots\dots\dots(16)$$

$(R^2 = 0.83; SEE = 0.15)$

Where, SI = site index; H_d = Dominant height (m); A = Age (year); A_i = index age, which is 25 years; e = exponential function and $\ln$ = Natural logarithm

This equation was used to obtain site index values for the individual plots. The average values of site indices obtained are presented in the Table 2.

Table 2: Site index values obtained for the five stands.

Mean Dominant height	Age	SI	Stand
28.71	54	24.45	UISG
23.11	43	20.39	ISI
23.93	30	22.77	AGD
13.86	10	21.71	OKBA
13.10	8	24.74	OGBM

In order to generate a set of anamorphic site index curves for the different stands, the information on Table 2 and

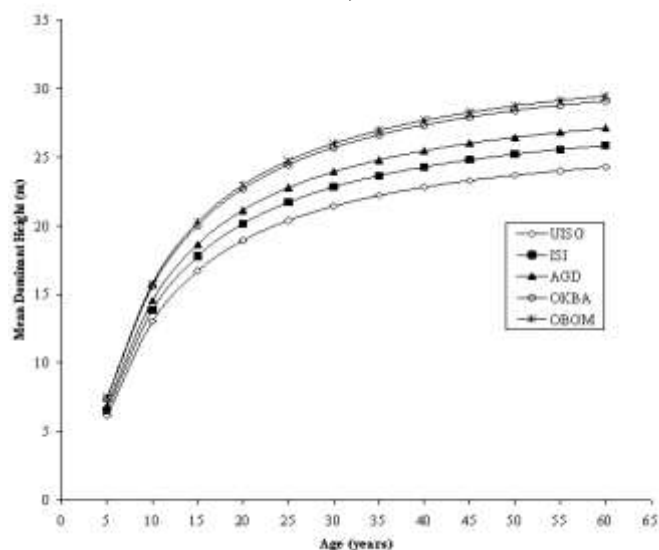


Fig. 2: Site index curves for *Tectona grandis* in Ibadan Metropolis

the site index equation were used to generate a set of dominant height values at specified ages. Hence, using the site index equations obtained as well as index age, different dominant heights were generated for age range of between 5 and 60 years, which fall within the age range used for this study. The values generated for dominant heights were used to plot the site index curves presented in Fig. 2.

The summary of statistics of individual tree growth variables obtained in this study is presented in Table 3. The descriptive statistics of the tree variables across the whole stands is presented in Table 4. The basal area/ha obtained in this study ranged from 5.067 m²/ha to 39.592 m²/ha. The stem volume/ha obtained ranged from 21.336 m³/ha to 561.920m³/ha. Also, the crown projection area/ha ranged from 1385.578m²/ha to 9080.290 m²/ha. The site indices ranged from 20.39m to 24.74m.

Table 3: Statistics of tree growth variables used for modeling

Variables	Stand (Age in parenthesis)				
	UISG (54)	ISI (43)	AG (30)	OKB(10)	OBG(8)
THT					
Mean	27.8422	21.4519	22.2590	13.4483	12.1773
Stand deviation	3.8533	3.1551	3.0989	1.5394	1.6276
MHT					
Mean	18.0771	12.5260	12.1423	9.0497	8.2725
Standard deviation	3.4134	2.9940	3.0163	1.6833	1.8613
SQ					
Mean	13.3575	10.2296	9.7949	7.7126	6.3743
Standard deviation	2.9350	2.4785	2.5634	1.5138	1.5389
DBH					
Mean	0.3567	0.3667	0.3223	0.1501	0.1207
Standard deviation	0.0777	0.0525	0.0767	0.0319	0.0274
CL					
Mean	9.3889	7.9926	9.5962	4.3636	3.8646
Standard deviation	2.6150	2.4364	2.4767	1.3968	1.2244
CD					
Mean	4.7386	4.5133	5.5539	2.3422	2.8308
CPA					
Mean	18.8349	17.5497	26.1220	4.8668	6.7894
Standard deviation	9.3105	9.9209	14.3785	3.3944	4.0105
BA					
Mean	0.1047	0.1077	0.0861	0.0185	0.0120
Standard deviation	0.0469	0.2897	0.093	0.0080	0.00055
SV					
Mean	1.2900	0.7348	0.6488	0.1049	0.0543
Standard deviation	0.6599	0.3101	0.3521	0.0488	0.0365

THT = Total height (m), MHT = Merchantable height (m), SQ = Stem quality (m), DBH = Diameter at breast height (m), CL= Crown length (m), CD = Crown diameter (m), CPA= Crown projection area (m²), BA = Basal area (m²), SV= Stem volume (m³)

Table 4: Summary of statistics of the tree growth variables for the whole stand

Variables	Mean	Min.	Max.	Std. Dev.
THT	18.7503	8.0000	35.0000	7.2325
MTH	11.9823	3.0000	27.0000	4.8313
SQ	9.3372	2.0000	21.5000	3.5646
DBH	0.2339	0.0681	0.5668	3.5646
CL	6.5263	0.0000	18.5000	3.2929
CD	3.6994	0.0000	9.2000	1.6384
CPA	12.8532	0.0000	66.4761	11.1895
BA	0.0545	0.0036	0.2523	0.0521
SV	0.5313	0.0105	3.8103	0.6516

The yield Models**Prediction equations for current yields**

The yield models were constructed under two resolutions. They are individual tree models and whole-stand models. The prediction equations obtained for individual trees in this study are expressed as follows:

$$\ln SV = 1.59 + 0.02A + \ln BA \dots\dots\dots (17)$$

$$(R^2 = 0.95, SEE = 0.329)$$

Where,

SV, *ln*, A and BA are as defined earlier.

$$\ln SV = -3.82 + 0.23CD + 0.05A \dots\dots\dots (18)$$

$$(R^2 = 0.84, SEE = 0.59)$$

Where, CD = Crown diameter; R² = Coefficient of determination; SEE = Standard error of estimates.

$$\ln SV = -3.27 + 0.04A + 13.10BA \dots\dots\dots (19)$$

$$(R^2 = 0.88, SEE = 0.515)$$

$$\ln SV = 3.16 - 0.10 \ln CPA + 2.81 \ln Dbh \dots\dots\dots (20)$$

$$(R^2 = 0.94, SEE = 0.37)$$

The Prediction equations based on whole-stand yield models obtained for this study were:

$$\ln SV = 1.83 - 11.89A^{-1} + 0.73 \ln BA + 0.07SI \dots\dots\dots (21)$$

$$(R^2 = 0.97, SEE = 0.19)$$

Where, SV= stand volume per hectare (m³/ ha); A⁻¹= Inverse of age in (year⁻¹); BA = Basal area per hectare (m²/ha) and SI = Site index.

$$\ln SV = 2.85 + 0.0001CPA + 0.04A \dots\dots\dots (22)$$

$$R^2 = 0.92, SEE = 0.29$$

Where, CPA = crown projection area per hectare (m²/ha); A = age (year)

$$\ln SV = -2.61 + 0.299MSQ + 0.53 \ln CPA \dots\dots\dots (23)$$

$$(R^2 = 0.96, SEE = 0.22)$$

Where, MSQ = Mean Stem Quality per plot

A suitable prediction model is identified with relatively high coefficient of determination (R²) and small standard error of estimate (SEE).

DISCUSSION

Forest management is concerned with effective forest planning so as to obtain the maximum benefits possible.

Finding a way to quantify site differences is possibly one of the important tasks of a forest manager. According to Vanclay (2004), meaningful growth and yield forecasts require some evaluation of site differences. The site index equation that was found suitable for site quality evaluation was a linearized regression model, originally suggested by Schumacher (1939). The model fitted well to the dominant height-age data with R² value of 0.83 and SEE value of 0.15. The suitability of this form of model was also confirmed by Akindele (1991), FORMECU (1991) and Adesoye (2002). This equation is useful for predicting current and future values of site index for *T. grandis* plantations in Ibadan Metropolis within the age range studied. Thus, foresters can estimate site index of *T. grandis* stands by obtaining information on tree age and dominant height using the site index equation.

The site index curves obtained in this study revealed that the site index values for the five stands were relatively close. However, two of the stands that had the highest site index values were OKBA (24.74m) and OBGm (24.45m). The result obtained here is lower compared to that obtained by Akindele (1991). For example, a ten year old plantation within the study area will attain an average dominant height of 16m, whereas Akindele (1991) obtained 21m for site studies in southwestern Nigeria. One possible reason for the disparity in the values could be due to temporal variations in the sites considered. A close look at the site of the two young stands revealed that the soils were well drained, deep and having little or no indication of erosion. The least site index value (20.39m) was obtained for UISG, the oldest stand in this study. There was indication of erosion, high human activities that could possibly lead to soil compaction and hence affect the productivity of the stand. The findings from the site quality assessment have shown that, even within Ibadan metropolis (a small geographic range), there were notable site differences.

Two categories of models were developed in this study, the individual tree yield models and whole-stand yield models. Generally the whole stand models had an advantage of including the site index as a variable. Furthermore, the whole stand models were predominantly multiple linear models. This stems from the significant linear relationships observed among the stand growth variables. This is consistent with the reports of previous researchers such as Akindele (1991), Onyekwelu (1995), FORMECU (1999), Pretzsch (2001) and Adesoye (2002). Site index, age and basal area were

significantly and positively related to stem volume on stand basis. Similar trend was noticed under individual tree models, especially with tree growth variables such as tree dbh, crown diameter, age and basal area.

Equations 17, 18, 19, 20, 21, 22 and 23 are very useful for predicting current and future yield of *T. grandis* stands in the area covered by this study. Equations 17 (individual tree model) and 21 (whole-stand model) were considered suitable because of their highest values of coefficient of determinations and least values of standard errors of estimates ($R^2 = 95$; $SEE = 0.329$ and $R^2 = 97$; $SEE = 0.19$ respectively).

When current values of age, basal area and site index were used in these equations, estimates of current yield were obtained. For the prediction of future yield, the equations were solved with appropriate values for basal area, age and site index at the projection age. Since site quality seldom change over a short period of years, the current site index may be used in the prediction equations for future yield. This procedure was also used by Akindele (1991) and Bhat (2000).

CONCLUSION

The result of this study gave some indications about site quality of *T. grandis* plantations in Ibadan metropolis. The site index equation, which incorporated various stand growth variables, will enhance future site quality assessment of *T. grandis*. High accuracy of the model, depicted by the high coefficient of determinations and low standard error of estimate, suggests its suitability as a quantitative basis for estimating stand growth parameters in Ibadan metropolis. The study shows that the site index approach to site quality assessment can be satisfactorily applied for the estimation of productivity of *T. grandis* stands within the study area. Thus, it is possible to estimate site quality for *T. grandis* plantations by obtaining information only on stand growth variables without information on soil parameters. It is therefore recommended for use in forestry studies involving site quality assessment for the *T. grandis* plantations in Ibadan metropolis. The results of this study might also be useful for other species having similar growth requirements and growth pattern. These possible usefulness should however, be confirmed by independent testing before its application.

Yield prediction equations, both at individual tree and whole-stand levels, which incorporated various stand growth variables, are valuable to enhance future yield predictions of the species. The yield prediction equations provide the means through which the production potential of the existing *T. grandis* plantations can be estimated in the study area. It is believed that the equations obtained in this study will inform sound management decisions of *T. grandis* stands in Ibadan metropolis.

The data used for this study were collected from temporary sample plots established in the five stands, and such limits subsequent monitoring of the site potential and yield in the study area. It is therefore recommended that permanent sample plots be established and maintained in these stands to ensure

regular data collection for future site quality and yield studies. In this study, multiple linear equations were found to have good predictions for *T. grandis* yields; this might be as a result of the age range of the data used. As more data covering a wide age range becomes available, further studies on suitability of other equations will be relevant.

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